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Customer-Supplier relationships and the cost of debt☆

Kelly Cai[a], Hui Zhu[b,*]

[a] College of Business, University of Michigan - Dearborn, Dearborn, MI 48126, United States
[b] Faculty of Business and IT, Ontario Tech University, Oshawa, ON L1G 0C5, Canada

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ABSTRACT

We study whether the presence of major customer-supplier relationships affects a supplier's cost of debt. Using 5,704 U.S. corporate bonds issued from 1983 to 2013, we find that the cost of debt tends to be reduced when there are major customer-supplier relationships. This finding is robust to alternative measures of major customer-supplier relationships, subsample analyses, a propensity score matched sample analysis, and an instrumental variables approach. The results are consistent with the certification hypothesis, where a major customer serves as a monitoring and certifying entity for its supplier, thereby reducing information asymmetry between the supplier and its creditors. Moreover, the supplier's cost of debt is further reduced if the issuing supplier has higher asset specificity, whereas suppliers in more competitive industries do not incur the benefits of the validation.

1. Introduction

Customer-supplier relationships are known to influence many financial activities of a firm. There are two major potential mechanisms through which a major customer-supplier relationship might affect a supplier firm's cost of debt: the concentrated credit risk hypothesis and the certification hypothesis. According to the concentrated credit risk hypothesis (e.g., Becchetti and Sierra, 2003; Kale and Shahrur, 2007; Banerjee et al., 2008), a firm with major customer-supplier relationships often has to undertake relationship-specific investments, which will in turn lead to higher concentrated credit risk and higher cost of debt. In contrast, the certification hypothesis (Johnson et al., 2010; Hui et al., 2012; Cen et al., 2016) suggests a monitoring and certifying channel through which major customer-supplier relationships affect the value of the supplier. According to this hypothesis, customer-supplier relationships facilitate major customers' incentives on monitoring their suppliers, thereby reducing information asymmetry between the suppliers and their creditors, resulting in a lower cost of debt for the suppliers.[1]

Using various measures of major customer-supplier relationships, we find that in the corporate bond market, major customer-supplier relationships reduce a supplier's cost of debt, which is consistent with the certification hypothesis (Johnson et al., 2010; Cen et al., 2016). Given that an average issuing amount of our sample is $449 M, our regression analysis implies that issuing suppliers with at least one major customer can save approximately $462 K relative to otherwise identical firms at the time of the corporate bond offering. The results are robust to controlling for issue-specific variables and firm-related characteristics.

We further test the certification hypothesis by analyzing the differential effects of asset specificity and product market competition on the relationship between the presence of major customer-supplier relationships and the cost of debt. The transaction cost theory (e.g., Coase, 1937; Titman, 1984; Titman and Wessels, 1988) argues that a firm's customers incur switching costs if the supplier is liquidated. These costs are especially high if the supplier's assets are more specific. According to the certification hypothesis, major customers have higher incentives to monitor their suppliers that have higher asset specificity. Thus, the suppliers experience more benefits from monitoring and certification. The cost of

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* Corresponding author.
E-mail addresses: kcai@umich.edu (K. Cai), hui.zhu@ontariotechu.ca (H. Zhu).

[1] A customer-supplier relationship occurs when a supplier firm's business relies on one or more of its major customers. According to the Statement of Financial Accounting Standards (SFAS) No. 131, firms must periodically release their financial information for their major customers that represents at least 10% of total reported sales.

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debt for suppliers is therefore lower at the time of the corporate bond offering. Consistent with the certification hypothesis, we find that the negative relationship between major customer-supplier relationships and the cost of debt is more pronounced for an issuer with higher asset specificity.

When market competition is higher, it is easier for major customers to switch to a different supplier. The lower switching cost leads to fewer incentives for major customers to monitor their suppliers. According to the certification hypothesis, the cost of debt for the supplier will not be reduced at the time of the corporate bond offering. Following the literature (e.g., Valta, 2012), we use the Herfindahl-Hirschman Index to measure industry competition. We find that suppliers in the more competitive industries do not benefit from certification as the cost of debt is not significantly lower. Our results are, once again, consistent with the certification hypothesis.

For a sample of firms that have major customers, we also find that higher customer concentration reduces the cost of debt in the corporate bond market. This finding is consistent with the certification hypothesis suggesting that major customers have strong incentives to screen and/or monitor suppliers to ensure supply-chain stability and therefore facilitate lowering the supplier's cost of debt (Cen et al., 2016). To further compare our findings in the corporate bond market with those in the bank loan market, we examine what would happen if a supplier has a significant amount of bank loans and then subsequently issues corporate bonds. We find that the presence of a major customer for a supplier with higher bank debt does not play as much of a role as for one with lower bank debt. This is because when a supplier has a significant amount of bank debt and then issues corporate bonds, the lending banks still have exposure to the issuing supplier and they still actively monitor the issuing supplier. Thus, the monitoring role played by major customers may not be as important.

We also explore how the negative relation between the presence of major customers and the cost of debt is affected by their leverage level and use of trade credit. If the supplier's major customers are highly levered, then the likelihood for the customers to default would be high. This would lead to higher risk for the supplier, along with a higher cost of debt. Murfin and Njoroge (2015) examines the cost of extending credit to large buyers and suggests that major customers use trade credit to squeeze their suppliers, which increases the default risk of the suppliers. If the supplier extends trade credit to its major customers, the cost of debt should be higher. We find that the negative relation between the presence of major customers and the cost of debt is less pronounced for a supplier with highly levered major customers and extensive use of trade credit.

We further test the certification hypothesis using subsample analyses. Based on the certification hypothesis, if a supplier has a longer-term relationship with major customers, a major customer has a better credit rating than the supplier, or the size of a major customer is significantly large, then the certification/monitoring role played by major customers should be stronger. Within suppliers that have major customers, we find that the negative relation between the presence of major customers and the cost of debt is stronger if: (i) major customers have a longer-term relationship with the issuing supplier; (ii) major customers have a better creditor rating than the issuing supplier; or (iii) major customers are significantly large in firm size. Our results are consistent with the certification hypothesis.

Customer-supplier relationships in the product market can be relatively weak during market turmoil. Since our sample spans from 1983 to 2013 and includes the stock market crash of 1987, the 1997 Asian financial crisis, and the 2009 U.S. subprime financial crisis periods, we need to be more concerned with market turmoil caused by these large macro events. We retest our model specifications with both bond- and firm-specific controls excluding the years of 1987, 1997, and 2009. The results remain quantitatively unchanged.

To mitigate potential concerns of sample selection bias arising from changes in firm policy at the time of bond issuance, we create a subsample where a bond is issued to replace a maturing bond issued ten years prior. Such a new bond is unlikely to accompany other changes in firm policy. We find that a supplier issuing bonds to replace a maturing bond issued ten or more years prior still has a lower cost of debt.

Our estimates of the impact of customer concentration on a supplier's cost of debt might potentially suffer from an omitted variable bias. In particular, one could argue that some unobserved characteristics might simultaneously cause a firm's customer concentration to increase and its cost of debt to decrease. To alleviate these endogeneity concerns, we perform a propensity score matched sample analysis and use an instrumental variables approach. The results from both analyses continue to show that the presence of major customers significantly reduces the supplier's cost of debt in the corporate bond market.

Our findings contribute to the literature examining how the presence of major customers affects the supplier's financial policies. Prior work documents that suppliers with major customers are likely to maintain lower leverage to protect themselves from operating risk (Shantanu et al., 2008), pay less dividends (Wang, 2012), and cost more at the time of raising capital (Dhaliwal et al., 2016). Our work relates to the certification hypothesis that customer-supplier relationships facilitate major customers' incentives to monitor their suppliers (Johnson et al., 2010; Hui et al., 2012; Cen et al., 2016). We show that because of the major customers' monitoring role, suppliers with higher relationship-specific investments experience a lower cost of debt whereas the certification benefit is not significant for suppliers that operate in a highly competitive market.

Our study also extends the literature that examines the relationship between a supplier's cost of bank debt and its customer base concentration. Prior work predominantly shows that in the bank loan market, the concentrated credit risk hypothesis dominates and suppliers with a concentrated base of major customers tend to have a higher bank loan cost (e.g., Huang et al., 2015; Dhaliwal et al., 2016; Campello and Gao, 2017). Our study contributes to the literature by showing a negative relationship between the presence of major customers and a supplier's cost of debt. We argue that the different results are due to different investor bases and information sets in two debt markets. In the bank loan market, the concentrated credit risk hypothesis dominates because banks have the expertise and ability to regularly monitor the issuing firm throughout the life of the loan. Banks do not merely rely on major customer-supplier relationships for monitoring and certification. However, in the corporate bond market, due to the free rider problem, investors do not have incentives to monitor the issuing firm. In addition, investors can only obtain limited public information about the borrowing firm. Thus, the monitoring role played by major customers is more important and the certification hypothesis dominates in the corporate bond market.

The rest of the paper is organized as follows. We develop the hypotheses in Section 2. In Section 3, we discuss the data and variables. We report the results in Section 4. In Section 5, we discuss additional analyses while endogeneity tests are presented in Section 6. We conclude in Section 7.

2. Hypotheses development

According to the concentrated credit risk hypothesis, the reliance on major customers could be costly and risky for a supplier (Dhaliwal et al., 2016). Major customers have more bargain-

ing power over purchase prices (Bhattacharyya and Nain, 2011) and the timing of payments (Murfin and Njoroge, 2015), which could reduce the supplier's profit margin. If a major customer switches to a different supplier or declares bankruptcy, the supplier's sales volume would be negatively impacted. As a result, the supplier will have a higher cost of debt at the time of the corporate bond offering. We therefore offer Hypothesis 1a:

H1a. According to the concentrated credit risk hypothesis, suppliers that have major customers experience a higher cost of debt at the time of the corporate bond offering.

In contrast, according to the certification hypothesis, there is a monitoring and certifying channel through which major customer-supplier relationships affect the supplier's cost of capital. Johnson et al. (2010) and Cen et al. (2016) argue that by virtue of their business relations with the supplier, major customers have strong incentives and the ability to monitor their suppliers to ensure supply chain stability. Monitoring decreases information asymmetry between the supplier and its creditors, thereby reducing the credit premium required by investors. Consequently, major customers provide an implicit certification effect on the supplier's quality, which favorably influences the debt contract terms of these firms. This leads to Hypothesis 1b:

H1b. According to the certification hypothesis, suppliers that have major customers experience a lower cost of debt at the time of the corporate bond offering.

The customer-supplier relationship often involves relationship-specific investments. When the supplier has assets that are highly specific to one customer, according to the concentrated credit risk hypothesis, the supplier's reliance on this customer increases its risk. If this customer switches to another supplier or goes bankrupt, it will be more difficult for a supplier that has a higher asset specificity to change the use of its assets to a new customer. On the other hand, to switch to a new supplier, a customer bears the exit costs, such as time and search investment (e.g., Titman, 1984; Titman and Wessels, 1988). These transaction costs are especially high when the supplier's asset specificity is high. As a result, customers have stronger incentives to monitor suppliers with a higher asset specificity, which reduces the cost of debt of the suppliers. We therefore offer Hypotheses 2a and 2b:

H2a. According to the concentrated credit risk hypothesis, suppliers with a higher asset specificity experience a higher cost of debt at the time of the corporate bond offering.

H2b. According to the certification hypothesis, suppliers with a higher asset specificity experience a lower cost of debt at the time of the corporate bond offering.

If the supplier operates in a highly competitive industry, it is easier for a major customer to switch to another supplier. Thus, a supplier in a highly competitive industry faces a greater risk of losing customers. According to the concentrated credit risk hypothesis, the cost of debt for the supplier should be higher. On the other hand, when it is easier for a customer to find another supplier, the exit cost for the customer is lower. Therefore, the customer has less incentive to monitor a supplier operating in a highly competitive industry. The certification benefit, in this case, might not be significant. We therefore offer Hypotheses 3a and 3b:

H3a. According to the concentrated credit risk hypothesis, suppliers that operate in a highly competitive market experience a higher cost of debt at the time of the corporate bond offering.

