

Product Market Competition and Financial Structure —Evidence from a Textual Analysis of Chinese Listed Firms *

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Received 17th of October 2019 Accepted 22nd of July 2020

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Abstract

On the basis of a textual analysis of listed firms' annual reports, we measure the extent of product market competition and study how product market competition affects firms' financial structure. We find that as a firm's product market competition becomes fiercer, the firm tends to rely less on debt financing, especially short-term debt financing. In addition, we find that the effect of product market competition on financial structure only works in non-state-owned firms (non-SOEs). Overall, this study contributes to the literature that discusses product market competition's impact on financial structure. Furthermore, our research findings provide some evidence about the channel through which product market competition affects firms' financing choices.

Keywords: Product Market Competition, Financial Structure, Textual Analysis

* This paper is sponsored by the National Natural Science Fund (Grant no. 71372048) and the Fundamental Research Funds for the Central Universities of China (Grant no. 63202029).

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I. Introduction

Researchers have engaged in debates over the relationship between product market competition and financial structure for a long time. Given that a company's stakeholders have different goals and constraints, leading to potential conflicting interests, researchers have proposed several theoretical models, such as the strategic bankruptcy effect (Telser, 1966; Benoit, 1984; Chevalier, 1995) and the limited liability effect (Brander *et al.*, 1986; Maksimovic, 1988), and have conducted empirical tests for different theories.

Due to differences in the measurement of product market competition, empirical evidence on the relationship between product market competition and financial structure is, at best, mixed. Some studies suggest that fiercer product market competition leads to a lower debt ratio (Bolton and Scharfstein, 1990; Zhao and Sun, 2004). For instance, Zhu *et al.* (2002) analyse the development trend of the beer industry and take Yanjing Beer as an example, finding that companies tend to have more conservative financial structures as product market competition becomes fiercer. In contrast to those findings, some studies have found a positive relationship between product market competition and the debt ratio (Liu *et al.*, 2003; Zhong *et al.*, 2004; Wu *et al.*, 2017). Jiang *et al.* (2005) use the market share of listed companies as a proxy for the degree of product market competition and find that fiercer product market competition leads to more debt financing.

Previous studies mainly use industry-level measurements, such as concentration ratios and the Herfindahl index, to proxy for the degree of competition within a certain industry. However, these measurements ignore differences in the degree of competition among various companies in the same industry. Some studies also use corporate profit margins and revenue growth rates as proxies for corporate competitive advantages; however, these proxies are endogenous to corporate financial conditions and closely related to financial structure and thereby fail to precisely measure product market competition for certain companies (Xu *et al.*, 2015; Wu *et al.*, 2017; Ren and Wang, 2019). These shortcomings of proxies for product market competition affect the findings on its relationship with financial structure.

Utilising the product description texts of businesses used in the financial reports of Chinese A-share listed companies, this study adopts a textual analysis method to develop a new product market competition measure by calculating product similarity and explores the relationship between product market competition and corporate financial structure. Compared with commonly used measures in prior research, the measures of new product market competition developed from textual analysis are more accurate and comprehensive and therefore at least partly address the problems with prior measures that ignore individual differences and face endogeneity issues (Hoberg *et al.*, 2014). Utilising the new production competition measure, we find that companies facing fierce competition in their product markets are more likely to choose conservative financial and debt maturity structures. Moreover, this relationship will be moderated by the company's ability to undertake risks.

Therefore, we argue that the strategic bankruptcy effect could better explain the phenomenon of Chinese listed companies' financial structures.

Specifically, we find that a company's debt ratio is lower when it is facing greater product market competition. According to the strategic bankruptcy effect hypothesis, companies faced with fierce product market competition have higher operating risks. Hence, such companies need to control their debt risks to prevent bankruptcy, thus leading to a conservative financial strategy. Our main conclusion is not sensitive to the number of competitors we choose to calculate the similarity. Moreover, we find that product market competition mainly affects the short-term debt ratio when partitioning the debt ratio into short-term and long-term debt ratios. Next, we split the sample firms into two groups on the basis of ownership, namely, state-owned enterprises (SOEs) and non-state-owned enterprises (non-SOEs). SOEs are more able to undertake risks due to soft budget constraints (Lin and Li, 2004; Lin *et al.*, 2004). Consistent with this argument, we find that the effect of product market competition on financial structure mainly works in non-SOEs. Our conclusions are robust to using alternative measures of financial structure, excluding the period of financial crisis, and to considering both reverse causality and alternative explanations for increased debt financing costs.

