Proceedings of the 5th International Conference on Financial Technology and Business Analysis
DOI: 10.54254/2754-1169/2026.39111

Supplier Concentration and the Cost of Debt Financing: Evidence from Midea Group and Gree Electric Appliances

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Abstract. This research employs the balanced panel data of Midea Group and Gree Electric Appliances, which are two major listed companies in the Chinese white goods industry, for the period of 2018-2024. The sample consists of 14 observations and tests the hypothesis that supplier concentration influences the cost of debt capital and whether there exists an influence-moderating effect from gross margin. Ordinary least squares regression analysis with heteroskedasticity-robust standard errors demonstrates that there exists a positive and significant relationship between supplier concentration and the cost of debt. There is no statistical significance between the relation of supplier concentration and the gross margin, and the relationship observed between the two firms is inconsistent with the mechanism underlying this hypothesis, hence Hypothesis two does not hold. The sample size is too small for the results to be generalized, and it would be best to consider this study as exploratory in nature with a comparison of two well-matched firms; the most important contribution of this paper is the data set collected on an individual firm level relating to the underexplored link between supply-chain concentration and financing cost of debt in China.

Keywords: Supplier concentration, Cost of debt, Gross margin, Information asymmetry, White-goods industry

1. Introduction

In its 2024 annual report, Midea Group (000333.SZ) noted that the contribution of the top five suppliers to purchases was 7.78 percent, whereas in its 2025 annual report, Gree Electric Appliances (000651.SZ) noted that the contribution of the top five suppliers was 32.75 percent, which is more than four times as high. The two firms are operating in the same sector, and yet the two firms are drastically different in terms of their reliance on suppliers. Is a more concentrated supplier structure perceived by a bank as a potential cause of default risk, thus requiring a higher return from the bank's side, when pricing a loan or analyzing the interest-bearing debt of a firm, and, if yes, is this effect independent from the profitability margin of a firm or not?

In addressing the above two research questions, this paper uses the data on Midea and Gree from the years 2018 to 2024. This sample is used because the setting ensures the industry, listing, and the regime of disclosure remain unchanged while the supplier concentration varies significantly between the two firms. The gross margin is used as the moderating variable because the lower it is, the more difficulty it faces in cushioning itself against any shock from a dominant supplier.

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The findings reveal that there is a significant positive relationship between supplier concentration and the cost of debt, which supports the view that credit terms are set in response to supply chain concentration risk. However, there is no statistical significance in the relationship between the level of supplier concentration and gross margin, and the pattern for the two companies is inconsistent with the buffering theory that motivates this hypothesis, hence failing to provide evidence in support of the above hypothesis.

2. Literature review

2.1. The economic consequences of supply-chain concentration

Studies on the impact of focused buyer-supplier relationships on the financing implications draw from the stakeholder theory of capital structure. Titman maintains that the extent of firm leverage influences the ability of the firm's stakeholders, which include its suppliers and buyers, to make specific investments for the relationship [1]. Following this train of thought, a study shows that supplier concentration is positively related to the speed with which firms adjust toward their target leverage [2].

The second strand of the literature that is more relevant to the topic at hand is not concerned with the impact of concentration on the choice of leverage by firms, but on its influence on the cost of capital paid by the firm [3]. A study shows that customer concentration is mainly related to the cost of equity capital of suppliers, while customer concentration also shows a relationship with the cost of debt, but this is more of an additional observation. It should be noted that all studies mentioned above do not necessarily agree with each other, as a study analyzes a sample of U.S. purchasing firms and demonstrates that firms with more diversified than concentrated supplier base incur higher cost of equity and cost of debt due to greater information asymmetry caused by monitoring multiple supplier relationships [4]. While this literature addresses the effects of customer concentration in the business model of firms, one should note that the key issue that lies beneath – namely, the impact of dependence on a few counterparties and thus higher exposure to risk associated with cash flows and therefore credit risks – affects equally well the issue of concentration in the procurement process.