H3b. According to the certification hypothesis, the certification benefit might not be significant for suppliers that operate in a highly competitive market.

3. Data and variables

3.1. Sample selection

We use Securities Data Corporation, Inc. (SDC) data from 1983 to 2013 to identify the sample of corporate bonds issued in the U.S. We use the Moody's credit rating whenever it is available and use a Standard and Poor's (S&P) rating when a Moody's rating is not available. Detailed issue characteristic information such as issue date, issue amount, seniority, country of domicile, and maturity date are obtained from SDC. We delete bonds issued by financial firms (SIC=6XXX) from the sample.

We then merge these debt issuing firms with their linked principal customers retrieved from the Compustat Segment Database. According to the Regulation SFAS No. 131, firms must periodically release their financial information for any linked customer that represents: i) at least 10% of total reported sales, ii) at least 10% of total reported profit (loss), or iii) at least 10% of the combined sales, profit (loss), or assets of all operating segments. Lastly, we obtain the corresponding suppliers' and customers' financial information from Compustat North America. Our final sample contains 5704 corporate bonds.

3.2. Measure of the cost of debt

We use yield spreads to measure the cost of debt. Yield spread (*YIELD*) is computed as the bond's offer yield minus the Treasury rate of comparable maturity. The data on the yields of Treasury bonds are obtained from the Federal Reserve Economic Data (FRED) database. They represent the daily averages of the constant-maturity yield. If the maturity period of a corporate bond does not exactly match that of Treasury bonds, we use the Treasury bonds with the closest maturity.

3.3. Measures of major customer-supplier relationships

We use various variables to measure major customer-supplier relationships. Our first and main measure of major customer-supplier relationships is a dummy variable *LINK*, which equals one if the supplier has at least one customer that accounts for 10% or more of its total sale (major customer) and zero otherwise. Our second measure follows Dhaliwal et al. (2016) and is the customer concentration variable *LC_RATIO*, which is the sum of the squared percentage sales to each major customer. The third measure is the total major customer sales ratio variable *TT_RATIO*, defined as the total percentage sales to all major customers.[2]

3.4. Bond- and firm-specific characteristics

To better understand the impact of major customer-supplier relationships on bond yields, it is important to control for other relevant bond- and firm-specific variables. The bond-specific variables are as follows: *AMT* denotes the logarithm of the dollar size of the bond's offer in millions of dollars; *TTM* denotes the bond's time to maturity in years; and *RATING* denotes an issuing firm's rating number with higher values indicating better ratings. For example, if a bond is rated as Aaa, it corresponds to the rating number of 20. *SENIOR* is a dummy variable that equals one if the bond is senior and zero otherwise. *RULE144A* is a dummy variable that equals

[2] For example, if a supplier has three major customers, each accounts for 10%, 12%, and 14% of the total sales. Then $LC\_Ratio = (10\%)^2 + (12\%)^2 + (14\%)^2 = 4.4\%$; $TT\_Ratio = 10\%+12\%+14\% = 36\%$. Since this firm has major customers, the dummy variable $LINK = 1$.

one if the issue is in the Rule 144a bond market and zero otherwise. *COVENANT* is a dummy variable that equals one if there is any type of covenant associated with the issue.

We also control for the issuing firm-specific characteristics. *SIZE* denotes the natural logarithm of an issuing supplier's value of total assets. *MB* is the market-to-book ratio defined as closing price at the fiscal year end times the common shares outstanding divided by the book value of equity. *LEV* measures an issuing supplier's leverage ratio, defined as the debt in current liabilities plus the total long-term debt scaled by total assets. *PROFIT* is defined as an issuing supplier's earnings before interest, taxes, depreciation, and amortization scaled by total assets. *AGE* denotes the natural logarithm of one plus the firm's age. *EXCHANGE* is an indicator variable that equals one if an issuing supplier's stock is traded on the NYSE and zero otherwise. Table A1 in the Appendix provides detailed definitions and the data sources for all the variables.

3.5. Descriptive statistics

Panel A in Table 1 reports the sample distribution by year. The average bond issue size for the sample period is about $449 M, where 23.84% of issuing suppliers have major corporate customers. The largest number of issues occur in 2012 (418), 1998 (375), and 2013 (365). These three years account for 20.30% of the debt issues in our sample. Based on whether the issuing supplier has major customers, we split the full sample into two subsamples. There are 1360 issuing suppliers that have major customers.[3] In this subsample, 2012 has the largest number of the debt issues (142), followed by 2010 (109), and 2013 (107). These three years account for 26.32% of the debt issues by suppliers with major customers. On average, suppliers with major customers have 1.43 corporate customers. The percentage of sales to the all major customers is 45%, whereas to the largest major customer is 24%.

Panel B of Table 1 reports the sample distribution by industry using the 12 Fama-French industry classification codes. Table A2 in the Appendix presents the detailed description of the 12 Fama-French industry classification codes. For the full sample, the largest numbers of debt issues occur for suppliers in the manufacturing (1373), shops (751), and energy (649) industries. These three industry groups account for 48.62% of the sample. For the 1360 issuers that have at least one major customer, the healthcare industry on average has most major customers per firm (1.75) and the highest percentage of sales to the largest corporate customer (29%). Business equipment has the largest percentage of sales to all major customers (80%). Panel C shows the sample distribution of major corporate customers. In our sample, there are 1360 issuing suppliers that have at least one major customer. On average, each supplier has 1.43 major corporate customers. Thus, total major customers for these 1360 issuing suppliers are 1946. Within 1946 major customers, 46% of them are public firms, 24% are private firms, and the rest of 30% are not identified by name, which is consistent with Ellis et al. (2012).

Table 2 presents the summary statistics of our key variables for the full sample. Panel A reports the descriptive statistics of the yield spread, three customer-supplier relationship measures, asset specificity, and product competition variables. The average yield spread in our sample is 2.45%. The average customer concentration ratio and the average percentage sales to all major customers are 3.5% and 10.7%, respectively. The average asset specificity and high competitiveness in product market are 0.009 and 0.25, respectively.

Panels B and C of Table 2 report the descriptive statistics of the bond- and firm-specific variables. The average issue size is about $449 M, the average time to maturity is about 11 years, and the average rating is between Baa2 and Baa3. The average size for the issuing suppliers is approximately $3.7B The average firm age at the time of the bond issuance is about 20 years. The average market-to-book ratio is 2.30.

4. Results

4.1. Impact of major customer-supplier relationships on the cost of debt

Table 3 reports the regression results of the impact of major customer-supplier relationships on the cost of debt. In all the models, we control the 12 Fama-French industry fixed effects and the customer fixed effects. The *t*-statistics are based on robust standard errors with clustering at the supplier level. In Model (1) of Table 3, the coefficient estimate on *LINK* is negatively significant at the 5% level with a magnitude of −0.103, which suggests that issuing suppliers with at least one major corporate customer tend to experience lower debt costs. Given that the sample mean of the yield spread is 2.446%, this 10.3 bps reduction implies a 4.21% (= −0.103/2.446) drop in a supplier's yield spread relative to the sample mean. Empirically, given that an average amount of the bond issue is $449 M, our regression analysis implies that issuing suppliers with at least one major customer can save approximately $462 K relative to otherwise identical firms. Our results suggest that major customer-supplier relationships facilitate major customers' incentives to monitor their suppliers. Their monitoring and certifying activities reduce information asymmetry between the issuing supplier and the bondholders, thereby reducing the supplier's debt cost at the time of the issuance. The results provide support for the certification hypothesis (Johnson et al., 2010).

Due to the nature of the customer-supplier relationship, one supplier could have more than one major customer. According to the monitoring and certification hypothesis, the higher the proportion of sales to major customers, the stronger monitoring role the major customers play. To incorporate these features into our analyses, we use the sum of the squared percentage sales to each major customer, *LC_RATIO*, and the percentage sales to all major customers, *TT_RATIO*, as alternative measures to retest the monitoring role of a major customer.

In Model (2), we test the impact of the sum of the squared percentage sales to each major customer, *LC_RATIO*, on the cost of debt. The coefficient on *LC_RATIO* is negative and statistically significant at the 1% level with a magnitude of −0.324. The effect of *LC_RATIO* is also economically significant. Since the average supplier with (without) at least one major customer has an *LC_RATIO* of 0.147 (0), the difference in reducing the yield spread between these two types of suppliers is 4.76 (= -0.324×0.147) bps. In Model (3), we test the impact of total corporate customer sale concentration ratio on the cost of debt. The coefficient on *TT_RATIO* is statistically significant at the 1% level with a magnitude of −0.221. Since the average supplier with (without) at least one major customer has *TT_RATIO* of 0.451 (0), the difference in reducing the yield spread between these two types of suppliers is 9.97 (= -0.221×0.451) bps. The absolute value of the coefficients in Models (2) and (3) are higher than that in Model (1), which sug-

[3] As pointed by Dhaliwal et al. (2016), "suppliers often voluntarily report customers that account for less than 10% of sales." In our sample, there are 1,906 issuing firms with at least one customer, including voluntary disclosures, which usually report customers accounting for less than 10% of suppliers' sales. To mitigate concerns of these voluntary disclosures, we exclude these customers in computing our measures of major customer-supplier relationships, thus we end up with the 1,360 major customer-supplier relationship-only-focused subsample. As a robustness test, we use these alternative definitions by including customers accounting for less than 10% of a supplier's sales in all our measures of major customer-supplier relationships. Including these additional customer-supplier relationships does not appreciably impact the results reported in the paper.

Table 1
Sample distribution over time, across industry, and by major customers.

Year	Overall sample			Issuing suppliers without major customers		Issuing suppliers with major customers				
	N	Issue size ($M)	% of issuing firms with major customers	*N*	Issue size ($M)	*N*	Issue size ($M)	Largest customer sales ratio	Total customer sales ratio	# of major customers
Panel A: Sample distribution by year										
1983	6	115.00	33.33	4	135.00	2	75.00	0.14	0.14	1.00
1984	19	119.34	10.53	17	112.79	2	175.00	0.17	0.35	1.50
1985	28	106.19	17.86	23	106.23	5	106.00	0.15	0.20	1.20
1986	35	153.29	5.71	33	154.39	2	135.00	0.15	0.15	1.00
1987	25	175.99	12.00	22	184.08	3	116.67	0.30	0.42	1.33
1988	22	156.23	13.64	19	161.17	3	125.00	0.24	0.24	1.00
1989	36	188.75	2.78	35	191.29	1	100.00	0.10	0.10	1.00
1990	37	162.97	8.11	34	155.29	3	250.00	0.21	0.36	1.33
1991	103	185.56	11.65	91	190.53	12	147.92	0.19	0.27	1.25
1992	102	181.67	9.80	92	184.35	10	157.00	0.21	0.23	1.10
1993	144	187.61	17.36	119	192.23	25	165.64	0.30	0.39	1.28
1994	72	207.40	20.83	57	208.65	15	202.67	0.25	0.29	1.13
1995	171	193.28	18.71	139	185.69	32	226.25	0.27	0.39	1.25
1996	200	228.13	21.50	157	235.30	43	201.95	0.26	0.31	1.12
1997	299	218.70	27.09	218	216.50	81	224.63	0.28	0.46	1.32
1998	375	245.45	24.80	282	245.34	93	245.78	0.27	0.83	1.73
1999	279	375.79	13.26	242	391.54	37	272.80	0.26	0.47	1.30
2000	150	406.10	14.67	128	418.59	22	333.41	0.29	0.51	1.32
2001	280	480.05	16.79	233	483.41	47	463.40	0.20	0.34	1.38
2002	231	389.40	16.45	193	404.56	38	312.37	0.22	0.34	1.39
2003	290	376.16	21.03	229	384.71	61	344.07	0.20	0.32	1.36
2004	207	363.45	27.54	150	370.57	57	344.72	0.27	0.40	1.26
2005	166	380.14	30.72	115	419.43	51	291.55	0.21	0.34	1.37
2006	178	593.69	32.58	120	655.84	58	465.09	0.21	0.33	1.31
2007	225	595.18	30.67	156	637.47	69	499.58	0.23	0.39	1.41
2008	189	752.21	27.51	137	797.52	52	632.83	0.22	0.51	1.65
2009	356	634.56	24.72	268	654.83	88	572.84	0.25	0.38	1.30
2010	357	559.16	30.53	248	594.21	109	479.40	0.26	0.47	1.43
2011	339	659.83	26.55	249	665.43	90	644.33	0.26	0.66	1.64
2012	418	651.82	33.97	276	673.56	142	609.55	0.23	0.47	1.63
2013	365	747.88	29.32	258	861.45	107	474.02	0.24	0.45	1.51
Total	5704	449.09	23.84	4344	458.65	1360	418.56	0.24	0.45	1.43
Panel B: Sample distribution by industry										
NoDur	503	438.15	33.00	337	384.62	166	546.84	0.19	0.38	1.57
Durbl	9	228.89	77.78	2	275.00	7	215.71	0.16	0.19	1.14
Manuf	1373	380.23	19.30	1108	403.03	265	284.88	0.22	0.35	1.31
Enrgy	649	428.49	45.61	353	449.96	296	402.90	0.27	0.42	1.35
Chems	363	404.76	24.79	273	402.02	90	413.06	0.26	0.43	1.33
BusEq	505	617.48	23.76	385	646.75	120	523.60	0.28	0.80	1.70
Telcm	481	729.58	8.52	440	765.51	41	344.02	0.24	0.36	1.27
Shops	751	391.97	9.72	678	395.77	73	356.61	0.24	0.40	1.36
Hlth	437	546.87	36.84	276	525.99	161	582.67	0.29	0.70	1.75
Other	633	309.62	22.27	492	300.27	141	342.26	0.21	0.30	1.23
Total	5704	449.09	23.84	4344	458.65	1360	418.56	0.24	0.45	1.43