This study makes the following contributions to the literature. First, we propose a new measure of product market competition at the Chinese firm level and re-examine the controversial research questions. The strategy of product market competition has long been recognised as one of the most important strategies (Chamberlin, 1933; Porter, 1980; Lieberman *et al.*, 1988), but relevant studies have been limited by the measurement of product market competition. This study follows the same methodology as that used by Hoberg and Phillips (2016) to measure the similarity of the products and businesses of Chinese listed companies with the help of deep learning technology. Second, we introduce textual analysis technology into financial- and accounting-related research. While most previous studies have focused on the limited liability effect of Chinese corporations, our study supports the view that the strategic bankruptcy effect is the main factor considered when Chinese firms make decisions about their financial structures, which provides empirical support to better understand the impact of market competition on financial structure decisions. Third, on the basis of the differences in risk-taking ability caused by ownership, this study suggests that risk balance is the main channel by which product market competition affects financial structure. Combined with theoretical reasoning and empirical tests, we provide new evidence to support the strategic bankruptcy effect.

The rest of this paper is arranged as follows: The second part presents a literature review and the research hypotheses, the third part introduces the data sources and the definitions and measurements of the variables, the fourth part presents the results of the empirical test and further analysis, and the last part concludes the paper.

II. Literature Review and Hypotheses

The impact of product market competition on financial structure is a profound theoretical and empirical issue that has attracted the attention of many scholars (Telser, 1966; Brander *et al.*, 1986; Titman, 1984; Zhu *et al.*, 2002; Jiang *et al.*, 2005; Deng *et al.*, 2006; Xu *et al.*, 2015; Wu *et al.*, 2017). The relationship between product market competition and financial structure is not especially clear. In a simple way, product market competition and financial structure reflect two aspects of firm risk: operational risk and financial risk. To avoid bankruptcy, companies balance these two risks to reach an equilibrium. Most companies will not choose to bear high operational risk and high financial risk at the same time. Therefore, companies faced with high (low) product market competition should have a relatively conservative (aggressive) financial structure. However, different stakeholders of a company have different utilities and goals which result in conflicts of interest between different stakeholders and lead to a complicated relationship between product market competition and financial structure. Specifically, depending on the subject of the conflict of interest, both the strategic bankruptcy effect and the limited liability effect could affect the relationship.

Some researchers hold the view that companies faced with fierce product market competition are inclined to choose a conservative financial structure. Telser (1966) was the first to propose the strategic bankruptcy effect, while Benoit (1984), Brander and Lewis (1988), and Bolton and Scharfstein (1990) developed this theory in their research and formed the strategic bankruptcy effect theory. The strategic bankruptcy effect considers the conflicts of interest between a company and its competitors, and the basic assumption is that competitors will target a company's weaknesses stemming from high financial risk and will increase their production (or lower prices) to drive the company into bankruptcy and grab its market share. This means that a company with high financial risk may fall into a high operational risk situation because of its competitors' grabbing strategies, thus further increasing its risk of bankruptcy. Therefore, in anticipation of high financial risks, companies with high operational risk tend to avoid a higher debt ratio and to pick a relatively conservative financial structure to strike a balance between operational and financial risk.

Some researchers argue that companies faced with fierce product market competition have an incentive to choose an aggressive financial structure. On the one hand, conflicts of interest between shareholders and creditors (Jensen and Meckling, 1976) affect the choice of the company's financial structure: this is called the limited liability effect. As stipulated by modern laws, shareholders bear limited liability: that is, creditors have priority to claim a company's assets if the company goes bankrupt, and that right to claim is limited to the company's assets. This means that as the company's debt ratio rises, creditors can claim an increasing share of assets, while the share of assets that shareholders can claim gets closer to zero. Brander and Lewis (1986) suggest that limited liability would greatly increase the probability that shareholders will take on more risk—in other words, that they would adopt

more aggressive strategies. When the debt ratio is 100%, the share of assets that shareholders could claim is 0; if shareholders decide to take risks and the value of the company remains unchanged, the asset share they could claim is still 0. If the value of the company increases, the share of assets that shareholders could claim will be greater than zero. Therefore, the best choice for rational shareholders is to take greater financial risk as competition increases, which will lead to a simultaneous increase in operational and financial risks (Maksimovic, 1988). On the basis of this theory, Liu *et al.* (2003), Jiang (2005) and Deng *et al.* (2006) find a positive correlation between the debt financing ratio and product market competition in the Chinese market.

However, Brander and Lewis (1986) assume that companies could freely choose operational risks after obtaining debt financing. In fact, creditors would not allow shareholders to hurt their interests but would instead restrict shareholders' behaviours in various ways (Smith *et al.*, 1979). Under this logic, the more leveraged a company is, the greater the constraints faced by shareholders. Shareholders and management could not increase financial risk indefinitely.