2.2. Profitability, buffer capacity, and supply-chain risk

There is another literature focused on why some firms are more resistant to supply chain disruptions. In the household appliance industry, where price competition between a few large firms has always narrowed down the gross margin, such a buffer becomes even more important. In line with this reasoning, a study finds that Chinese listed companies that have more concentrated supply chains have more financial investments, suggesting this behavior represents precautionary self-insurance against the risk of being dependent on few counterparties [5]; this, in turn, indicates that firms are worried about the risks of supply chain concentration, thus supporting the logic of this research.

2.3. Research gap

Collectively, the literature surveyed above confirms two observations convincingly. The concentration of a firm's dealings with its trading partners—whether on the selling or buying side—is capitalized by the capital market in the form of cost of debt, and the firm's profitability determines its susceptibility to shocks from outside of the supply chain. Recently, studies have started exploring this literature for China and supply chain risk in a more general sense: A study looks at the supplier

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concentration in China but considers maturity of debt, not its cost [6]; another study employs supply chain risk measures based on input-output tables, not the disclosure-based supplier concentration measure that companies listed in China are obliged to report [7]. Little attention has been paid to the possibility that these two observations may be related, in other words, the financing cost consequences of supplier concentration may be contingent upon the firm's profitability, and if this relationship can be empirically confirmed using the disclosure-based, purchasing side supplier concentration metrics in China. This study attempts to fill these gaps.

3. Theoretical framework and hypotheses

3.1. Information asymmetry and the pricing of debt

The theoretical basis of the current study is drawn from the simple fact that any borrowing contract involves information asymmetry between the firm and its creditors. The above idea is expressed in the theory that banks and other creditors are delegated monitors [8]. Chinese listed firms are obliged to report the share of purchases covered by top five suppliers. However, the identity of suppliers and type of relationship with them remain unknown; hence, it is impossible for the creditor to evaluate whether a certain degree of concentration represents weak dependence on the input difficult to replace or a stable low-risk sourcing system.

The direction of the effect of supplier concentration on the cost of debt is conceptually ambiguous. From one perspective, a high degree of supplier concentration represents a source of weakness because the potential loss of, or higher cost from, a major supplier could cause disruption in the production process, cut into profit margins, and eventually make it more likely for the firm to default on its debt payments. However, from the opposite point of view, a focused and stable supplier relationship will mean lower transactions costs and better purchasing terms, hence a lower cost of debt.

3.2. Hypothesis development

In light of the risk signaling model as the dominant avenue, and in line with the bulk of the literature discussed before, the first hypothesis in this paper states that if a company concentrates its purchases from a few suppliers, then it will be at higher risk of encountering disruptions in its production process, and a rational lender that foresees this risk would ask for compensation for the same by way of charging higher interest rate on interest bearing liabilities. This results in hypothesis one that supplier concentration has a positive relationship with cost of debt financing.

The second hypothesis is drawn from the fact that every firm does not have equal vulnerability to the same supplier concentration. This rationale has led to the formulation of the second hypothesis, which states that the relationship between supplier concentration and cost of debt will be stronger for firms having a narrower gross margin.

4. Research design

4.1. Sample and data

The sample comprises observations of firms per year from Midea Group (000333.SZ) and Gree Electric Appliances (000651.SZ) for the period 2018 to 2024. Most importantly, there is a distinct difference between the two companies in terms of the concentration of their supplier base, providing useful cross-sectional variation in the paper's key independent variable.

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4.2. Variable definitions

All the variables of this research are listed in Table 1. The dependent variable in this study is the cost of debt financing, designated Cost, which is the ratio of interest expense to interest-bearing debt. Interest expense is defined as the interest-expense item contained in the financial-expenses footnote in the annual report. The interest-bearing debt is the year-end value of short-term borrowing, long-term borrowing, bonds payable, and current portion of long-term debt. Lease liabilities are excluded from interest-bearing debt.

The primary independent variable, supplier concentration, represented as SC, is the ratio of purchases from the top five suppliers to the total yearly purchases of the firm. The moderating variable, gross margin, represented as Margin, is the difference between the operating revenue and the operating cost, divided by the operating revenue.