Panel C: Sample distribution by the presence of major corporate customers

Major corporate customers	1946	100%
Public firm	897	46%
Private entity	463	24%
Name not disclosed	586	30%

Note: This table presents the sample of 5704 U.S. bonds issued in 1983–2013 across different industries. Panel A reports sample distribution by year in the full sample, subsample of issuing suppliers without major customers, and subsample of issuing suppliers with major customers. In particular, it shows the percentage of issuing suppliers with major customers, largest customer sales ratio, total customer sales ratio, and total number of major customers by year. Panel B reports sample distribution by industry. Panel C reports frequency distribution of the presence of major corporate customers. Table A1 in the Appendix provides the definitions and data sources for the variables. Table A2 provides the 12 Fama-French industry classification codes.

gests that the suppliers that have a more concentrated customer base experience a stronger certification effect. The results are consistent with the certification hypothesis.

In all models in Table 3, the resulting signs of other key control variables are consistent with the literature. For example, the credit rating variable *RATING* is economically and statistically significant. A negative relationship between the yield spread and the credit rating provides evidence that a better credit rating facilitates reducing the cost of debt. The coefficients for the *Rule 144a* dummy are significantly positive. The Rule 144a bond allows firms to raise U.S. dollar-dominated bonds in the U.S. corporate bond market to qualified institutional buyers (QIBs). It imposes less regulation on the bond issuing firms. Firms only need to provide basic information and financial information to QIBs. As a result, it provides speedy access to the U.S. corporate bond market. However, Rule 144a issues represent a less efficient issuing process compared to public offerings. Thus, these issues are associated with higher debt costs.

Table 2
Descriptive statistics.

VARIABLES	*N*	P25	Mean	Median	P75	S.D.
Panel A: Dependent, independent, and IV variables						
YIELD	5704	0.963	2.446	1.763	3.492	1.972
LINK	5704	0.000	0.238	0.000	0.000	0.426
LC_RATIO	5704	0.000	0.035	0.000	0.000	0.156
TT_RATIO	5704	0.000	0.107	0.000	0.000	0.317
SPECIFICITY	5704	0.000	0.009	0.000	0.004	0.024
L_HHI	5323	0.000	0.250	0.000	0.000	0.433
*LC_RATIO**	1360	0.034	0.147	0.065	0.143	0.293
*TT_RATIO**	1360	0.207	0.451	0.327	0.520	0.517
IndAvg LINK	5670	0.091	0.233	0.195	0.323	0.194
IndAvg LC_RATIO	5670	0.005	0.033	0.014	0.035	0.060
IndAvg TT_RATIO	5670	0.024	0.101	0.063	0.128	0.134
FAR	5704	1.000	0.865	1.000	1.000	0.342
Panel B: Bond-specific variables						
AMT	5704	12.206	12.685	12.612	13.122	0.794
TTM	5704	7.016	11.547	10.014	10.074	8.002
RATING	5704	8.000	11.354	12.000	14.000	3.901
SENIOR	5704	1.000	0.893	1.000	1.000	0.310
RULE144A	5704	0.000	0.282	0.000	1.000	0.450
COVENANT	5704	0.000	0.721	1.000	1.000	0.449
Panel C: Firm-specific characteristics						
SIZE	5704	7.492	8.214	8.757	9.890	2.783
MB	5704	0.000	2.304	1.374	2.725	17.986
LEV	5704	0.000	0.238	0.240	0.384	0.232
PROFIT	5704	0.000	0.089	0.091	0.151	0.089
AGE	5704	2.473	3.060	3.276	3.838	1.036
EXCHANGE	5704	1.000	0.854	1.000	1.000	0.354

Note: This table presents the summary statistics for variables used in the main regression analysis of the impact of major customer-supplier relationships on the cost of debt. The sample period is 1983–2013. Table A1 in the Appendix provides the definitions and data sources for the variables. Panels A-C report the summary statistics of the dependent and independent variables, issue-specific variables, and supplier-specific characteristics, respectively. * denotes the sample statistics for suppliers with at least one major customer.

Table 3
The effect of major customer-supplier relationships on the cost of debt.

VARIABLES	(1) *YIELD*	(2) *YIELD*	(3) *YIELD*
LINK	−0.103**		
	(−2.25)		
LC_RATIO		−0.324***	
		(−4.91)	
TT_RATIO			−0.221***
			(−5.59)
AMT	0.197***	0.199***	0.201***
	(10.55)	(10.67)	(10.76)
TTM	−0.012	−0.011	−0.010
	(−0.93)	(−0.82)	(−0.76)
RATING	−1.483***	−1.479***	−1.482***
	(−47.57)	(−47.72)	(−47.90)
SENIOR	0.366***	0.365***	0.370***
	(5.46)	(5.45)	(5.52)
RULE144A	0.600***	0.593***	0.597***
	(6.00)	(5.95)	(6.00)
COVENANT	0.177*	0.176*	0.181**
	(1.95)	(1.95)	(2.00)
SIZE	−0.006	−0.007	−0.004
	(−0.35)	(−0.46)	(−0.28)
MB	−0.028	−0.029	−0.029
	(−1.34)	(−1.38)	(−1.38)
LEV	0.078***	0.082***	0.082***
	(2.62)	(2.77)	(2.77)
PROFIT	−0.039	−0.041	−0.041
	(−1.36)	(−1.43)	(−1.43)
AGE	0.122***	0.121***	0.120***
	(5.58)	(5.49)	(5.50)
EXCHANGE	−0.270***	−0.269***	−0.274***
	(−4.10)	(−4.09)	(−4.18)
Constant	2.254***	2.185***	2.210***
	(6.02)	(5.94)	(6.01)
N	5704	5704	5704
R^2	0.598	0.598	0.599

Note: This table presents the estimation results obtained by regressing the yield spread (*YIELD*) on major customer-supplier relationships (*LINK*). Customer concentration ratios measured as the sum of the squared percentage sales to all the largest major customers (*LC_RATIO*) and the total percentage sales to all major customers (*TT_RATIO*) and on controls of bond-specific variables and suppliers' characteristics. Table A1 in the Appendix provides the definitions and data sources for the regression variables. All regressions include industry fixed effects and customer fixed effects. The industry controls are based on the 12 Fama-French industry classification codes. All continuous control variables are winsorized at the 1% and 99% levels and standardized to zero mean and one standard deviation. *t*-statistics based on robust standard errors with clustering at the supplier level are reported in parentheses.
*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

Overall, our findings are consistent with the monitoring and certification hypothesis, suggesting that major customer-supplier relationships negatively affect an issuing supplier's cost of debt through its major customers' monitoring roles. In addition, a more concentrated customer base plays a stronger monitoring role in the corporate bond market.

4.2. Asset specificity

The literature (e.g., Tirole, 1988; Johnson et al., 2010) suggests that the level of asset specificity may affect a firm's cost of debt. In Models (1) and (2) of Table 4, we add the specificity variable, *SPECIFICITY*, in contrast to Model (1) of Table 3. *SPECIFICITY* is computed by using a supplier's R&D expenses scaled by the book value of total assets in the issuing year.

The coefficients of *SPECIFICITY* in Models (1) through (2) in Table 4 are statistically significant at the 1% level with magnitudes ranging from 3.433 to 4.750. The findings are consistent with the literature (Tirole, 1988) and suggest that it is more difficult for firms with a higher level of asset specificity to find outside investors to fund investments. As a result, the cost of debt is higher for suppliers that have a higher asset specificity.

We use the interaction term between *LINK* and *SPECIFICITY* (*LINK* × *SPECIFICITY*) to test Hypothesis 2. When the supplier has assets that are more specific to major customers, according to the concentrated credit risk hypothesis, the coefficient for the interaction variable *LINK* × *SPECIFICITY* should be significantly positive because the supplier encounters some difficulties when changing the use of assets from an old customer to a new one. On the other hand, according to the certification hypothesis, the coefficient for the interaction variable *LINK* × *SPECIFICITY* should be significantly negative because major customers have stronger incentives to monitor the supplier whose asset is more specific.

The results in Table 4 show that the coefficient on the interaction term *LINK* × *SPECIFICITY* in Model (2) is negatively significant at the 5% level with a magnitude of −3.353. The results suggest that the degree of a supplier's asset specificity affects its customers' incentives to monitor. A supplier's asset specificity also increases its major customers' exiting costs such as time-consuming search costs when the customer-supplier relationship ceases. Thus, major customers have stronger incentives to monitor their suppliers after a relationship has been established. The close ties enable them to serve as valuable certifying/monitoring entities for their suppliers, which reduces the suppliers' debt costs. The results provide support for Hypothesis 2b (the certification hypothesis).

Table 4
The roles of suppliers' asset specificity and product market competition on the relationship between major customers and the cost of debt.

