International Review of Financial Analysis 20 (2011) 41–51

Contents lists available at ScienceDirect

International Review of Financial Analysis

The relationship between product market competition and capital structure in Chinese listed firms

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A R T I C L E I N F O

Article history:
Received 27 July 2009
Received in revised form 8 April 2010
Accepted 29 October 2010
Available online 10 November 2010

Keywords:
Capital structure
Product market competition
Chinese firms
Endogeneity
System-GMM

A B S T R A C T

Financial and industrial economists have increasingly recognized the interaction between product market competition and financing decisions of firms. This paper analyzes the relationship between product market competition (measured by Tobin's Q) and the capital structure of Chinese listed firms in a static and dynamic setting. We study an unbalanced panel dataset of 10,416 firm-year observations in 12 industries from 1994 to 2006. Employing several empirical methods, this study finds that there are significant differences in the debt ratios and product market competition across different industries. Our results suggest that the relationship between leverage and product market competition is non-linear (parabolic or cubic), depending on industry type, company size and firms' growth opportunities. The system-GMM results reveal that Chinese firms tend to adjust their leverage ratios through time. Overall, the fixed effects and GMM estimates detect a linear and inverse relationship between the intensity of competition and leverage ratio, which supports the predation theory.

1. Introduction

Traditionally, a firm's financing decision and its behavior in the product market have been studied in isolation. Increasingly, financial and industrial economists recognize that a firm's capital structure and product market behavior may be interrelated (see, e.g., Brander & Lewis, 1986; Showalter, 1995, 1999). At the same time, scholars are beginning to understand that corporate finance practices may not be internationally universal but may be country- and context-specific, depending on a country's culture, legal systems, institutions, and stage of development (see, e.g., Gaud, Hoesli, & Bender, 2007; La Porta, Lopez De Silanes, Shleifer, & Vishny, 1997; La Porta, Lopez De Silanes, Shleifer, & Vishny, 2000a; La Porta, Lopez De Silanes, Shleifer, & Vishny, 2000b).

Hence, scholars are increasingly analyzing the country-specific effects on the relationship between product market competition and debt. The seminal work in this area was presented by Pandey (2004), who analyzed the effect of product market competition on debt in Malaysian companies. In this paper, we contribute to this area of research by analyzing the case of China. The market, cultural and institutional factors of China make this an interesting case to consider. Furthermore, researchers have found a preference for equity financing in Chinese companies (a kind of reverse pecking order effect). We are particularly interested in whether this financing preference may affect the relationship between product market competition and debt.

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1057-5219/$ – see front matter © 2010 Elsevier Inc. All rights reserved.
doi:10.1016/j.irfa.2010.10.003

A firm may use financial leverage strategically to affect a rival's behavior. Scholars have developed three main modeling approaches to explain how firms' debt choices and product market behavior may be related; limited liability models, deep purse or predation models, and investment effect models.

In the limited liability approach, equity-maximizing firms use debt levels to strategically affect product market competition. As a result, oligopoly firms may choose higher strategic debt levels than firms in competitive markets, either to soften Bertrand price competition (Showalter, 1995, 1999) or toughen Cournot quantity competition (Bolton & Scharfstein, 1990; Brander & Lewis, 1986; Maksimovic, 1988; Ravid, 1988). Therefore, limited liability models predict a positive relationship between the leverage ratio and product market power.

In predation models (Bolton & Scharfstein, 1990; Brander & Lewis, 1986; Opler & Titman, 1994; Telser, 1966), a highly-leveraged firm is subject to predatory threat by a low-leveraged firm. According to these models, an entrant has a more vulnerable financial structure than an incumbent when he just comes into a new market. Therefore, an incumbent with a “deep-pocket” can engage in predatory behaviors (such as a price war or an output increasing) in order to exhaust the entrant financially and drive him out of the market. Therefore, firms have an incentive to reduce debt levels. The empirical implication of these arguments is that there might be a negative relationship between the relative use of debt and product market competition. Hence, the limited liability and predation models provide opposite predictions. The limited liability model predicts a positive relationship between market power and debt, while the predation model predicts a negative relationship.

In the investment effect models, debt causes under-investment due to the asset substitution effect (Myers, 1977, 1984; Phillips, 1995; Kovenock & Phillips, 1995). Increasing debt is a signal not to invest in the future because the percentage of cash flow to be paid out each period will increase. Signaling costs take the form of a transfer of profits from stockholders to creditors. Further, internal financing is cheaper than external debt or equity financing due to asymmetric information. Hence, the pecking order and asymmetric information theories predict a negative relation between leverage and market power.