Table 1. Variable definitions

Variable	Definition	Measurement
Cost	Cost of debt financing (dependent variable)	Interest expense / interest-bearing debt
SC	Supplier concentration (independent variable)	Purchases from top five suppliers / total annual purchases
Margin	Gross margin (moderating variable)	(Operating revenue − operating cost) / operating revenue
Size	Firm size (control variable)	Natural logarithm of total assets
Lev	Leverage (control variable)	Total liabilities / total assets
ROA	Return on assets (control variable)	Net profit / total assets
CF	Operating cash flow ratio (control variable)	Net cash flow from operating activities / total assets

Note. All variables are constructed from figures disclosed in the notes to Midea Group's and Gree Electric Appliances' annual reports for the fiscal years 2018 through 2024.

Control variables are also listed in Table 1. Size represents the natural logarithm of the firm's total assets. Lev is the ratio of total liabilities to total assets. ROA is the ratio of net profit to total assets. CF is the ratio of net cash flows from operating activities to total assets.

4.3. Model specification

Two ordinary least squares regressions are run to test the two hypotheses. The first ordinary least squares regression, which tests hypothesis one, includes the cost of debt, supplier concentration, and the four control variables. The second ordinary least squares regression, which tests hypothesis two, includes the same independent variables as Model 1 along with gross margin and the interaction effect between supplier concentration and gross margin. Thus, pooled ordinary least squares are used.

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5. Empirical results and discussion

5.1. Descriptive statistics

Descriptive statistics for the complete sample of fourteen firm-years are provided in Table 2 below.

Table 2. Descriptive statistics full sample (n = 14)

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Cost	14	0.0035	0.0042	0.0000	0.0131
SC	14	0.1655	0.1155	0.0499	0.3507
Margin	14	0.2682	0.0238	0.2248	0.3057
Size	14	26.582	0.244	26.250	27.127
Lev	14	0.6418	0.0316	0.5814	0.7130
ROA	14	0.0781	0.0109	0.0641	0.1050
CF	14	0.0930	0.0336	0.0059	0.1532

The average cost of debt is 0.35 percent, with a standard deviation of 0.42 percent and a range between almost zero and 1.31 percent. The average concentration level of suppliers is 16.55 percent, with a standard deviation of 11.55 percent. The average gross margin is 26.82 percent and relatively stable among the observations, whereas leverage averages 64.18 percent and firm size, proxied by the natural log of total assets, is highly concentrated.

Two companies' descriptive statistics are compared in Table 3. Supplier concentration in Gree company is 27.08 percent on an average basis during the sample period, which is about four and a half times higher than that of Midea company, which is 6.02 percent on an average basis. The cost of debt in Gree company is also much higher (0.54 percent) than that of Midea company (0.17 percent). There is not much difference in terms of firm size and leverage of the two firms, but in the case of operating cash flow ratio, Gree's is both smaller on average and considerably more volatile than Midea's.

Table 3. Descriptive statistics by firm

Variable	Midea Mean	Midea SD	Gree Mean	Gree SD
Cost	0.0017	0.0016	0.0054	0.0052
SC	0.0602	0.0096	0.2708	0.0541
Margin	0.2588	0.0213	0.2775	0.0240
Size	26.690	0.280	26.475	0.153
Lev	0.6438	0.0106	0.6399	0.0452
ROA	0.0744	0.0070	0.0817	0.0132
CF	0.1010	0.0178	0.0849	0.0445

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5.2. Correlation analysis and regression results

The pairwise correlation matrix appears in Table 4. The simple correlation coefficient between Cost and SC turns out to be 0.638 – a significantly high correlation, positive in sign, as expected in Hypothesis one. The correlation coefficient between ROA and Size equals -0.720 and this is the largest correlation among the control variables.

The coefficient for SC in Model 1 which was developed to estimate hypothesis one is 0.0098 and is significant at 5 percent (t = 2.57, p = 0.033). The results mean that a 10-percentage point increase in supplier concentration leads to an increase in the cost of debt by about 0.10 percentage points.