VARIABLES	(1) *YIELD*	(2) *YIELD*	(3) *YIELD*	(4) *YIELD*
LINK	−0.113**	−0.077*	−0.137***	−0.128**
	(−2.50)	(−1.71)	(−2.92)	(−2.38)
SPECIFICITY	3.433***	4.750***		
	(3.69)	(4.55)		
LINK × SPECIFICITY		−3.353**		
		(−2.54)		
L_HHI			0.164***	0.173***
			(3.35)	(3.14)
LINK × L_HHI				−0.039
				(−0.37)
AMT	0.196***	0.198***	0.259***	0.260***
	(10.48)	(10.53)	(11.55)	(11.51)
TTM	−0.013	−0.013	−0.013	−0.013
	(−1.00)	(−0.99)	(−0.98)	(−0.98)
RATING	−1.492***	−1.492***	−1.447***	−1.448***
	(−47.74)	(−47.65)	(−44.40)	(−44.24)
SENIOR	0.369***	0.370***	0.392***	0.394***
	(5.50)	(5.53)	(5.70)	(5.78)
RULE144A	0.593***	0.597***	0.593***	0.593***
	(5.91)	(5.99)	(5.79)	(5.79)
COVENANT	0.175*	0.182**	0.183**	0.183**
	(1.92)	(2.00)	(1.98)	(1.98)
SIZE	−0.007	−0.010	−0.192***	−0.191***
	(−0.46)	(−0.63)	(−4.32)	(−4.30)
MB	−0.038*	−0.041**	−0.024	−0.024
	(−1.83)	(−1.97)	(−1.17)	(−1.16)
LEV	0.087***	0.089***	0.084***	0.084***
	(2.89)	(3.01)	(2.80)	(2.79)
PROFIT	−0.064**	−0.066**	−0.056*	−0.056*
	(−2.17)	(−2.26)	(−1.91)	(−1.90)
AGE	0.118***	0.117***	0.134***	0.134***
	(5.37)	(5.30)	(6.12)	(6.04)
EXCHANGE	−0.250***	−0.254***	−0.246***	−0.247***
	(−3.81)	(−3.85)	(−3.62)	(−3.64)
Constant	2.240***	2.218***	1.865***	1.858***
	(5.97)	(5.95)	(12.69)	(12.43)
N	5704	5704	5323	5323
R^2	0.599	0.599	0.597	0.597

Note: This table presents the estimation results obtained by regressing the yield spread (*YIELD*) on the presence of major customer-supplier relationships (*LINK*) and its interaction with asset specificity (*SPECIFICITY*) or high product competition (*L_HHI*), as well as on controls of bond-specific variables and suppliers' characteristics. Columns (1)-(2) present the results on asset specificity (*SPECIFICITY*) and its interaction with the presence of a major customer (*LINK* × *SPECIFICITY*) whereas columns (3)-(4) address high product competition (*L_HHI*) and its interaction with the presence of a major customer (*LINK* × *L_HHI*). Table A1 in the Appendix outlines the definitions and data sources for the regression variables. All regressions include industry fixed effects and customer fixed effects. The industry controls are based on the 12 Fama-French industry classification codes. All continuous control variables are winsorized at the 1% and 99% levels and standardized to zero mean and one standard deviation. *t*-statistics based on robust standard errors with clustering at the supplier level are reported in parentheses.

*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

4.3. Product market competition

Following the metrics of the Herfindahl-Hirschman Index (HHI) measures in Valta (2012), we use a dummy variable *L_HHI* to proxy product market competition. Specifically, *L_HHI* (high competition) equals one if a supplier's HHI is less than 25% of the bottom quantile in the annual industry distribution and zero otherwise.

We add the product market competition variable *L_HHI* in contrast to Model (1) for Table 3. Models (3) and (4) in Table 4 show that the coefficients on *L_HHI* are statistically significant at the 1% level with magnitudes ranging from 0.164 to 0.173, respectively. The findings are consistent with the product market competition literature that higher competition in the product market is likely to increase the issuing firm's cost of debt when raising capital.

To test Hypothesis 3, we add the interaction term *LINK* × *L_HHI* to Model (4). If the supplier operates in a highly competitive industry, *LINK* × *L_HHI* = 1, major customers can easily switch to another supplier. The supplier faces a greater risk of losing a major customer. According to the concentrated credit risk hypothesis, the coefficient for the interaction term *LINK* × *L_HHI* should be significantly positive. On the other hand, according to the certification hypothesis, if the supplier operates in a highly competitive industry, it is easier for major customers to find another supplier. The certification benefit should not be significant (i.e., the coefficient for the interaction term *LINK* × *L_HHI* should not be significant).

The results show that the coefficient on the interaction term *LINK* × *L_HHI* is statistically insignificant, suggesting that major customers have fewer incentives to monitor their supplier and the certification benefit is not significant when the supplier operates in a highly competitive industry. The results are consistent with Hypothesis 3b (the certification hypothesis).

Overall, the coefficients on *LINK* in Models (1) through (4) in Table 4 are economically and statistically significant with magnitudes ranging from −0.077 to −0.137. The results are consistent with Hypothesis 1b (the certification hypothesis) and suggest that the presence of major customers reduces the suppliers' debt costs even after we control for their asset specification and product market competition level.

5. Additional analyses

5.1. Customer-supplier relationship-only-focused analyses

Within firms that have major customers, Huang et al. (2015) and Campello and Gao (2017) argue that the supplier is more affected by the possibility that one or more of its major customers file for bankruptcy when its customer base becomes more concentrated. They find that a concentrated customer base is associated with a higher level of bank loan spread. To further test how major customer concentration affects the cost of corporate bonds, we follow Huang et al. (2015) and Campello and Gao (2017) and use only a subsample of suppliers that have major customers.

Table 5 replicates the regressions we used for Table 3 and focus only on the suppliers that have major customers. The results in Table 5 show that the coefficients of two customer concentration measures, *LC_RATIO*, and *TT_RATIO*, are both negative and statistically significant at the 1% level. These findings suggest that customer base concentration reduces the cost of debt in the corporate bond market. Our results are different from Huang et al. (2015) and Campello and Gao (2017) because the bank loan market and the corporate bond market have different investor bases and different information sets.

The lenders in the bank loan market have the expertise and ability to regularly monitor the issuing suppliers throughout the life of the loan. For example, James (1987) and Kashyap et al. (2002) show that bank loans may have positive effects on the valuation of borrowing firms. By granting a loan, banks actively certify and monitor the financial conditions of borrowers. Thus, the monitoring role played by major customers is less important in the bank loan market. On the other hand, investors in the corporate bond market do not have the incentive to monitor the issuing supplier because the monitoring cost is borne solely by the monitors. The benefits of monitoring, however, are shared by all investors (free rider problem), who rely more on the customer-supplier relationship for loan monitoring.

In addition, banks have an informational advantage over corporate bond investors. Using financial reports and private disclo-

Table 5
The effect of major customer sales on the cost of debt.

VARIABLES	(1) *YIELD*	(2) *YIELD*
LC_RATIO	−0.234***	
	(−3.09)	
TT_RATIO		−0.193***
		(−3.97)
AMT	0.245***	0.249***
	(4.78)	(4.88)
TTM	−0.050	−0.046
	(−1.65)	(−1.52)
RATING	−1.755***	−1.753***
	(−27.47)	(−27.55)
SENIOR	0.560***	0.566***
	(4.21)	(4.25)
RULE144A	0.576***	0.579***
	(2.62)	(2.63)
COVENANT	0.569***	0.573***
	(2.61)	(2.63)
SIZE	−0.058	−0.037
	(−0.68)	(−0.44)
MB	0.039	0.038
	(0.71)	(0.69)
LEV	0.131*	0.138**
	(1.94)	(2.03)
PROFIT	−0.108	−0.112*
	(−1.61)	(−1.66)
AGE	0.118***	0.118***
	(2.81)	(2.84)
EXCHANGE	−0.275***	−0.282***
	(−2.76)	(−2.84)
Constant	2.032***	2.064***
	(4.38)	(4.45)
N	1360	1360
R^2	0.615	0.616

Note: This table presents the estimation results of the relationship-only focused subsample obtained by regressing the yield spread (*YIELD*) on customer concentration ratios measured as the sum of the squared percentage sales to all major customers (*LC_RATIO*) and the total percentage sales to all major customers (*TT_RATIO*), and on controls of bond-specific variables and suppliers' characteristics. Table A1 in the Appendix provides the definitions and data sources for the regression variables. All regressions include industry fixed effects and customer fixed effects. The industry controls are based on the 12 Fama-French industry classification codes. All continuous control variables are winsorized at the 1% and 99% levels and standardized to zero mean and one standard deviation. *t*-statistics based on robust standard errors with clustering at the supplier level are reported in parentheses.

*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

sures, banks have the expertise to estimate the supplier's operating risk from the concentrated customer base. The bank loan spreads therefore reflect the financial distress risk of major customers and its impact on the supplier. Different from lenders in the bank loan markets, investors in the corporate bond market can only obtain public information about the issuing supplier through its financial reports. Since such disclosures can also be observed by the supplier's current and potential rivals, to increase its competitive advantage, the supplier might conceal critical information from the public. For example, Ellis et al. (2012) find that many suppliers choose to disclose less information than what the U.S. Securities Exchange Commission's (SEC) regulation appears to mandate. With limited public information, investors in the corporate bond market may not be able to accurately predict the impact of major customers' financial conditions on the supplier. As a result, the bank loan and corporate bond markets view a firm's customer base differently. In the corporate bond market, the certification hypothesis still dominates for suppliers with major customers, which is different from the results in the bank loan market.

5.2. Impacts of bank debt, customer leverage, and trade credit

Prior studies (e.g., Dhaliwal et al., 2016; Campello and Gao, 2017) document that the significant bank debt before a supplier's bond issuance could affect the cost of bond financing. Thus, we examine the effect of the presence of major customers on the cost of debt in subsamples split by the supplier's bank loan level at bond issuance.

Following Eberhart et al. (2008), we measure *Bank Debt* as the sum of notes payable and other long-term debt. *High Bank Debt* denotes that a supplier's bank debt before its bond issuance is higher than the 90th percentile of the total amount of bank debt in the sample. If a supplier has a significant amount bank debt and then issues bonds, presumably banks would continue to monitor the loans. Thus, the benefit for customer monitoring declines. As a result, the cost of corporate debt may not be reduced by the presence of major customers. Table 6 shows that the coefficient is insignificant in column (1) for the regression that includes *LINK* and *High Bank Debt*, and is negative and significant in column (2) for the remaining sample. The findings suggest that for a supplier with higher bank debt, the presence of a major customer does not play a significant role in reducing debt costs. When a supplier has a significant amount bank loans and then issues bonds, banks will still actively monitor the supplier. In this case, the need for the customer monitoring is not as high, and the cost of debt is not significantly reduced by the presence of major customers.

Prior studies (e.g., Dhaliwal et al., 2016; Campello and Gao, 2017) document that the major customers' characteristics, such as customers' leverage level and the amount of trade credit, could affect the cost of bond financing. Following Campello and Gao (2017), we measure *Customer Leverage* as the ratio of each customer's leverage to its sales, where leverage is the sum of debt in current liabilities and total long-term debt. *High Customer Leverage* denotes that a major customer's leverage is higher than the 90th percentile of customer leverage in the sample. That is, *High Customer Leverage* indicates more indebted and higher default risk, which could increase the supplier's risk. As a result, when a major customer is highly levered, the risk factor will dominate and the effect of a major customer on the cost of debt should be weaker or even change signs. Consistent with this argument, we find that the coefficient on *LINK* in column (3) of Table 6 is positive and significant, whereas the coefficient on *LINK* in column (4) is negative and significant. The findings suggest that highly levered major customers increase the cost of debt, which is similar to Campello and Gao's (2017) findings in the bank loan market.

In addition, a major customer's use of trade credit could also affect the cost of debt. Murfin and Njoroge (2015) examine the costs of extending credit to large buyers and suggest that major customers use trade credit to squeeze their suppliers, which increases the default risk of the suppliers. Following Campello and Gao (2017), we measure *Trade Credit* as the ratio of accounts payable to cost of goods sold (COGS) and present the results in columns (5) and (6) of Table 6, and as the ratio of accounts payable to sales in the results in columns (7) and (8). *High Trade Credit* denotes that the accounts payable of a major customer is higher than the 90th percentile of *Trade Credit* in the sample. Thus, *High Trade Credit* indicates that major customers tend to delay payments to their suppliers. If the supplier extends high trade credit to its major customers, the concentrated credit risk factor will dominate and the benefits of customer monitoring will decline. Consistent with this argument, we find that the coefficients on *LINK* in columns (5) and (7) of Table 6 are positive and insignificant, whereas the coefficients on *LINK* in columns (6) and (8) are still negative and significant. The findings suggest that the negative effect of the presence of major customers on the cost of debt be-

Table 6
The impacts of bank debt, customer leverage, and trade credit.