In summary, the limited liability and predation models provide conflicting predictions regarding the relationship between product market competition and debt (with limited liability models predicting a positive, and predation models predicting a negative relationship). Empirical tests of these models have provided mixed results. Some researchers find a negative relationship (Barclay, Smith , & Watts, 1995; Barclay & Smith, 1996; Chevalier, 1995; Rajan & Zingales, 1995; Titman & Wessels, 1988), while others find a positive relationship (Michaelas, Chittenden, & Poutziouris, 1999; Phillips, 1995; Rathinasamy, Krishnaswamy, & Mantripragada, 2000).

Importantly, most of the aforementioned empirical studies predict a linear relationship between capital structure and market power. Pandey's (2004) contribution was to suggest that, due to the complex interaction of market conditions, agency problems and bankruptcy costs, the relationship may in fact be non-linear. His findings reveal that at lower and higher ranges of market power (proxied by Tobin's Q), firms employ higher debt, and they reduce their debt at intermediate range. Fairchild's (2004) theoretical modeling suggests that this non-linearity may be due to the conflicting limited liability and predation effects.

We develop Pandey's (2004) work by considering the relationship between product market competition and debt in another developing country, China. Furthermore, we examine whether this relationship is monotonous. In studying China, we consider a country with unique cultural and institutional factors which may affect the relationship.

The particular institutional and market features that may affect the relationship between leverage and product market competition in China are as follows. Firstly, China is in transition from a command economy to a market economy, and most Chinese listed firms were state-owned enterprises. Furthermore, the state has maintained its controlling right for many of the firms that went public. This may affect managerial incentives within the firm, and therefore may affect debt levels. Secondly, the co-existence of two types of investors, and the difficulty to monitor stock trading may result in stock price manipulation in the Chinese stock markets. Related to this point, in most circumstances, Chinese firms prefer to use equity financing once they go public as most firms enjoy a favorable high stock price. Researchers have identified a type of reversed pecking order, whereby firms prefer to issue equity rather than debt.[1] Finally, creditors' protection rights are relatively underdeveloped. Therefore, these institutional features may affect Chinese firms' capital structure. Hence, if we find a strong non-monotonic relationship, then product market conditions may affect the use of debt, *despite* the unique features of China.

There is a growing area of research examining the determinants of capital structure in Chinese listed firms. In Zhu, Chen, and Wu (2002) duopoly model, strong product market competition induces firms to adopt low financial leverage (predation effect). Liu, Jiang, and Lu (2003) examined a sample of 3526 Chinese listed firms from 1997 to 2001, and found that debt ratios were significantly and positively related to the degree of product market competition. They concluded that these firms use leverage strategically to affect the soft or tough nature of product market competition (limited liability effect).[2]

Table 1
Industry classification and panel data structure.

Panel A. Industry classification		Panel B. Panel data structure		
Industry type	Industry code	No. of years	No. of firms	No. of observations
Agriculture, forestry, fishing and hunting	A	3	194	582
Mining	B	4	124	496
Manufacturing	C	5	94	470
Utilities (power, gas and water generation)	D	6	143	858
Construction	E	7	98	686
Transportation and warehousing	F	8	170	1360
Information and IT	G	9	151	1359
Wholesale and retail trade	H	10	147	1470
Real estate	J	11	95	1045
Social services	K	12	68	816
Disseminator and culture	L	13	98	1274
Other services	M	Total	1382	10,416

Some researchers (e.g., Guo, Yang, & Sun, 2004) have examined the relationship between product market competition and leverage across industries. This involves firstly examining whether differences in leverage exist across industries, and then examining whether differences exist in product market competition across industries, and finally examining the relationship between product market competition and leverage across industries. This is the approach we adopt in this paper.

We study an unbalanced panel dataset which includes 10,416 firm-year observations based on Chinese listed companies for the period between 1994 and 2006 (see Table 1 for the panel data structure). Our main objective is to test whether there are differences in leverage and product market competition across Chinese industries, and whether there is a linear or non-linear relationship between these two factors. We also examine whether Chinese managers attempt to adjust their firm's capital structure. Most existing research supports the conclusion of linear relationship between these two factors, while Pandey (2004) indicate a positively non-linear (cubic) relationship using the data of Malaysian listed firms. However, given the unique institutional background in China, we doubt if these findings are common and also suitable for Chinese listed firms.