In summary, there is no consensus on the effect of product market competition on financial structure. In the Chinese setting, the research conclusions are also mixed when they rely on different theories and product market competition measurements.

Some studies suggest that a competitive product market would result in a lower debt ratio. Zhu *et al.* (2002) find that as product market competition becomes fiercer, financial structures tend to become more conservative. However, some Chinese researchers use different indicators to proxy for product market competition and arrive at an opposite conclusion to that of Zhu *et al.* (2002). For example, Liu *et al.* (2003) use the number of firms in the same industry and the Herfindahl index to measure product market competition and conclude that product market competition is positively correlated with the debt ratio. Jiang *et al.* (2005) propose that product market competition is directly reflected in the company's market share, and using market share as a measurement, they find that intense product market competition results in a higher debt ratio. Wu *et al.* (2017) think that product market competition should consider market share, profitability, cash generation ability, investment return ability, and growth ability; they use a comprehensive index to proxy for competition and conclude that product market competition is positively correlated with the debt ratio.

Hoberg *et al.* (2014) suggest that the proxies for competition employed in prior studies have difficulty reflecting a company's product market competition in an accurate and timely fashion. Industry indicators such as the industry concentration ratio and Herfindahl index are unable to capture differences among various companies in the same industry, while other indirect indicators of competition calculated from financial data may cause concerns about endogeneity. For example, profit margin is used to measure the degree of competition, while it is also associated with the debt ratio, which might raise endogeneity concerns. There is a

lack of consensus on the measurement of product market competition, and it remains unclear how product market competition affects financial structure because of the differences in how it is measured.

On the basis of the Chinese-based computational linguistics literature, we process the product description texts of Chinese listed companies and calculate the similarity of product descriptions with reference to the method of Hoberg *et al.* (2016). We propose a new measure of product market competition for Chinese listed companies. Measurement based on textual analysis is less subject to endogeneity and can reflect the level of product market competition for individual companies in a more reliable and timely way. Taking advantage of this product market competition measure based on textual analysis, we provide new evidence for the controversial research findings.

Based on the strategic bankruptcy effect and limited liability effect hypotheses, the effect of product market competition on financial structure is still unclear. Thus, our first hypothesis is as follows:

Hypothesis 1: All else being equal, product market competition has no impact on a company's debt ratio.

The debt maturity structure is the other aspect of a company's financial structure. We suggest that companies faced with fierce product market competition are more likely to reduce their short-term debt. The reason for this is that the repayment pressure of short-term debt is relatively high, and companies with high short-term debt may fall into bankruptcy when facing liquidity risk (Diamond, 1991; Stohs *et al.*, 1996). On the one hand, companies faced with fierce product market competition are squeezed by their competitors in terms of profit and market share; on the other hand, competitors might use methods to increase firms' liquidity risks in exchange for sacrificing short-term benefits. In this case, to avoid the risk of bankruptcy, the companies will reduce short-term debt, such as paying off short-term borrowings or refinancing short-term debt with longer maturities. However, from the perspective of creditors, if the company faces fierce competition in its product market, it may prefer to issue short-term loans to reduce their risk; thus, it is easier for the company to obtain short-term loans.² Therefore, our second hypothesis is as follows:

Hypothesis 2: All else being equal, product market competition has no impact on a company's debt maturity structure.

Companies usually take the balance of risks into account when choosing a financial structure, such as the trade-off between operational and financial risks. Therefore, it can be anticipated that companies with different risk-resistance capabilities would have different choices of financial structure. To test this prediction, we divide the sample into two groups

² We appreciate the helpful advice from reviewers who suggested considering debt maturity structures from the perspective of creditors.

according to their risk-resistance capabilities.

It is difficult to distinguish the ability to resist risks from a third dimension. At present, prior research commonly uses profit margin or volatility to measure this ability, but both profit margin and volatility have a strong relationship with a company's product market competition. Other measurements, such as leverage, are directly related to the financial structure we are looking at. We divide the Chinese listed firms on the basis of their ownership. Because of the special institutional environment, SOEs undertake certain government functions which have soft budget constraints (Lin and Li, 2004; Lin *et al.*, 2004). Therefore, we argue that the ability of SOEs to resist risks is higher than that of non-SOEs and that non-SOEs will have more incentives to avoid high financial risks in the case of fierce competition. Thus, our third hypothesis is as follows:

Hypothesis 3: Compared with its effect on SOEs, product market competition has a stronger effect on the debt ratios of non-SOEs.

III. Data and Variables

3.1 Sample Selection

This study chooses A-share listed firms in China from 2002 to 2014 as the research sample. We extract the PDF version of each company's financial reports from the website of the China Securities Regulatory Commission and the WIND database. Our study excludes firms whose annual reports cannot be recognised by computers or cannot be processed by word segmentation. In addition, samples of financial companies are excluded. The final sample consists of approximately 20,991 fiscal-year observations. The firm-level data required for this study are all acquired from the CSMAR database.