	High bank loan		High customer leverage		High trade credit (Cost of goods sold)		High trade credit (Customer sales)	
VARIABLES	Yes	No	Yes	No	Yes	No	Yes	No
	(1) *YIELD*	(2) *YIELD*	(3) *YIELD*	(4) *YIELD*	(5) *YIELD*	(6) *YIELD*	(7) *YIELD*	(8) *YIELD*
LINK	−0.223	−0.119**	0.522	−0.109**	0.143	−0.123***	0.089	−0.122***
	(−1.32)	(−2.48)	(1.62)	(−2.36)	(0.29)	(−2.76)	(0.19)	(−2.74)
AMT	0.384***	0.180***	0.597**	0.196***	0.482*	0.196***	0.499**	0.196***
	(6.92)	(8.48)	(2.54)	(10.42)	(1.88)	(10.38)	(2.05)	(10.38)
TTM	0.029	−0.009	0.053	−0.012	−0.156	−0.010	−0.151	−0.010
	(0.97)	(−0.64)	(0.61)	(−0.91)	(−1.09)	(−0.71)	(−1.09)	(−0.71)
RATING	−1.212***	−1.518***	−1.081***	−1.484***	−1.239***	−1.481***	−1.315***	−1.481***
	(−14.72)	(−44.93)	(−3.85)	(−46.67)	(−5.10)	(−46.86)	(−5.55)	(−46.86)
SENIOR	−0.074	0.415***	0.695	0.353***	−0.121	0.373***	−0.009	0.373***
	(−0.18)	(5.82)	(1.30)	(5.27)	(−0.14)	(5.59)	(−0.01)	(5.58)
RULE144A	0.318	0.586***	0.799	0.587***	2.011***	0.587***	1.915***	0.587***
	(1.12)	(5.71)	(1.61)	(5.81)	(3.28)	(5.86)	(3.27)	(5.86)
COVENANT	−0.042	0.156	0.472	0.166*	1.336**	0.166*	1.186**	0.166*
	(−0.20)	(1.63)	(0.92)	(1.82)	(2.61)	(1.83)	(2.53)	(1.83)
SIZE	0.005	−0.004	−0.567***	−0.005	−0.431	−0.007	−0.368	−0.007
	(0.13)	(−0.25)	(−2.73)	(−0.34)	(−1.62)	(−0.42)	(−1.49)	(−0.43)
MB	−0.048	−0.029	−0.963***	−0.022	−0.633	−0.024	−0.448	−0.024
	(−0.76)	(−1.31)	(−3.04)	(−1.07)	(−1.33)	(−1.14)	(−1.10)	(−1.14)
LEV	0.294**	0.066**	0.300	0.075**	0.042	0.080***	−0.025	0.080***
	(2.44)	(2.14)	(1.31)	(2.50)	(0.14)	(2.70)	(−0.09)	(2.70)
PROFIT	−0.189**	−0.020	0.542**	−0.040	0.408	−0.042	0.366	−0.043
	(−2.13)	(−0.65)	(2.15)	(−1.38)	(0.89)	(−1.47)	(0.83)	(−1.48)
AGE	0.190**	0.120***	−0.321	0.128***	0.277	0.119***	0.184	0.120***
	(2.23)	(5.04)	(−1.53)	(5.83)	(0.97)	(5.45)	(0.75)	(5.46)
EXCHANGE	−0.099	−0.270***	−0.881*	−0.268***	0.394	−0.276***	0.503	−0.275***
	(−0.28)	(−3.85)	(−1.77)	(−4.08)	(0.49)	(−4.22)	(0.66)	(−4.20)
Constant	2.170***	1.908***	0.761	2.278***	0.951	2.278***	1.187	1.923***
	(3.68)	(13.80)	(0.96)	(6.07)	(0.65)	(6.08)	(1.12)	(14.01)
N	553	4983	102	5602	108	5596	113	5591
R^2	0.619	0.598	0.814	0.597	0.666	0.599	0.670	0.599

Note: This table presents the estimation results relating the supplier's cost of debt to the presence of major customers in subsamples, which are split by bank debt, customer leverage, and trade credit. Bank debt is the sum of notes payable and other long-term debt. High bank debt denotes a supplier's bank debt before its bond issuing is higher than the 90th percentile of total amount bank debt in the sample. Customer leverage is the ratio of leverage of each customer to its sales, where leverage is the sum of debt in current liabilities and total long-term debt. High customer Leverage denotes leverage of a major customer is higher than the 90th percentile of total customer leverage in the sample. *Trade Credit* is both the ratio of accounts payable to cost of goods sold (COGS) and the ratio of accounts payable to sales. *High Trade Credit* denotes account payable of a major customer is higher than the 90th percentile of *Trade Credit* (COGS) and *Trade Credit* (Sales) in the sample, respectively. Table A1 in the Appendix provides the definitions and data sources for the regression variables. All regressions include industry fixed effects and customer fixed effects. The industry controls are based on the 12 Fama-French industry classification codes. All continuous control variables are winsorized at the 1% and 99% levels and standardized to zero mean and one standard deviation. *t*-statistics based on robust standard errors with clustering at the supplier level are reported in parentheses.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

comes weaker when major customers delay payments to their suppliers.

5.3. Impacts of changes in major customers

Cen et al. (2016) argue that a continuing long-term relationship with major customers provides stronger certification and monitoring of the supplier. When a supplier experiences a loss in major customers, the monitoring effect could be weakening or dysfunction, especially if customers are truly monitoring the supplier. Consequently, the negative effect of the presence of major customers on the supplier's debt costs becomes weaker. We next compare the bond yield for a supplier that lost a major customer two years ago with a supplier that kept the same major customers.

Within the relationship-only-focused sample, we further split the sample by whether a supplier issuer's customer base changes in two years. If the supplier incurs no major customer changes in the two years before it issues bonds, then the negative relation between major customer-supplier relationships and the cost of debt is likely more pronounced. In columns (1) and (2) of Table 7, we find that the coefficients on *LC_RATIO* and *TT_RATIO* are still negative and statistically significant, respectively. Consistent with the certification hypothesis, the findings suggest that the negative and statistically significant relation between our measures of major customer-supplier relationships and the supplier's debt costs is more pronounced when the supplier experiences no changes in its major customer base during the two-year period before bond issuance.

5.4. Impacts of major customers' characteristics

Credit ratings can be used to imply firm quality. If a major customer's credit rating is better than its supplier's, it is plausible that this customer is helping to certify supplier value. Likewise, if the size of a major customer is significantly large, it is also likely that the major customer could confirm the value of the supplier. To determine whether this quality verification is more important for the suppliers whose major customers are associated with better credit ratings and larger firm size, we examine the bond yield for a supplier that has a major customer with relative better credit ratings and greater firm size.

Within the relationship-only-focused sample, we further split the sample by whether a major customer's credit rating is better than its supplier's. When the major customer credit ratings are

Table 7
Relationship-only focused subsample analyses: Customer base, credit ratings, and firm size.

VARIABLES	No changes in major customers in 2 years		Better customer credit ratings		Larger customer size	
	(1) *YIELD*	(2) *YIELD*	(3) *YIELD*	(4) *YIELD*	(5) *YIELD*	(6) *YIELD*
LC_RATIO	−0.301**		−0.233*		−0.352***	
	(−2.55)		(−1.67)		(−3.75)	
TT_RATIO		−0.206***		−0.223***		−0.271***
		(−2.87)		(−2.71)		(−4.09)
AMT	0.304**	0.297**	0.027	0.038	0.236***	0.238***
	(2.05)	(2.03)	(0.40)	(0.56)	(3.29)	(3.33)
TTM	0.098**	0.102**	−0.072*	−0.069*	−0.084*	−0.080*
	(1.98)	(2.08)	(−1.89)	(−1.82)	(−1.77)	(−1.68)
RATING	−1.431***	−1.446***			−1.718***	−1.715***
	(−8.69)	(−8.77)			(−20.18)	(−20.32)
SENIOR	0.607	0.632	0.003	0.010	0.633***	0.638***
	(1.49)	(1.57)	(0.01)	(0.04)	(4.01)	(4.05)
RULE144A	0.546*	0.549*	1.411***	1.406***	0.749***	0.756***
	(1.67)	(1.69)	(3.88)	(3.88)	(2.65)	(2.67)
COVENANT	0.083	0.098	0.571	0.573	0.808***	0.817***
	(0.28)	(0.33)	(1.58)	(1.59)	(2.89)	(2.92)
SIZE	0.011	0.072	−0.064	−0.048	−0.152	−0.122
	(0.04)	(0.24)	(−1.02)	(−0.75)	(−1.12)	(−0.90)
MB	0.047	0.048	−0.117*	−0.119*	0.086	0.084
	(0.42)	(0.43)	(−1.76)	(−1.79)	(1.12)	(1.09)
LEV	0.269*	0.281**	0.637***	0.645***	0.206**	0.214**
	(1.94)	(2.02)	(5.99)	(6.05)	(2.46)	(2.55)
PROFIT	−0.085	−0.088	−0.419***	−0.420***	−0.188**	−0.195**
	(−0.63)	(−0.65)	(−4.36)	(−4.38)	(−2.04)	(−2.12)
AGE	0.075	0.069	−0.215***	−0.214***	0.086	0.089*
	(0.39)	(0.36)	(−3.20)	(−3.35)	(1.62)	(1.69)
EXCHANGE	−0.426*	−0.429*	−0.709***	−0.745***	−0.178	−0.170
	(−1.91)	(−1.94)	(−4.26)	(−4.42)	(−1.21)	(−1.16)
Constant	1.950***	3.872***	2.117***	2.189***	1.638***	1.667***
	(4.34)	(4.72)	(4.02)	(4.14)	(3.12)	(3.16)
N	310	310	689	689	857	857
R^2	0.633	0.635	0.411	0.412	0.605	0.606

Note: This table presents the estimation results relating the supplier's cost of debt to the presence of major customers in relationship-only-focused subsamples, which are further split by (i) a supplier with no changes its major customers in two years, (ii) a major customer's credit rating is better than its supplier, and (iii) a major customer is significantly larger in firm size. Customer credit rating is better if a major customer's credit rating is better than its corresponding supplier's credit rating. Customer size is larger if a major customer's firm size is larger than the 90th percentile of the sample customer size. Table A1 in the Appendix outlines the definitions and data sources for the regression variables. All regressions include industry fixed effects and customer fixed effects. The industry controls are based on the 12 Fama-French industry classification codes. All continuous control variables are winsorized at the 1% and 99% levels and standardized to zero mean and one standard deviation. *t*-statistics based on robust standard errors with clustering at the supplier level are reported in parentheses.

*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

better than the supplier credit ratings, we expect the negative relation between major customer-supplier relationships and the cost of debt is likely more pronounced. The results in columns (3) and (4) of Table 7 show that the coefficients on *LC_RATIO* and *TT_RATIO* are still negative and statistically significant, respectively. Consistent with the certification hypothesis, the findings suggest that the negative and statistically significant relation between our measures of major customer-supplier relationships and the supplier's cost of debt is more pronounced when the major customer's credit rating is better than the supplier's.

Likewise, we further split the sample by whether a major customer's size is greater than the 90th percentile of the total customer firm size in the sample. Customer size is large if a major customer's size is greater than the 90th percentile of total customer firm size in the sample. When the major customer size is significantly large, we expect the negative relation between major customer-supplier relationships and the cost of debt is likely more pronounced. The results in columns (5) and (6) of Table 7 show that the coefficients on *LC_RATIO* and *TT_RATIO* are still negative and statistically significant, respectively. The findings suggest that the negative and statistically significant relation between our measures of major customer-supplier relationships and the supplier's debt costs is more pronounced when the major customer is significantly large, which further supports the certification hypothesis.