To the best of our knowledge, we are the first to employ panel data and use different statistical methods (OLS, fixed effects, and system-GMM) to test the relationship between product market competition and leverage in Chinese firms and industries. Furthermore, we investigate whether the relationship is non-linear, and relate our findings to the predation and limited liability effects. Our GMM estimates, which control for the unobservable firm-specific factors and the endogeneity problem, show that there is an inverse link between leverage and product market competition for the full sample, which gives credit to the predation hypothesis. The results based on the partitioned samples suggest that for large firms together with firms with low growth options, the aforementioned association is cubic, which supports the mixed effects explanation. Finally, we find for the whole sample and sub-samples that Chinese firms seem to adjust their capital structure towards their desired level.

The remainder of this paper is organized as follows. In Section 2, we present the research design. Section 3 reports the main empirical findings, and Section 4 provides our conclusions and discussions.

[1] A preference for equity financing is a widespread phenomenon in China. This may lead to a relatively conservative financial policy; that is, a low debt ratio for most Chinese firms and industries. Furthermore, Ng and Wu (2006) state that stock preferences exist both for institutional and individual investors in China. See also Cai, Fairchild, and Guney (2008) and Guo and Brooks (2008) for a brief discussion on corporate environment in China.

[2] For a more comprehensive literature review and wider reading, see Istaitieh and Rodriguez (2006).

2. Research design

We analyze the relationship between industry, product market competition, and leverage in Chinese listed firms. In order to do so, we consider an unbalanced panel dataset which contains a sample of 10,416 firm-year observations from different industries in the Shanghai (SHSE) and Shenzhen (SZSE) stock exchanges for the period 1994 to 2006. Standard data filtering has been applied. We ignore firms that have incomplete data, and exclude the finance and insurance industry and the other outliers. In addition, for the GMM regression analysis, firms should have at least three years' consecutive data. All the data are obtained from the CCER (Beijing Sinofin Ltd. Corp.) database, and the websites of SHSE and SZSE. We adopt the CSRC industry classification standard as shown in Table 1.

Our methodology is as follows. We first examine the differences in leverage and Tobin's Q in the various industries, using descriptive statistics and non-parametric analysis. We then employ pooled OLS, fixed effects and system-GMM methods, using both linear and non-linear models, to study the static and dynamic capital structure of Chinese firms.

2.1. Development of hypotheses

We follow the methodology of Guo et al. (2004). This involves examining whether differences in leverage exist across industries, then examining whether differences in product market competition exist across industry, and, finally, if such differences exist, examining the relationship between product market competition and leverage across industries. Formally, we test the following hypotheses.

Hypothesis 1a. There is no significant difference in capital structure between industries in Chinese listed companies.

Hypothesis 1b. There is a significant difference in capital structure between industries in Chinese listed companies.

Hypothesis 2a. There is no significant difference in product market competition between industries in Chinese listed companies.

Hypothesis 2b. There is a significant difference in product market competition between industries in Chinese listed companies.

Hypothesis 3a. There is no significant relationship between financial leverage and product market competition across Chinese companies.

Hypothesis 3b. There is a significant relationship between financial leverage and product market competition across Chinese companies.

Specifically, we test whether the relationship between leverage and product market competition is positive (indicative of limited liability effects), negative (indicative of predation effects), or non-linear (indicative of a combination of limited liability and predation effects). Further, as discussed previously, if we find support for Hypothesis 3b, then this suggests that product market competition affects debt through product market conditions such as limited liability and predation issues are carried from other countries to China, in spite of the unique conditions.

2.2. Definition of variables

Our dependent variable is capital structure. Capital structure may be defined in various ways. Rajan and Zingales (1995) argue that the definition of capital structure depends on the objective of the analysis. In this study, we define capital structure as the ratio of total debt to total assets.

Product market competition is the main independent variable in our study. In operational terms, degree of product market competition implies a firm's monopoly, or oligopoly or competitive power. Rathinasamy et al. (2000) state that market power could be measured by the Lerner index, or the Herfindahl–Hirschman Index, or Tobin's Q. Lindenberg and Ross (1981) show that Tobin's Q is a theoretically sound and powerful indicator of a firm's market power. In our investigation, we use two possible measures for product market competition. Following Pandey (2004) and Chung and Pruitt (1994), we mainly employ Tobin's Q as the proxy for product market competition and define it as the sum of total liabilities at book value and total shares at market value over total assets at book value. The relationship between Tobin's Q and product market competition is ambiguous. It may be positive, negative or non-linear (depending on the strength of the limited liability and predation effects). In a further analysis, we also use the Herfindahl–Hirschman Index as a subsidiary measurement of product market competition (see Table 5).