3.2 Definition of Variables

3.2.1 Product market competition

We use the "Board Report" part of each financial report as the product description text of the company. Given that the board report contains more discussions about the company's business and products and is less noisy, it will have fewer errors in textual analysis. We follow the methodology used by Clarkson *et al.* (1994) and Jiang *et al.* (2017). First, we copy the board report from the company's financial report. Next, we segment the text³ and preprocess⁴ it to keep only the product- and business-related vocabulary. The final product and business

³ Unlike natural languages such as English, the processing of Chinese paragraphs requires word segmentation first. The word segmentation method used in this paper is the THULAC tool of Tsinghua University (Sun *et al.*, 2016).

⁴ Preprocessing includes removing stop words in the dictionary ("的", "也", etc.) and words that do not convey product information ("利润", "融资", etc.).

dictionary contains 9,313 words. Then, we refer to the method of Hoberg and Phillips (2016) to transform each company's board report into a 9,313-dimensional vector. Specifically, if the n^{th} word in the dictionary is involved in the board report, then the n^{th} bit of the vector is 1; otherwise, it is 0.⁵ Finally, the similarity between any two companies can be calculated as the cosine of the angle between the two vectors:

$$\text{Similarity}(\text{firmA}, \text{firmB}) = \frac{\overrightarrow{\text{firmA}} \cdot \overrightarrow{\text{firmB}}}{(|\overrightarrow{\text{firmA}}| \times |\overrightarrow{\text{firmB}}|)} \quad (1)$$

The value ranges from 0 to 1. When two companies' businesses and products become more similar, they use increasingly more of the same vocabulary, thereby leading to a higher degree of vector overlap, which is mathematically expressed as the angle between their vectors. In summary, an increase in the similarity between the two companies' products and businesses will result in a higher value of similarity.⁶

Then, we consider the number of competitors for any given company and calculate an average similarity index on the basis of the number of competitors. We choose 20 as the number of competitors as the median number of listed companies in the same industry (three-digit code) under the CSRC industry classification is 20. Specifically, we first find the 20 most similar companies and then define a company's product market competition as the average of the similarity of the company's product and business terms with 20 competitors. We measure product market competition as follows:

$$\text{PMC} = \frac{\sum \text{similarity of nearest } N \text{ firms}}{N} \quad (2)$$

If product market competition becomes fiercer, the similarity of other companies to the company tends to become greater, thereby contributing to a greater value of PMC. Conversely, firms with unique products have less similarity with other companies, which is true even for the 20 most similar companies. In the sensitivity analysis, we also calculate the most similar 5, 10, 50, and 100 competitors. The calculation and processing of similarity is the same as that in Ren and Wang (2019).

We suggest that the new measure of product market competition based on textual analysis outperforms the measures employed in prior literature in the following four ways. First, product market competition derived from textual analysis is more intuitive. In particular, the product should be the focus when studying the market competition of products. Product description text demonstrates the features and functions of the product, and the similarities and differences between products is reflected by similarities in the product description text. Second, the product market competition measure obtained by textual analysis, which considers the difference in the degree of competition within the same industry, varies from

⁵ We also replace the 0/1 mark vector with word frequency, and the results are not significantly different.

⁶ Hoberg *et al.* (2016) redefine the extension of "industry" on the basis of the calculation of similarity and examine the validity of its definition. Since then, relevant studies have gradually recognised the validity of product market similarity measured by textual analysis.

company to company. Existing measures for product market competition generally assume that each company in the same industry has the same degree of product competition in terms of number of companies in the industry, concentration ratio, and market share. In fact, companies in the same industry may face different product competition environments, and their competitors are not necessarily all or only companies in the same industry (Hoberg *et al.*, 2016). Third, product differences can be compared in detail through their product descriptions. A company may have multiple products, and even a single product has multiple dimensions. Previous studies ignore the differences in the details of these products, while computational linguistics indicators can accurately capture any details of the product even if two companies only have a competitive relationship for that one product. For example, the convenience store business operated by Sinopec (Yi Jie Convenience Store) objectively competes with supermarkets, which cannot be captured by prior measures since they are in different industries. However, their level of competition can be captured by our measure based on textual analysis. Fourth, textual analysis can provide a more timely reflection of product market competition. Listed companies do not necessarily submit changes in their industries to the CSRC in real time. In addition, there will be a delay for the CSRC to update a company's industry and classification, while the company's product descriptions are generally updated annually. Therefore, product market competition based on the description of the company's product is also real-time and thus more timely in reflecting the change.