5.5. Roles of non-price contract terms

Prior studies (Campello and Gao, 2017) discuss that customer concentration influences bank loan maturity. To assess how the presence of major customers affects non-price contract terms in the corporate bond market, we replicate the main analyses for the results in column (1) of Table 3 by augmenting the interaction terms between *LINK* and non-price contract terms, such as time to maturity (*TTM*) of the issue and credit ratings (*RATING*).

Table 8 presents the estimation results. We augment the interaction term $LINK \times TTM$ and the interaction term $LINK \times RATING$. The results in columns (1) and (2) show that the coefficients on *LINK* are still negative and statistically significant at the 5% level. The coefficient on $LINK \times TTM$ is negative and statistically significant at the 1% level with a magnitude of −0.102. This finding indicates that a supplier with longer time to maturity debt tends to benefit more from the monitoring role of its major customers, which reduces its debt costs. Furthermore, the coefficient

Table 8
The roles of non-price contract terms: Time to maturity and credit ratings.

VARIABLES	(1) *YIELD*	(2) *YIELD*
LINK	−0.109**	−0.150***
	(−2.43)	(−3.54)
LINK × TTM	−0.102***	
	(−2.89)	
LINK × RATING		−0.223***
		(−5.00)
AMT	0.198***	0.199***
	(10.56)	(10.62)
TTM	0.006	−0.012
	(0.36)	(−0.92)
RATING	−1.482***	−1.438***
	(−47.48)	(−43.89)
SENIOR	0.365***	0.360***
	(5.45)	(5.39)
RULE144A	0.599***	0.596***
	(6.00)	(5.97)
COVENANT	0.179**	0.188**
	(1.97)	(2.08)
SIZE	−0.006	−0.008
	(−0.39)	(−0.52)
MB	−0.028	−0.027
	(−1.34)	(−1.29)
LEV	0.078***	0.078***
	(2.63)	(2.64)
PROFIT	−0.040	−0.040
	(−1.38)	(−1.41)
AGE	0.122***	0.129***
	(5.59)	(5.88)
EXCHANGE	−0.271***	−0.287***
	(−4.11)	(−4.34)
Constant	2.252***	2.330***
	(6.07)	(6.79)
N	5704	5704
R^2	0.598	0.600

Note: This table presents the estimation results obtained by regressing the yield spread (*YIELD*) on the presence of major customer-supplier relationships (*LINK*) and its interaction with non-pricing contract terms, as well as on controls of bond-specific variables and suppliers' characteristics. The regression for column (1) includes the interaction with time to maturity (*LINK × TTM*) and we add the interaction with credit ratings (*LINK × RATING*) to the regression to obtain the results in column (2). Table A1 in the Appendix provides the definitions and data sources for the regression variables. All regressions include industry fixed effects and customer fixed effects. The industry controls are based on the 12 Fama-French industry classification codes. All continuous control variables are winsorized at the 1% and 99% levels and standardized to zero mean and one standard deviation. *t*-statistics based on robust standard errors with clustering at the supplier level are reported in parentheses.

*** Significant at the 1% level.

** Significant at the 5% level.*Significant at the 10% level.

on *LINK × RATING* is also negative and statistically significant at the 1% level with a magnitude of −0.223. The results suggest that the negative relationship between the presence of major customers and the supplier's debt costs is magnified further for suppliers that issue debt with better credit ratings.

5.6. Financial crises

Prior studies (Erel et al., 2012; Cai et al., 2013) suggest that when market conditions are unfavorable, only high-quality bond issuers have access to the debt market, and the market reacts favorably to successful debt issues during economic downturns. The ability of an issuing supplier to access the U.S. corporate bond market under challenging conditions might reflect the quality of the supplier and reduce its debt costs. Our sample period includes the stock market crash of 1987, the 1997 Asian financial crisis, and the 2009 U.S. subprime financial crisis periods. To mitigate concerns that our results may be driven by financial crises, we replicate our estimations for Table 3 by excluding the years of 1987, 1997, and 2009. Panel A of Table 9 shows that a negative relationship between major customer-supplier relationships and the supplier's debt costs remains quantitatively unchanged.

5.7. Bond issued to replace a maturing bond

A supplier that is issuing bonds may experience a large influx of cash and likely a change in investment policy. It may be that suppliers time their bond issuance to coincide with good financial results, strong sales, a few good quarters, etc. To mitigate these potential sample selection concerns, we create a subsample where a bond is issued to replace a maturing bond issued ten years prior. Such a new bond is unlikely to accompany other changes in firm policy. To test the robustness of our main findings, we replicate the main tests for Table 3 on a bond issuance to repay old bonds with a ten-year maturity. Panel B of Table 9 shows the results. We find that the negative relationship between major customer-supplier relationships and the cost of debt still holds, suggesting that sample selection bias related to a change in investment policy or timing bond issuance is not likely driving our results.

6. Endogeneity

6.1. Propensity score matched sample analysis

A potential endogeneity concern arises as firm characteristics might influence both the supplier's cost of debt and the status of its major customer-supplier relationships, inducing a sample selection bias. To address the concern, we first investigate whether firm characteristics impact the status of the customer-supplier relationship. We conduct a logistic regression with *LINK* as the dependent variable and use the same control variables as those in the main tests for Table 3. The result is shown in column (1) of Table 10 Panel A. We find that the individual control variables are statistically significant. The Pseudo-R^2 and *p*-value from the chi square test of the overall logit model are 0.130 and 0.000, respectively, indicating that the control variables provide explanatory power for the probability of the customer-supplier relationship.

To address the sample selection bias, we use the propensity score matching approach. Following Fang et al. (2014), we estimate the propensity scores from the logistic regression above. Then we match a major customer-related supplier with a non-major customer-related supplier using the nearest neighbor propensity score in the same Fama-French industry in a given year. We pursue a non-repetitive matching scheme that a non-major customer-related supplier can be used only once for the matching. Our final matched sample has 1912 firm-year observations with 956 suppliers having major customers and 956 suppliers without a major customer.

We then perform three diagnostic tests to evaluate the propensity score matching. First, we test whether the issue-specific variables and firm-related characteristics provide explanatory power for the major customer *LINK* dummy after matching. If they do not, our matching procedure is successful. To do this, we conduct a logistic regression of the *LINK* dummy on controls in the post-match sample. Column (2) in Panel A of Table 10 shows the results. The coefficients of all control variables are statistically insignificant. The Pseudo-R^2 and *p*-value from the chi square test of the overall logit model with the post-match sample are 0.004 and 0.944, respectively, indicating that the overall logit model specification fails to fit. Therefore, in the matched sample, the issue-specific variables and firm-related characteristics no longer have power to explain whether a supplier has major customers. Second, we examine the difference between the propensity scores of suppliers that have

Table 9
Subsample analyses.

VARIABLES	(1) *YIELD*	(2) *YIELD*	(3) *YIELD*
Panel A: Non-crisis periods			
LINK	−0.108***		
	(−2.77)		
LC_RATIO		−0.262***	
		(−4.33)	
TT_RATIO			−0.191***
			(−5.74)
AMT	0.101***	0.103***	0.104***
	(6.13)	(6.22)	(6.30)
TTM	0.045***	0.046***	0.047***
	(3.96)	(4.04)	(4.14)
RATING	−1.423***	−1.418***	−1.421***
	(−45.78)	(−46.08)	(−46.11)
SENIOR	0.250***	0.248***	0.253***
	(3.58)	(3.57)	(3.63)
RULE144A	0.604***	0.597***	0.601***
	(6.70)	(6.62)	(6.69)
COVENANT	0.105	0.103	0.108
	(1.21)	(1.19)	(1.25)
SIZE	−0.056***	−0.058***	−0.056***
	(−3.80)	(−4.02)	(−3.83)
MB	−0.047**	−0.048**	−0.048**
	(−2.30)	(−2.35)	(−2.36)
LEV	0.107***	0.112***	0.111***
	(3.93)	(4.13)	(4.11)
PROFIT	−0.017	−0.019	−0.019
	(−0.63)	(−0.71)	(−0.71)
AGE	0.076***	0.075***	0.075***
	(3.68)	(3.62)	(3.62)
EXCHANGE	−0.306***	−0.303***	−0.309***
	(−5.01)	(−4.95)	(−5.05)
Constant	1.992***	2.284***	2.293***
	(15.34)	(16.68)	(16.84)
N	4835	4835	4835
R^2	0.689	0.689	0.689
Panel B: Bond issues to replace a maturing bond issued ten or more years prior			
LINK	−0.100*		
	(−1.76)		
LC_RATIO		−0.355***	
		(−5.32)	
TT_RATIO			−0.196***
			(−4.92)
AMT	0.081***	0.217***	0.219***
	(2.99)	(8.39)	(8.44)
TTM	0.065***	0.017	0.017
	(4.19)	(0.96)	(0.98)
RATING	−1.308***	−1.383***	−1.386***
	(−31.87)	(−34.34)	(−34.51)
SENIOR	0.171	0.316**	0.322**
	(1.34)	(2.13)	(2.17)
RULE144A	0.782***	0.865***	0.869***
	(4.63)	(4.47)	(4.49)
COVENANT	0.113	0.368**	0.371**
	(0.71)	(2.10)	(2.12)
SIZE	−0.098***	−0.029	−0.027
	(−4.46)	(−1.39)	(−1.29)
MB	0.023	−0.001	−0.001
	(0.96)	(−0.05)	(−0.02)
LEV	0.139***	0.132**	0.131**
	(2.95)	(2.53)	(2.51)
PROFIT	−0.058*	−0.075*	−0.075*
	(−1.66)	(−1.70)	(−1.70)
AGE	0.129***	0.187***	0.188***
	(4.12)	(5.22)	(5.25)
EXCHANGE	−0.243***	−0.364***	−0.369***
	(−2.75)	(−3.41)	(−3.45)
Constant	3.257***	1.872***	1.864***
	(13.95)	(6.60)	(6.59)
N	2914	2914	2914
R^2	0.683	0.534	0.534

Note: This table presents the subsample test results obtained by regressing the yield spread (*YIELD*) on the presence of major customer-supplier relationships (*LINK*), customer concentration ratios measured as the sum of the squared percentage sales to all major customers (*LC_RATIO*) and the total percentage sales to all major customers (*TT_RATIO*), and on controls of bond-specific variables and suppliers' characteristics. Panel A provides the subsample results where 1987, 1997, and 2009 have been excluded from the regression analyses, whereas Panel B provides the results for the bond replacement subsample. Table A1 in the Appendix provides the definitions and data sources for the regression variables. All regressions include industry fixed effects and customer fixed effects. The industry controls are based on the 12 Fama-French industry classification codes. All continuous control variables are winsorized at the 1% and 99% levels and standardized to zero mean and one standard deviation. *t*-statistics based on robust standard errors with clustering at the supplier level are reported in parentheses.

*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

Table 10
Propensity score matched sample analysis.