In addition, referring to Titman and Wessels (1988), Titman (1984), Harris and Raviv (1990, 1991) and others (Ferri & Jones, 1979; Gul, 1999; Pushner, 1995; Wiwattanakantang, 1999), we also employ the other eight controlling independent variables to control for other effects on the debt ratio, including profitability (expected sign +/−), size (+/−), collateral value of assets (+), growth (+), uniqueness of assets (−), non-debt tax shield (−), capability of generating internal resources (+/−), and current ratio (+/−). Furthermore, we incorporate time dummy variables to control for the effect of the macroeconomic factors. The definitions and expected signs of these variables are in Table 2.

2.2.1. Profitability

The pecking order theory suggests that firms use internal funds firstly and then use external funds. Myers and Majluf (1984) construct a signaling model under asymmetric information, and suggest that firms with higher profitability should have a lower debt ratio. On the other hand, according to Jensen's (1986) free cash flow model, firms with high profitability may wish to use high debt in order to control agency problems associated with managerial discretionary use of firms' resources. Furthermore, Brander and Lewis (1986) argue that firms will tend to use higher leverage under high profitability which means debt ratio is positively correlated with profitability. We use return on assets (ROA) as the proxy variable for profitability, which equals to operating profit divided by total assets.

2.2.2. Size

Theoretically, the relationship between size and debt ratio is uncertain. Some studies argue that larger firms tend to be more diversified and hence are less likely to go bankrupt so that they would like the higher leverage (see Istaitieh & Rodriguez, 2006). However,

Table 2
Definition of the variables.

Variables	Symbol	Definition
Dependent variable:		
Capital structure	DR	Debt ratio = total liabilities / total assets
Independent variables:		
Tobin's Q	Q	Book value of total liabilities plus market value of total shares / book value of total assets
Return on assets	ROA	Operating profit / total assets
Firm size	SIZE	Ln (total assets)
Collateral value of assets	CVA1	Inventory plus fixed assets / total assets
	CVA2	Total assets-intangible assets / total assets
Growth rate	GR_TA	Total assets_t − total assets_{t-1} / total assets_{t-1}
	GR_OI	Total operating income_t − total operating income_{t-1} / total operating income_{t-1}
Non-debt tax shield	NDTS	Depreciation / total assets
Uniqueness of assets	UNIQ	Operating expense / sales
Capability of generating internal resources	CGIR	Net cash flow of operations / total assets
Current ratio	CR	Current assets / current liabilities

Rajan and Zingales (1995) argue that size may be inversely related to the debt ratio because large firms tend to release more information to public than smaller ones which will make larger firms favor equity financing. A firm's size is measured by the natural logarithm of its deflated total assets.

2.2.3. Collateral value of assets

Tangible assets can be used as the collateral for debt financing. Thus, collateral value of assets will be positively correlated with debt. The proxy variables for this factor include CVA1 (the sum of inventory and fixed assets over total assets) and CVA2 (total assets minus intangible assets divided by total assets).

2.2.4. Growth

Firms with high growth opportunities will have good expectations for their future profit and have more flexibility in their choice of future investments so that debt ratio may be positively correlated with growth. Indicators of growth in this study include two proxy variables: growth rate of total assets (GR_TA) and growth rate of operating income (GR_OI).

2.2.5. Uniqueness of assets

Titman and Wessels (1988) suggest that uniqueness of assets will make it difficult for a firm's workers and suppliers to change their skills or products. As a result, its liquidation cost may be very high so that such a firm will employ a lower debt ratio. That is, uniqueness is expected to be negatively related to debt ratio. As a measure of uniqueness, we use the ratio of operating expenses to total sales.

2.2.6. Non-debt tax shields

DeAngelo and Masulis (1980) argue that firms can use other non-debt items such as depreciation, tax credit, and pension funds to reduce corporate tax payments. Therefore, firms that have higher non-debt tax shields are likely to use less debt. The non-debt tax shield factor is measured by the ratio of depreciation to total assets.

2.2.7. Capability of generating internal resources

According to the trade-off theory, Jensen (1986) argued that the capability of generating more free cash flow may be positively correlated with the debt ratio because the firms that have a strong capability of generating internal resource tend to employ higher leverage to obtain the benefit of tax. However, the pecking order theory predicts the opposite relationship because under asymmetric information, a firm may prefer to employ equity financing first. Hence, the relationship is unclear. We use net cash flow of operating over total assets to measure the capability of generating internal resource (CGIR).

2.2.8. Current ratio

The current nature of assets (liquidity) may improve the solvency of a firm so that it will employ higher leverage. However, for firms with high long-term debt, the current ratio may not affect the debt ratio. That is, the relationship between debt ratio and current ratio may be positive or negative. Current ratio is total current assets divided by total current liabilities.