3.2.2 Financial structure

The main dependent variable is financial structure. To make the results comparable, we follow the same methodology as that used in domestic and foreign studies (Jiang *et al.*, 2005; Chen *et al.*, 2013; Zhong *et al.*, 2014) to define a company's debt ratio (Debt_Financing), which is the ratio of the company's total liabilities to total assets. In the robustness test, we also use interest-bearing debt to measure debt financing.⁷

To examine the effect of market competition on the maturity structure of corporate debt, we define the current debt ratio (Current_Debt) and noncurrent debt ratio (Noncurrent_Debt), as shown in Table 1.

3.2.3 Other variables

Following a previous study (Bae *et al.*, 2011), we control for the following variables: firm size (SIZE), return on assets (ROA), market to book ratio (MTB), fixed assets ratio (PPE), selling and administrative expenses (SGA), cash dividend (DIV), and sales income (SALE).⁸ All variables are defined in Table 1.

⁷ We appreciate the helpful advice from reviewers who suggested using interest-bearing debt to measure debt structures.

⁸ We also add some additional control variables. The results are unchanged.

Table 1 Definitions of Variables

Variable	Definition
PMC _N	Product market competition: the average of the similarity of the company's product and business terms with N competitors; calculation is shown in detail in the context
Debt_Financing	Debt ratio: a firm's total debt in proportion to total assets
Current_Debt	Current debt ratio: a firm's current debt in proportion to total assets
Noncurrent_Debt	Noncurrent debt ratio: a firm's noncurrent debt in proportion to total assets
SIZE	Firm size: natural logarithm of the firm's total assets
ROA	Return on assets: a firm's net profit in proportion to total assets
MTB	Market to book ratio: the market value of equity divided by that equity's book value
PPE	Fixed assets ratio: a firm's fixed assets in proportion to total assets
SGA	Selling and administrative expenses: a firm's selling and management expenses in proportion to total assets
DIV	Cash dividend: dummy variable that equals 1 if the firm pays cash dividends and 0 otherwise
SALE	Sales: a firm's sales revenue in proportion to total assets

Table 2 Descriptive Statistics

Variable	Obs	Mean	Std. Dev	P25	Median	P75
Debt_Financing	20,991	0.479	0.242	0.305	0.479	0.632
Current_Debt	20,972	0.399	0.322	0.235	0.372	0.513
Noncurrent_Debt	20,972	0.087	0.163	0.006	0.037	0.124
PMC20	20,991	0.216	0.044	0.186	0.212	0.241
SIZE	20,991	21.614	1.221	20.774	21.465	22.277
PPE	20,991	0.255	0.178	0.115	0.223	0.368
ROA	20,991	0.034	0.067	0.012	0.035	0.064
MTB	20,991	2.627	2.566	1.338	1.860	2.963
SGA	20,991	0.088	0.071	0.041	0.070	0.111
DIV	20,991	0.613	0.487	0	1	1
SALE	20,991	0.659	0.480	0.343	0.543	0.825

The statistical results for all variables are shown in Table 2. The average debt ratio of listed companies is 47.9%, and the debt ratio varies greatly from company to company. The current debt ratio has a mean of 39.9%, which is higher than the average noncurrent debt ratio of 8.7%. The average ratio of fixed assets to total assets is 25.5%, and the average ROA is 3.4%. On average, 61.3% of sample firms have issued cash dividends.

IV. Research Design and Empirical Results

4.1 Product Market Competition and Financial Structure

We first conduct a univariate test. We divide observations into two groups on the basis of the median value of PMC and compare the differences in the financial structure and (non)current debt ratio of the two groups. The results are shown in Table 3.

Table 3 Univariate Test

Variable	PMC below median		PMC above median		Mean Difference
	Obs	Mean	Obs	Mean	
Debt_Financing	10,139	0.519	10,852	0.442	0.077***
Current_Debt	10,124	0.440	10,848	0.357	0.083***
Noncurrent_Debt	10,124	0.080	10,848	0.085	-0.005

Note: The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

As seen from Table 3, we observe a debt ratio of 0.519 (0.442) when the company's product market competition is low (high), and companies faced with low product market competition have a higher debt ratio. Furthermore, there is a significant difference in current debt between the high- and low-PMC groups, while there is no significant difference in noncurrent debt. The univariate test results show that the degree of product market competition might affect the choice of corporate financial structure. When product market competition becomes fiercer, companies tend to choose a conservative financial structure.