Panel A: Pre- and post-matched regression

VARIABLES	Pre-matched (1)*LINK*	Post-matched (2)*LINK*
AMT	−0.052	−0.046
	(−1.15)	(−0.75)
TTM	−0.009	−0.050
	(−0.24)	(−1.02)
RATING	−0.600***	−0.073
	(−10.24)	(−0.91)
SENIOR	0.444***	0.144
	(4.64)	(0.85)
RULE144A	0.478***	−0.085
	(2.82)	(−0.40)
COVENANT	0.474***	−0.037
	(2.96)	(−0.18)
SIZE	0.383***	0.086
	(9.63)	(1.31)
MB	0.029	−0.076
	(0.78)	(−1.31)
LEV	−0.159***	−0.014
	(−3.59)	(−0.21)
PROFIT	0.109**	0.030
	(2.32)	(0.42)
AGE	−0.142***	0.061
	(−3.50)	(1.14)
EXCHANGE	−0.471***	−0.073
	(−4.06)	(−0.48)
Constant	−1.796***	0.020
	(−7.41)	(0.06)
N	5704	1912
Prob> χ^2	0.000	0.944
Pseudo R^2	0.130	0.004

Panel B: Estimated propensity score distribution

Propensity Scores	*N*	Mean	S.D.	Min	P25	Median	P75	Max
With a Major Customer	956	0.308	0.156	0.015	0.192	0.280	0.408	0.853
Without a Major Customer	956	0.307	0.157	0.015	0.190	0.275	0.407	0.865
Difference	0.000	0.001	0.001	0.000	0.002	0.004	0.001	0.012

Panel C: Univariate tests: Propensity matched sample

	With a major customer (Obs.=956)		Without a major customer (Obs.=956)		Difference	
	Mean	S.D.	Mean	S.D.	Difference	t-statistics
AMT	12.693	0.717	12.684	0.797	0.009	0.263
TTM	10.959	7.091	11.333	7.644	−0.373	−1.107
RATING	10.575	3.781	10.608	4.004	−0.032	−0.182
SENIOR	0.882	0.323	0.867	0.340	0.015	0.966
RULE144A	0.335	0.472	0.343	0.475	−0.008	−0.386
COVENANT	0.694	0.461	0.687	0.464	0.006	0.297
SIZE	8.404	1.669	8.298	2.557	0.106	1.078
MB	1.682	5.617	2.389	13.216	−0.707	−1.522
LEV	0.235	0.225	0.238	0.231	−0.003	−0.287
PROFIT	0.089	0.089	0.091	0.090	−0.002	−0.542
AGE	2.973	1.104	2.921	1.023	0.051	1.053
EXCHANGE	0.824	0.381	0.826	0.379	−0.002	−0.120

Panel D: Multivariate test results

	(1)	(2)	(3)
VARIABLES	*YIELD*	*YIELD*	*YIELD*
LINK	−0.153**		
	(−2.39)		
LC_ RATIO		−0.264***	
		(−3.39)	
TT_RATIO			−0.203***
			(−4.33)
AMT	0.160***	0.164***	0.166***
	(4.22)	(4.36)	(4.43)
TTM	−0.072***	−0.067***	−0.065***
	(−3.26)	(−3.02)	(−2.94)
RATING	−1.684***	−1.683***	−1.683***

(*continued on next page*)

Table 10
(continued)

Panel D: Multivariate test results			
	(1)	(2)	(3)
	(−31.77)	(−31.49)	(−31.58)
SENIOR	0.571***	0.572***	0.576***
	(4.79)	(4.81)	(4.84)
RULE144A	0.483**	0.491**	0.494**
	(2.50)	(2.53)	(2.55)
COVENANT	0.216	0.230	0.234
	(1.15)	(1.23)	(1.25)
SIZE	0.027	0.027	0.031
	(0.84)	(0.88)	(0.98)
MB	−0.033	−0.033	−0.035
	(−0.80)	(−0.80)	(−0.84)
LEV	0.021	0.025	0.028
	(0.41)	(0.47)	(0.53)
PROFIT	−0.005	−0.006	−0.008
	(−0.10)	(−0.12)	(−0.17)
AGE	0.204***	0.196***	0.198***
	(5.44)	(5.27)	(5.34)
EXCHANGE	−0.304***	−0.300***	−0.305***
	(−2.81)	(−2.75)	(−2.80)
Constant	2.132***	2.053***	2.070***
	(7.31)	(7.11)	(7.20)
N	1912	1912	1912
R^2	0.599	0.599	0.600

Note: This table presents the propensity score matched sample analysis. Panel A reports marginal effects from conditional logistic regressions obtained by regressing the presence of a major customer (*LINK*) on control variables. Column (1) shows pre-match estimation results, whereas column (2) reports regression results using a propensity score matched sample. Panel B shows the distribution of propensity score matched suppliers. Panel C reports univariate test results for control variables using a propensity score matched sample. Panel D reports estimation results obtained by regressing the yield spread (*YIELD*) on the presence of a major customer (*LINK*), customer concentration ratios measured as the sum of the squared percentage sales to all major customers (*LC_RATIO*) and the total percentage sales to all major customers (*TT_RATIO*) and on controls of bond-specific variables and suppliers' characteristics. Table A1 in the Appendix provides the definitions and data sources for the regression variables. All regressions include industry fixed effects and customer fixed effects. The industry controls are based on the 12 Fama-French industry classification codes. All continuous control variables are winsorized at the 1% and 99% levels and standardized to zero mean and one standard deviation. *t*-statistics based on robust standard errors with clustering at the supplier level are reported in parentheses.

*** Significant at the 1% level.

** Significant at the 5% level.*Significant at the 10% level.

major customers versus suppliers that don't have. The results in Panel B of Table 10 show that the mean difference is 0.001, which validates the success of our propensity matching procedure. Third, we compare the issue-specific variables and firm-related characteristics with major customers versus those without a major customer in the matched sample. Panel C of Table 10 reports the univariate test results of all the control variables in our main analyses. The mean difference of all the variables across suppliers with versus without a major customer are statistically insignificant. Overall, the results of all three diagnostic tests indicate our propensity matching procedure is successful.

Finally, we test whether a supplier with major customers affects its cost of debt in the matched sample. Panel D of Table 10 shows the results. The coefficients on all three measures of major customer-supplier relationships are negative and statistically significant at the 5% level. The results imply that suppliers with major customers have lower debt costs even in the matched sample. Overall, the results from the propensity matched sample analysis indicate that our findings are not likely to be driven by sample selection bias.

6.2. Instrumental variables estimation

Our main variables of interest, major customer-supplier relationships, are choice variables. It is possible that there may be a potential endogeneity concern arising from unobserved omitted variables. To mitigate the endogeneity concern, following Dhaliwal et al. (2016), we use an instrumental variables (IVs) approach. We choose *Lagged Industry Average Measures* (*IndAvg LINK, IndAvg LC_HHI* or *IndAvg TT_RATIO*) as IVs, which are based on a supplier's Fama-French 12 industry and year (excluding the supplier). Another instrumental variable we select is a geographical IV, *FAR*, measured as an IV that is set to one if a supplier's geographical distance[4] to the largest firm in the customer's industry is higher than the 90th percentile of the distance in the sample.

To be considered valid instruments, our IVs must satisfy two conditions (e.g., Larcker and Rusticus, 2010; Roberts and Whited, 2013): (i) the relevance condition, where the selected IVs must be correlated with measures of major customer-supplier relationships but uncorrelated with the error terms; and (ii) the exclusion restriction, where the selected IVs are correlated with a supplier's debt costs only through their correlation with measures of major customer-supplier relationships. Specifically, the lagged industry average measures are generated from each supplier's major customer base and are thus highly correlated with measures of major customer-supplier relationships. With a one-year lag, the lagged industry average measures are unlikely to be correlated with the contemporaneous error term. Hence, the lagged industry average measures satisfy the relevance condition. Additionally, investors evaluate an individual supplier's future risk when assessing the supplier's financing costs. The lagged industry average measures are likely to be correlated with historical industry risk and

[4] To measure geographical distance between a supplier and its major customers, we use the Zip Code distance between two headquarters in miles calculated through CDX Technologies (https://www.cdxtech.com/). For any invalid route point, landmark, or address, we manually recheck these missing values through http://www.mapdevelopers.com.

Table 11
Instrumental variables regressions.

Panel A: First-stage results

VARIABLES	(1) *LINK*	(2) *LC_RATIO*	(3) *TT_RATIO*
Lagged Industry Average Measures	0.251***	0.223***	0.248***
	(7.47)	(2.85)	(3.27)
FAR	−0.586***	−0.069***	−0.241***
	(−33.74)	(−8.82)	(−15.24)
AMT	−0.018***	0.004	0.010**
	(−3.35)	(1.64)	(2.01)
TTM	0.004	0.005**	0.013***
	(0.93)	(2.15)	(2.65)
RATING	−0.073***	−0.013***	−0.031***
	(−9.28)	(−5.91)	(−6.23)
SENIOR	0.074***	0.018***	0.050***
	(4.23)	(3.82)	(5.33)
RULE144A	0.066***	0.004	0.019
	(2.62)	(0.30)	(0.75)
COVENANT	0.056**	0.021**	0.046**
	(2.41)	(2.07)	(2.32)
SIZE	0.048***	0.010***	0.027***
	(10.63)	(8.50)	(10.92)
MB	−0.000	−0.004**	−0.007*
	(−0.07)	(−2.38)	(−1.93)
LEV	−0.021***	0.003	0.007
	(−3.34)	(1.30)	(1.34)
PROFIT	0.013**	0.000	−0.001
	(2.09)	(0.03)	(−0.16)
AGE	−0.028***	−0.011***	−0.018***
	(−4.62)	(−3.40)	(−3.67)
EXCHANGE	−0.010	−0.010	−0.027
	(−0.56)	(−1.02)	(−1.45)
Constant	1.180***	0.084***	0.324***
	(5.55)	(4.34)	(8.01)
N	5670	5670	5670
R^2	0.352	0.076	0.149
Wu-Hausman F-statistics	5.06 ($p<0.02$)	5.31 ($p<0.02$)	3.28 ($p<0.07$)
F_statistcs	676.17 ($p<0.00$)	42.89 ($p<0.00$)	142.07 ($p<0.00$)
Partial R^2	0.2391	0.0261	0.0737
Sargan Test ($Pr>\chi^2$)	0.4584	0.5259	0.405

Panel B: Second-stage results

VARIABLES	(1) *YIELD*	(2) *YIELD*	(3) *YIELD*
Predicted LINK	−0.204***		
	(−2.81)		
Predicted LC_RATIO		−1.473**	
		(−2.57)	
Predicted TT_RATIO			−0.422**
			(−2.50)
AMT	0.039*	0.058***	0.052**
	(1.92)	(2.66)	(2.48)
TTM	0.044***	0.049***	0.048***
	(3.54)	(3.82)	(3.81)
RATING	−1.468***	−1.480***	−1.470***
	(−49.00)	(−46.29)	(−48.19)
SENIOR	0.274***	0.296***	0.286***
	(4.47)	(4.63)	(4.57)
RULE144A	0.719***	0.709***	0.713***
	(6.90)	(6.70)	(6.83)
COVENANT	0.151	0.173*	0.161
	(1.54)	(1.73)	(1.63)
SIZE	−0.067***	−0.059***	−0.063***
	(−3.84)	(−3.23)	(−3.54)
MB	−0.009	−0.014	−0.011
	(−0.46)	(−0.71)	(−0.58)
LEV	0.100***	0.104***	0.105***
	(3.93)	(4.02)	(4.09)
PROFIT	−0.021	−0.022	−0.023
	(−0.85)	(−0.89)	(−0.96)

(*continued on next page*)

Table 11
(continued)

Panel B: Second-stage results			
VARIABLES	(1) *YIELD*	(2) *YIELD*	(3) *YIELD*
AGE	0.076***	0.068***	0.075***
	(3.99)	(3.43)	(3.95)
EXCHANGE	−0.235***	−0.247***	−0.244***
	(−4.54)	(−4.57)	(−4.61)
Constant	2.172***	2.107***	2.135***
	(14.49)	(13.78)	(14.21)
N	5670	5670	5670
R^2	0.707	0.697	0.705

Note: This table presents the estimation results from two-stage least squares (2SLS) regressions. Panel A reports the first-stage results and Panel B reports the second-stage results. In the first-stage, we regress the presence of major customer-supplier relationships (*LINK*), customer concentration ratios measured as the sum of the squared percentage sales to all major customers (*LC_RATIO*) and the total percentage sales to all major customers (*TT_RATIO*) on the instrumental variables (*Lagged Industry Average Measures* (i.e., *IndAvg LINK/IndAvg LC_RATIO/IndAvg TT_RATIO)* and *FAR*) and on controls of bond-specific variables and suppliers' characteristics, respectively. *IndAvg LINK, IndAvg LC_RATIO*, and *IndAvg TT_RATIO* are one-year lagged industry averages of *LINK, LC_RATIO*, and *TT_RATIO* in the supplier's Fama-French 12 industry and year (excluding the supplier), respectively. *FAR* is an indicator variable set to one if a supplier's geographical distance to the largest firm in the customer's industry is higher than the 90th percentile of total distance in the sample. In the second stage, we regress the yield spread (*YIELD*) on the predicted values from the first-stage regressions and on controls of bond-specific variables and suppliers' characteristics. Table A1 in the Appendix provides the definitions and data sources for the regression variables. All continuous control variables are winsorized at the 1% and 99% levels and standardized to zero mean and one standard deviation. *t*-statistics based on robust standard errors with clustering at the supplier level are reported in parentheses.