Table 4. Correlation matrix (n = 14)

	Cost	SC	Margin	Size	Lev	ROA	CF
Cost	1.000						
SC	0.638	1.000					
Margin	-0.163	0.235	1.000				
Size	-0.532	-0.359	-0.319	1.000			
Lev	-0.377	-0.093	-0.138	0.131	1.000		
ROA	0.122	0.142	0.594	-0.720	-0.432	1.000	
CF	-0.624	-0.404	0.593	0.101	0.035	0.183	1.000

Results from the two OLS regressions are reported in Table 5. In the four control variables, two are as expected in terms of their signs in the cost of debt literature and are statistically significant at the 1 percent level, while one is significant at the 10 percent level: Size and ROA are negative and significant at the 1 percent level, while CF is significant at the 10 percent level. The fourth variable, Lev, is significant at the 1 percent level, but it has a negative sign, which is contrary to the expectation that higher leverage raises default risk and therefore the cost of debt. The adjusted R-squared of Model 1 is 0.861, meaning that a considerable portion of variance in the cost of debt is explained by the model, given the small sample size.

Model 2 incorporates gross margin and the interaction of the gross margin and supplier concentration variables to investigate Hypothesis two. The coefficient of the interaction of supplier concentration and gross margin is -0.3954 and is in line with the negative sign expected under Hypothesis 2; however, the coefficient fails to meet the standard criteria for statistical significance (t = -1.81, p = 0.121). Even though the coefficient of Supplier Concentration in Model 2 rises to 0.1201, it does not reach the conventional level of significance of 10 percent (p = 0.100, without star in Table 5 using the criteria of $p < 0.10$ for this paper), while the coefficient of gross margin is relatively low and insignificant.

In addition, Model 2 does not improve the explanatory power over Model 1. The adjusted R-squared in Model 2 is slightly lower compared to Model 1 at 0.858, implying that the inclusion of the interaction variable does not add explanatory value to the regression model.

Table 5. Regression results

Variable	Model 1 (Cost)	Model 2 (Inter)
SC	0.0098** (0.0038)	0.1201 (0.0619)

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Table 5. (continued)

Margin	—	0.0304 (0.0299)
SC × Margin	—	-0.3954 (0.2188)
Size	-0.0144*** (0.0020)	-0.0112*** (0.0023)
Lev	-0.0706*** (0.0168)	-0.0636** (0.0201)
ROA	-0.2700*** (0.0475)	-0.1818* (0.0745)
CF	-0.0348* (0.0185)	-0.0074 (0.0253)
Constant	0.4540*** (0.0559)	0.3456*** (0.0711)
N	14	14
Adjusted R^2	0.8609	0.8576

Note. Heteroskedasticity-robust standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

5.3. Discussion

The evidence given above is quite convincing for Hypothesis one but does not provide any evidence for Hypothesis two. The positive and significant coefficient of SC in Model 1 is aligned with the risk-signaling, as well as with previous research demonstrating that firm's concentration in their customer-supplier relations or in supplier relations is priced in the cost of external capital [9]. The economic significance of the effect is quite considerable and explains just over half of the financing cost difference between Midea and Gree.

It should be noted that the regression coefficient of Lev is negative and statistically significant in both regressions, contrary to what is typically expected if higher leverage mechanically raises default risk and therefore the marginal cost of debt. The coefficient cannot be interpreted in this case as evidence of the lower cost of debt associated with higher leverage for Midea and Gree since there are reasons why its interpretation causally is unreliable for this sample. First, the leverage ratio is the same in the two firms and exhibits almost no dispersion. Additionally, in a period when interest rates in China were falling, higher-leverage firms could also use lower-cost bank loans or financial instruments along their supply chain, rather than costly bond issues, and hence the negative correlation between Lev and Cost would arise independently of leverage being causally associated with lower costs [10].

The interaction term in Model 2 does not attain statistical significance, and there is no evidence in favor of Hypothesis two. That is because not only the result is not statistically significant, but more importantly, the pattern from Table 3: Gree not only has a higher supplier concentration on average but also has a higher, rather than a lower, gross margin compared to Midea. Given that the gross margin is supposed to help the firms to mitigate the effects of concentration in Hypothesis two, the firm with a higher gross margin (Gree) is expected to have a smaller cost of debt due to supplier concentration; instead, the opposite pattern is observed in the data.