As other characteristics of the company could affect the univariate test results, we use the following regression model, which controls some company characteristics, to test the relationship between product market competition and debt structure. We estimate the following model to test hypothesis 1:

$$\text{Debt_Financing} = \beta_0 + \beta_1 \text{PMC} + \text{controls} + \text{fixed effect} + \varepsilon \quad (3)$$

The variable of interest is product market competition, which is derived from the textual analysis of the financial report. The dependent variable is the company's debt ratio. We also include the firm and year fixed effects in the model to control the time-invariant omitted variables at the firm level. If the company reduces the debt ratio when facing fierce product market competition, then we expect β_1 in model (3) to be negative. The regression results are shown in Table 4.

Table 4 shows that the coefficients of product market competition are significantly negative, regardless of inclusion of the control variables. In column (2), the coefficient of PMC20 is -0.237, which is significant at the 1% level. This result is not only statistically significant. In terms of economic significance, a one standard deviation increase in product

market competition reduces the debt ratio by 3%, which is economically large compared with prior research in a Chinese setting (Wu *et al.*, 2017). The results show a negative relationship between product market competition and company debt ratios, which is in line with the prediction of risk balance and the strategic bankruptcy effect. This result indicates that risk balance is a company's main consideration in weighing its financial and operational risks in China.

Table 4 The Effect of Product Market Competition on Financial Structure

	(1)	(2)
	Debt_Financing	Debt_Financing
PMC20	-0.301*** (-5.07)	-0.237*** (-4.73)
SIZE		0.052*** (7.23)
ROA		-0.801*** (-21.32)
MTB		0.002 (1.11)
PPE		0.097*** (3.99)
SGA		0.319*** (4.25)
DIV		-0.023*** (-7.47)
SALE		-0.004 (-0.37)
Constant	0.478*** (36.21)	-0.645*** (-4.17)
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	20991	20991
Adjusted R^2	0.026	0.210

Notes: The t-statistics in parentheses are based on standard errors clustered at the firm level. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively, for two-tailed tests.

SIZE, PPE, and SGA are all significantly and positively related to the debt ratio, while ROA and DIV are negatively correlated with the debt ratio. The signs of the coefficients of the control variables are consistent with Bae *et al.* (2011).

We choose 20 as the number of competitors to define PMC as this is the median number of listed companies in the same industry (three-digit code) under the CSRC industry classification. Because the number of competitors is optional, we also select 5, 10, 50, and 100 as the number of competitors and recalculate the average similarity to measure product

market competition. Table 5 reports the results of using more or fewer competitors to calculate PMC.

Table 5 Sensitivity Test

	(1)	(2)	(3)	(4)
	Debt_Financing			
PMC5	-0.201*** (-4.39)			
PMC10		-0.218*** (-4.51)		
PMC50			-0.266*** (-5.16)	
PMC100				-0.289*** (-5.61)
SIZE	0.052*** (7.20)	0.052*** (7.22)	0.052*** (7.21)	0.052*** (7.19)
ROA	-0.801*** (-21.30)	-0.801*** (-21.31)	-0.802*** (-21.33)	-0.802*** (-21.35)
MTB	0.002 (1.12)	0.002 (1.11)	0.002 (1.10)	0.002 (1.09)
PPE	0.098*** (4.03)	0.098*** (4.01)	0.097*** (3.97)	0.096*** (3.97)
SGA	0.320*** (4.26)	0.319*** (4.26)	0.318*** (4.24)	0.317*** (4.23)
DIV	-0.023*** (-7.48)	-0.023*** (-7.48)	-0.023*** (-7.47)	-0.023*** (-7.47)
SALE	-0.003 (-0.34)	-0.004 (-0.35)	-0.004 (-0.37)	-0.004 (-0.36)
Constant	-0.645*** (-4.17)	-0.645*** (-4.17)	-0.642*** (-4.15)	-0.639*** (-4.13)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	20991	20991	20991	20991
Adjusted R^2	0.210	0.210	0.210	0.211

Notes: The t-statistics in parentheses are based on standard errors clustered at the firm level. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively, for two-tailed tests.

From Table 5, we find that the number of selected competitors has almost no influence on our conclusions. In contrast, a coefficient's significance and magnitude increase as more competitors are selected. In short, companies facing a highly competitive product market environment tend to have a lower debt ratio. Our conclusions are not sensitive to the number of selected competitors.

4.2 Product Market Competition and Debt Maturity Structure

The univariate test results shown in Table 3 suggest that companies with a fierce competitive product market have a lower current debt ratio. To exclude the influence of other characteristics of the company and explore the effect of product market competition on the current and noncurrent debt ratios, we construct the following model:

$$\text{Current/Noncurrent_Debt} = \beta_0 + \beta_1 \text{PMC} + \text{controls} + \text{fixed effect} + \varepsilon \quad (4)$$

In Equation (4), the dependent variable is the current or noncurrent debt ratio. The regression results are presented in Table 6.