*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

are thus unlikely to be directly related to an individual supplier's debt costs, which meets the exclusion condition. With respect to the geographical IV, industries tend to cluster. Being geographically close to General Motors makes it likely that an automotive parts supplier will have an automotive customer. Thus, a supplier's geographical distance to its largest customer's industry is highly correlated with measures of major customer-supplier relationships. Furthermore, a supplier's location is approximately exogenous or at least largely pre-determined. It is less likely that a supplier's geographical distance to the largest firm in its customer's industry will be correlated with a supplier's debt costs. Thus, our selected IVs (i.e., lagged industry average measures of major customer-supplier relationships and a supplier's geographical distance to the largest firm in the customer's industry) fairly meet both the relevance condition and the exclusion restriction.

Table 11 reports the results from the two stage least squares (2SLS) regressions. In the first-stage regressions, we regress the customer-supplier relationship variables on the IVs and controls of the bond-specific and suppliers' specific variables. The dependent variable in Model (1) is the dummy variable *LINK* used to measure the presence of major customer-supplier relationships; in Model (2), *LC_RATIO* is the customer concentration ratio measured as the sum of the squared percentage sales to all major customers; and in Model (3), *TT_RATIO* is the total percentage sales to all major customers.

Panel A of Table 11 shows that the coefficients on two IVs, *Lagged Industry Average Measures*[5] and *FAR*, are positive and significantly related to the measures of the customer-supplier relationship.[6] To validate these two IVs, we conduct three post-IV tests (e.g., Dhaliwal et al., 2016): the Wu-Hausman endogeneity test, the test of first-stage weak instruments, and the Sargan over-identification test. For each customer-supplier relationship measure, we find that the Wu-Hausman test results are statistically significant at the 5% level, suggesting that our customer-supplier relationship measures are not exogenous. The first-stage *F*-statistic and partial R^2 are all statistically significant at the 1% level, suggesting that the IVs are highly correlated with the customer-supplier relationship measures, mitigating the concern of weak instruments. We also use Sargan chi square tests[7] to examine the problem of over identification that are common in IV analyses. The Sargan ($Pr > \chi^2$) results suggest that we fail to reject the null hypothesis that our two IVs are uncorrelated with the error term. This implies that our two IVs are exogenous with respect to the yield spread. Collectively, these post-IV tests suggest that our two IVs are valid.

Panel B of Table 11 reports the second-stage regression results, where we regress the yield spread, *YIELD*, on the predicted values of the customer-supplier relationship measures from the first-stage and on controls of bond-specific variables and suppliers' characteristics. The findings show that all three predicted values of the customer-supplier relationship measures in Models (1) to (3) are negatively associated with a supplier's debt costs, suggesting that major customer-supplier relationships causally reduce a supplier's debt costs.

7. Conclusion

The extant literature in bond financing suggests that mitigating information asymmetry between borrowers and creditors reduces the cost of debt. The certification hypothesis provides a monitoring and certifying mechanism through which the presence of major customer-supplier relationships might reduce information asymmetry between borrowers and creditors, thereby lower a supplier's cost of debt. In this paper, using 5704 U.S. corporate bonds

[5] In calculating our *Lagged Industry Average Measures*, we exclude the supplier and take a one-year lag of *Industry Average Measures*, which makes our sample size drop from 5,704 to 5,670.

[6] Following Dhaliwal et al. (2016), we exclude the industry fixed effects and the customer fixed effects from this test since all the diagnostic tests suggest that our selected instruments are valid and have corrected for all omitted variables.

[7] Sargan (1958) chi square tests are used to examine whether selected instruments are valid, or the model specifications are correctly specified.

issued in 1983–2013, we find a negative relationship between a supplier's debt costs and major customer-supplier relationships. We also use alternative measures of major customer-supplier relationships, subsample analyses, a propensity score matched sample analysis, and an instrumental variables approach to verify the robustness of our results. The findings are consistent with the certification hypothesis. In particular, when a supplier has a large base of major customers, these customers have stronger incentives to monitor the supplier, thereby reducing the supplier's debt costs. The results are also consistent with the results from the bank loan market documented by Cen et al. (2016).

Within firms that have major customers, we find that customer concentration reduces the cost of debt in the corporate bond market, in contrast to Huang et al. (2015) and Campello and Gao (2017), who find that customer concentration increases the cost of bank debt. The different findings result from distinctive investor bases and information sets. The investor base in the bank loan market is mainly banking institutions, which can monitor their borrowers, thus, the monitoring role of major customers is less important. However, investors in the corporate bond market do not have ability or incentive to monitor bond issuers; they rely more on the customer-supplier relationship for monitoring.

In line with the certification hypothesis of Johnson et al. (2010), when the supplier's asset is more specific to major customers, the major customers incur costs to switch suppliers, thus they have a stronger incentive to monitor their suppliers. Our findings suggest that the negative relationship between major customer-supplier relationships and the cost of debt is more pronounced for issuing suppliers with higher asset specificity. On the other hand, when an issuing supplier operates in a more competitive market, it is easier for major customers to switch suppliers. Therefore, the incentive to monitor the supplier is weaker and the benefit of monitoring is not significant. Further analyses show that suppliers in highly competitive industries do not incur significantly lower debt costs.

We also explore how suppliers' bank debt, major customer characteristics, and use of trade credit affect the negative relation between major customer-supplier relationships and the cost of debt. Specifically, we find that the negative relation is less pronounced when: (1) a supplier has a significant amount of bank debt and then subsequently issues bonds; (2) major customers are highly levered; and (3) a supplier extends trade credit to its major customers. Within the customer-supplier relationship-only-focused sample, we also find that the negative relation is more pronounced if: (1) major customers have a longer-term relationship with the issuing supplier; (2) major customers have a better creditor rating than the issuing supplier; and (3) major customers are significantly large in size. In addition, the negative relation between major customer-supplier relationships and the cost of debt is robust to excluding the economic downturns in 1987, 1997, and 2009, mitigating the concern that our results may be driven by financial turmoil. We also show that a supplier who issues bonds to replace a maturing bond has a lower cost of debt, mitigating the concern of sample selection bias since such bonds are unlikely to accompany changes in firm policy. In addition, a supplier with a longer time to maturity or better credit rating tends to further reduce its debt costs.

Overall, we provide additional evidence of the important interaction between the product market and the financial market. The results suggest that a supplier's business relationships with its major customers reduce information asymmetry between borrowers and creditors through a monitoring channel, which in turn lowers its debt costs.

Appendix

Tables A1 and A2.

Table A1
Variable definitions and data sources.

Variables	Descriptions	Sources
Panel A: Dependent, independent, and IV variables		
YIELD	Yield spread is computed as the bond's offer yield over the Treasury rate of comparable maturity.	Federal Reserve Economic Data (FRED) and authors' calculation
LINK	An indicator variable equals to 1 if the bond issuing supplier has at least one corporate customer that counts 10% or more of its total sale (major customer) and 0 otherwise.	Compustat Segment and authors' calculation
LC_RATIO	The sum of the squared percentage sales to all major customers.	Same as above
TT_RATIO	The percentage of sales to all major customers.	Same as above
SPECIFICITY	Issuing suppliers' specificity is calculated as suppliers' R&D expenses scaled by book value of total assets in the issuing year.	Compustat and authors' calculation
L_HHI	*L_HHI* is a low HHI dummy (high competition) which equals one if customers' sales to an issuing supplier are less than 25% of the bottom quantile in the industry and zero otherwise.	Same as above
Lagged Industry Average Measures *IndAvg LINK* *IndAvg LC_RATIO* *IndAvg TT_RATIO*	Lagged industry average measures of *LINK, LC_RATIO*, and *TT_RATIO*. These one-year lagged industry averages are calculated by suppliers' 12 Fama-French industry classification and year excluding the supplier.	Compustat Segment and authors' calculation
FAR	An indicator variable equals one if a supplier's geographical distance to the largest firm in the customer's industry is higher than the 90th percentile of total distance in the sample.	CDX Technologies and Map Developers
Panel B: Bond-specific control variables		
AMT	Issue size. It is the natural logarithm of the dollar size of the bond's offer amount in millions of dollars.	Securities Data Corporation, Inc. (SDC)
TTM	Time to maturity. It is the issue's maturity in years.	SDC

(*continued on next page*)

Table A1 (*continued*)

RATING	An issuing supplier's rating number, transferred from Moody's 20 rating classifications with a higher number indicating a better credit rating.	SDC
SENIOR	1 if the bond is senior bond, 0 otherwise.	SDC
RULE144A	1 if the bond is Rule144a offer, 0 otherwise.	SDC
COVENANT	1 if the bond has covenants, 0 otherwise.	SDC
Panel C: Issuing supplier specific control variables		
SIZE	The natural logarithm of an issuing firm's total booking assets.	Compustat
MB	Market-to-book ratio is defined as closing price at the fiscal year end times common shares outstanding divided by book value of equity.	Compustat and Authors' calculation
LEV	An issuing firm's leverage is defined as debt in current liabilities plus total long-term debt scaled by total assets.	Compustat and Authors' calculation
PROFIT	An issuing firm's earnings before interest, taxes, depreciation, and amortization scaled by total asset.	Compustat and Authors' calculation
AGE	The natural logarithm of one plus a firm's age.	Compustat and Authors' calculation
EXCHANGE	An indicator variable that equals one if an issuing supplier's stock is traded on the NYSE and zero otherwise.	Compustat and Authors' calculation
Panel D: Other variables		
Bank Debt	Bank debt is the sum of notes payable and other long-term debt. High bank debt denotes a supplier's bank debt before its bond issuing is higher than the 90th percentile of total amount bank debt in the sample.	Compustat and Authors' calculation
Customer Leverage	Customer leverage is the ratio of leverage of each customer to its sales, where leverage is the sum of debt in current liabilities and total long-term debt. High customer leverage denotes leverage of a major customer is higher than the 90th percentile of total customer leverage in the sample.	Compustat and Authors' calculation
Trade Credit	*Trade Credit is* both the ratio of accounts payable to cost of goods sold (COGS) and the ratio of accounts payable to sales. *High Trade Credit* denotes account payable of a major customer is higher than the 90th percentile of *Trade Credit* (COGS) and *Trade Credit* (Sales) in the sample, respectively.	Compustat and Authors' calculation

Table A2
Fama-French 12 industry classification.

	Industry	Industry descriptions	Industry details
1	NoDur	Consumer NonDurables	Food, Tobacco, Textiles, Apparel, Leather, Toys
2	Durbl	Consumer Durables	Cars, TV's, Furniture, Household Appliances
3	Manuf	Manufacturing	Machinery, Trucks, Planes, Off Furn, Paper, Com Printing
4	Enrgy	Oil, Gas, and Coal Extraction and Products	
5	Chems	Chemicals and Allied Products	
6	BusEq	Business Equipment	Computers, Software, and Electronic Equipment
7	Telcm	Telephone and Television Transmission	
8	Utils	Utilities	
9	Shops	Wholesale, Retail, and Some Services (Laundries, Repair Shops)	
10	Hlth	Healthcare, Medical Equipment, and Drugs	
11	Money	Finance	
12	Other	Other	Mines, Constr, BldMt, Trans, Hotels, Bus Serv, Entertainment

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