Three reasons for the failure of gross margin to play the moderating role predicted by Hypothesis two are worth mentioning, none of which requires additional data. The first one is that in this case gross margin is related to the firm's bargaining power rather than its capacity to buffer risks. Secondly, gross margin is not an exogenous factor but rather a result of the decisions of the firm concerning its operations and sources of inputs, and thus a high margin may be a sign of dependency on few suppliers providing the firm with specialized inputs. Thirdly, and more specifically, the

DOI: 10.54254/2754-1169/2026.39111

difference in the gross margins of the two companies is just 1.87 percentage points on average (25.88% for Midea and 27.75% for Gree, according to Table 3), which means that there is hardly any cross-sectional variation to explain the moderating effect and, therefore, the interaction term is hard to estimate without having to even worry about the sample size.

6. Conclusion

6.1. Summary of findings

The purpose of this paper was to provide answers to two research questions through analysis of seven years of firm level data pertaining to Midea Group and Gree Electric Appliances. About the first research question, namely, "is supplier concentration factored into the cost of debt?", the answer is unambiguous since the variable is included in the regression analysis and carries a statistically significant positive coefficient. When it comes to the second research question ("is there any moderating effect?"), the answer in this case is negative, since the interaction effect is statistically insignificant, while the descriptive comparison shows that this goes against the idea that motivated the hypothesis. Thus, the gross margin is not a moderator in this case.

6.2. Managerial and policy implications

These findings mean that, for corporate management, supplier concentration is not only an operational decision. Because greater supplier concentration is associated with a higher cost of debt, supplier decisions also directly affect financing costs. The first step a company should take if it has a high value of concentration ratio in top-five-suppliers report is to think about whether there is a need to develop an alternative source for key components. Second, companies could take advantage of the disclosure process during the preparation of their annual reports to inform creditors, in qualitative form, about whether the level of concentration represents a fragile dependence.

The findings suggest two concrete changes that can be undertaken by banks and other creditors who operate in China. First, the top five suppliers' concentration ratio, which is currently required to be reported by firms in China, may be included as an explicit variable in the credit scoring model of banks for corporate borrowers in the manufacturing industries. Second, when it comes to loan renewal or covenant review, creditors can ask the firm to provide reasons behind this concentration ratio because the disclosure method employed in this study cannot, by itself, distinguish between the robust single-source relationship with a favorable price advantage from the fragile one.

6.3. Limitations

The sample includes fourteen firm-year data points from just two firms, specifically selected as a matched pair for study and not as random samples from a population. Due to the limited number of observations, certain econometric techniques are not applicable, such as the use of firm or year fixed effects, since it leaves very few degrees of freedom for statistical analysis; hence the use of pooled OLS. Other common robustness techniques such as bootstrap inference and re-estimation with alternative variable definitions are not possible due to the limited number of observations. The power of Model 2 in detecting the hypothesized moderating effect of gross margin is thus relatively small; this is regarded as the secondary rather than primary reason for the failure to support Hypothesis 2, because the primary reason given there is the observed descriptive trend that runs against the hypothesized trend.

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First additional limitation relates to the measurement of the dependent variable. Specifically, since the two companies' amounts of capitalized interest and their capitalization policy were not separately obtained in this study, it is impossible to estimate to what extent this limitation has influenced the estimation of the cost of debt difference between the two firms. Second, interest-bearing debt is measured using its end-of-the-year balance rather than the average balance during the year, and it does not include lease liabilities that are not provided by both companies in a comparable way throughout the whole sample period.

Moreover, the results in Section 5 regarding the regression analysis are unable to distinguish between the two mechanisms – risk and transactions costs – that were outlined in Section 3.1. Finally, the negative and statistically significant estimate for the effect of leverage in the model in Section 5.3 should not be seen as an indication that leverage reduces the cost of borrowing.

In addition, the gross margin is the single moderating variable in the study. It could be argued that there may be other firm attributes that affect the association between supplier concentration and cost of debt. It would be interesting to observe how future studies will be able to deal with the mentioned limitation along with others.

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