Table 6 The Effect of Product Market Competition on the (Non)Current Debt Ratio

	(1) Current_Debt	(2) Noncurrent_Debt
PMC20	-0.241*** (-5.20)	-0.008 (-0.29)
SIZE	0.021*** (3.31)	0.031*** (10.47)
ROA	-0.655*** (-19.79)	-0.155*** (-8.93)
MTB	0.002 (1.63)	-0.001 (-1.06)
PPE	0.045** (2.12)	0.059*** (4.34)
SGA	0.339*** (5.12)	0.008 (0.28)
DIV	-0.022*** (-7.48)	-0.001 (-0.38)
SALE	0.039*** (4.15)	-0.039*** (-7.57)
Constant	-0.064 (-0.47)	-0.578*** (-9.27)
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	20972	20972
Adjusted R^2	0.160	0.137

Notes: The t-statistics in parentheses are based on standard errors clustered at the firm level. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively, for two-tailed tests.

From Table 6, we find that the coefficient of PMC20 is -0.241 in the current debt ratio regression, which is significant at the 1% level. This shows that as product market competition becomes fiercer, companies tend to have a lower current debt ratio. In addition, the coefficient of PMC20 in the noncurrent debt ratio regression is -0.08 and becomes statistically insignificant, indicating that product market competition has no significant effect on the noncurrent debt ratio. Combined with the univariate test results in Table 4, we find that

product market competition affects debt financing mainly through current debt, which is also in line with the liability structure of Chinese firms in that current debt accounts for a larger proportion of total debt than noncurrent debt does (Liu *et al.*, 2004).

Given that current debt is more likely than noncurrent debt to increase bankruptcy risk (Diamond, 1991; Stohs *et al.*, 1996) and lead to more liquidity pressure, companies faced with fierce product market competition usually also have high operational risks. These companies have more incentives to reduce their current debt. However, the results in Table 6 show that there is no significant increase in the proportion of noncurrent debt for companies faced with fierce product market competition.⁹ Therefore, we infer that companies would lower their current debt ratio by reducing their short-term borrowing or in other ways.

4.3 The Effect of Risk-Bearing Ability

To support hypothesis 3, we estimate the model separately for SOEs and non-SOEs. We predict that SOEs are more resilient to risks (financial risks) than non-SOEs and that the influence of product market competition on debt structure is more evident in the non-SOE group. Table 7 reports the regression results.

Table 7 Regression Results for SOE and Non-SOE Groups

	(1) SOE	(2) Non-SOE
PMC20	-0.125 (-1.48)	-0.312*** (-4.83)
SIZE	0.068*** (8.97)	0.047*** (3.89)
ROA	-0.894*** (-18.33)	-0.570*** (-10.63)
MTB	0.006*** (3.57)	-0.001 (-0.42)
PPE	0.064** (2.28)	0.177*** (4.40)
SGA	0.046 (0.49)	0.473*** (4.65)
DIV	-0.025*** (-6.26)	-0.021*** (-4.93)
SALE	0.015 (1.39)	-0.019 (-1.07)
Constant	-0.976*** (-5.92)	-0.554** (-2.19)
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	10951	10039
Adjusted R^2	0.274	0.177

Notes: The t-statistics in parentheses are based on standard errors clustered at the firm level. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively, for two-tailed tests.

⁹ Consistent with the results in Table 6, we also find a significantly negative link between PMC20 and the change in current debt.

The dependent variable is the debt ratio, and the coefficient of PMC20 is -0.125 but statistically insignificant for the SOE group, while the coefficient is -0.312 and statistically significant at the 1% level for the non-SOE group. The coefficient difference test shows that the coefficients of PMC20 are significantly different at the 5% level. The results indicate that the association between product market competition and the debt ratio is more pronounced in non-SOEs.

Since SOEs' budget constraints are softer than those of non-SOEs, state ownership helps to mitigate the negative impact of product market competition on the debt ratio. The results suggest that a company's consideration of risk balance affects the relationship between product market competition and corporate financial structure, which provides empirical evidence to support the strategic bankruptcy effect.

4.4 Robustness Tests

To verify the robustness of our conclusions, we conduct a series of robustness tests.

First, there is the concern of reverse causality in our conclusions: that is, companies with a low debt ratio are more inclined to choose a highly competitive product market.¹⁰ Our study re-examines a classic research question—how market competition affects financial structure—with a new measurement of product market competition. Although we do not focus on the causality issue, we acknowledge that there might be a reverse explanation. Referring to the relevant studies, we try to address the concern of reverse causality using the following methods. On the one hand, we use a one-period lagged independent variable and control variables to reduce the concurrent influence of market competition on financial structure in the same period, thereby alleviating the possible reverse causality concern. We find that the main conclusion remains unchanged (regression results are presented in the first column of Table 8). On the other hand, we define regulated industries (including mining, resources, railway, aviation, communications, energy supply, and media) as those whose market competition is predetermined by national policies and will not be affected by a company's financial policies. We find that the debt ratio of regulated industries is higher than that of non-monopoly industries, illustrating that capital structure is affected by market competition.

Second, following prior research, financial structure in our study is measured as the ratio of the company's total liabilities to total assets. We also use the ratio of interest-bearing liabilities to total assets as an alternative measure of a company's financial structure. The results, reported in the second column of Table 8, suggest that companies faced with fiercer product market competition will have a lower ratio of interest-bearing liabilities, which lends further support to our conclusions. Moreover, given that the financial crisis had a great impact on corporate financial structures, we delete the samples from 2007 to 2009 to reduce the influence of the financial crisis. Our conclusions still hold (results reported in the third column

¹⁰ We thank our reviewers for proposing the possibility of reverse causality.

of Table 8).

Table 8 Robustness Checks

	(1)	(2)	(3)	(4)
	Debt Financing _{T+1}	Interest Debt	Debt Financing	Cost of Debt _{T+1}
PMC20	-0.238*** (-4.82)	-0.139*** (-3.95)	-0.252*** (-4.91)	0.044 (1.24)
SIZE	0.053*** (9.46)	0.061*** (16.30)	0.062*** (8.56)	-0.031*** (-11.61)
ROA	-0.723*** (-17.49)	-0.516*** (-20.05)	-0.952*** (-20.52)	0.019 (1.01)
MTB	0.001 (0.72)	0.001 (1.54)	0.004** (2.42)	0.001* (1.80)
PPE	0.046** (2.01)	0.137*** (8.34)	0.072*** (2.81)	-0.012 (-1.02)
SGA	0.193*** (2.73)	-0.087** (-2.04)	0.231*** (2.94)	0.033 (0.94)
DIV	-0.010*** (-3.29)	-0.016*** (-6.33)	-0.022*** (-6.03)	0.004* (1.68)
SALE	-0.016 (-1.63)	-0.028*** (-4.10)	0.014 (1.47)	0.008* (1.67)
Constant	-0.601*** (-4.95)	-1.022*** (-12.76)	-0.851*** (-5.46)	0.699*** (12.29)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	20942	20610	16387	16502
Adjusted R^2	0.142	0.219	0.245	0.037

Notes: The t-statistics in parentheses are based on standard errors clustered at the firm level. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively, for two-tailed tests.

Finally, the explanation for a company's choice of a lower debt ratio could also be interpreted as a response to higher debt financing costs driven by fierce product market competition. Valta (2012) finds that companies facing fiercer competition have higher debt financing costs. To rule out this alternative explanation, we examine the impact of product market competition on the debt financing cost. Using the ratio of the company's interest expenditure to total debt to proxy for the debt financing cost, the result in the fourth column of Table 8 indicates that there is no significant association between product market competition and the debt financing cost, which helps us rule out this alternative explanation.¹¹

¹¹ We appreciate the helpful suggestions from reviewers about the alternative explanation. We also re-estimate the results using the interest expense of the current period or the next period or two periods to measure the debt financing cost; the results are similar. We thank the reviewers for pointing out that there may be a time mismatch when using current interest payments as the measure of debt financing cost.

V. Conclusions

Previous studies have proposed a number of theoretical models and conducted a series of empirical tests to explore the effect of product market competition on financial structure. According to the different goals and constraints of corporate stakeholders, researchers have proposed theoretical models such as the strategic bankruptcy effect and limited liability effect, which have been supported by many empirical studies. However, since the existing proxies for product market competition are flawed, endogeneity problems may exist in prior studies, and the empirical evidence is at best mixed. With the further combination of computational linguistics and finance, Hoberg and Phillips (2016) suggest that the similarity of products between any two companies could be used to measure competition and is more accurate and objective than other measures. Therefore, we argue that it is necessary to re-study the important issue of the relationship between product market competition and financial structure.

With the help of textual analysis, we introduce a new measurement of product market competition based on the product and business descriptions in the financial reports of Chinese listed firms. Then, we test the relationship between product market competition and financial structure. We find that as product market competition becomes fiercer, corporations tend to have a lower debt ratio, especially for current debt. Furthermore, the effect only works with non-SOEs, which are weaker in bearing risk.

Our paper provides empirical evidence for the strategic bankruptcy effect, which advocates for risk balancing. By combining computational linguistics with industrial theory, our study proposes a more intuitive, accurate, comprehensive, and timely measure of product market competition, providing a new perspective for future research on product market competition in China.

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