3. Empirical findings

3.1. Descriptive statistics

We divided our dataset into 12 different industries based on the classification in Table 1. Panel A, Table 3 provides full-sample descriptive statistics. Next, we consider debt ratio and product market competition (as measured by Tobin's Q) across 12 industries. Panel B (Panel C), Table 3 reveals that there are some differences between average debt ratios (product market competition) across different industries.

Table 3
Descriptive statistics.

Variables	Mean	Standard deviation	Maximum	Median	Minimum	Number of observations
Panel A: descriptive statistics for the full sample						
DR	0.4756	0.1798	0.9986	0.4777	0.0748	10,416
Q	2.2392	1.2749	9.8383	1.8428	0.4031	10,416
ROA	0.0285	0.0704	0.8887	0.0324	−0.8585	10,416
SIZE	21.0476	0.9561	27.1111	20.9604	17.9174	10,416
CVA1	0.5032	0.1805	0.9850	0.5015	0.0037	10,416
CVA2	0.9645	0.0548	1.0000	0.9819	0.2028	10,416
GR_TA	0.1523	0.3644	13.9816	0.0906	−0.8386	10,416
GR_OI	−0.8122	76.7596	5459	−0.0296	−4258	10,416
NDTS	0.1382	0.1268	1.6843	0.1059	0.0000	10,416
UNIQ	0.0570	0.2130	19.0009	0.0326	0.0000	10,416
CGIR	0.0423	0.0833	1.3534	0.0353	−0.5787	10,416
CR	1.5690	1.2566	55.7406	1.2902	0.0273	10,416
Panel B: descriptive statistics for debt ratio (DR) by industries						
A	0.4552	0.1901	0.9610	0.4476	0.0811	238
B	0.3765	0.1463	0.7992	0.3668	0.0813	118
C	0.4679	0.1761	0.9986	0.4678	0.0767	5916
D	0.4259	0.1826	0.9359	0.4240	0.0822	417
E	0.6028	0.1408	0.9126	0.6328	0.2274	173
F	0.4116	0.1990	0.9372	0.3976	0.0827	377
G	0.4855	0.1689	0.9938	0.4956	0.1083	561
H	0.5224	0.1657	0.9964	0.5205	0.0927	906
J	0.5482	0.1585	0.9802	0.5498	0.0777	457
K	0.4046	0.1862	0.9666	0.3789	0.0748	336
L	0.3956	0.1755	0.9556	0.3805	0.0779	96
M	0.5182	0.1849	0.9929	0.5309	0.0784	821
Panel C: descriptive statistics for Tobin's Q by industries						
A	2.0938	1.1038	6.1749	1.6713	0.8829	238
B	2.2779	0.9844	7.2258	2.1259	0.9941	118
C	2.1876	1.2403	9.6890	1.7983	0.4031	5916
D	1.9745	1.0440	8.3308	1.6975	0.6335	417
E	1.8957	1.2318	9.7685	1.4890	0.8002	173
F	2.1783	1.0986	8.7938	1.8577	0.6842	377
G	2.5605	1.5554	9.8383	2.0613	0.8355	561
H	2.1423	1.0766	8.0269	1.8397	0.8359	906
J	2.0771	1.0850	7.7560	1.7403	0.7861	457
K	2.6227	1.5155	9.5724	2.2118	0.8927	336
L	3.4299	1.6409	8.4741	3.0745	0.8642	96
M	2.5639	1.5096	9.7470	2.1202	0.6684	821

The average debt ratio using book values for all companies is 48%, with a standard error of 18%. These figures are comparable to the findings of Huang and Song (2006) who also study on the Chinese data. Our findings imply that the Chinese companies are more levered than their counterparts in developed countries (see Antoniou, Guney, & Paudyal, 2008; Rajan & Zingales, 1995). This is not consistent with the results of existing research on Chinese capital structure which demonstrates that firms prefer equity financing once they go public and the bond market remains immature. The reliance on debt by Chinese firms may be because of the dominance of private bank debt that firms opt for and relatively underdeveloped stock markets that provide equity and public debt financing. This seemingly aggressive debt policy may stem from the role of the government when firms get financially distressed.

Regarding the industry-specific figures, we observe that the construction (60%) and real estate (55%) industries have the highest leverage ratios. The mining industry, on the other hand, has the lowest indebtedness (38%).

As for the product market competition, we observe that the dissemination and culture industry has the highest Q (3.43) and the construction industry has the lowest Q (1.90). A higher Q implies higher market power and thus lower product market competition. It is interesting to note that the industries with the highest leverage ratios also have the lowest Q, which implies high product market competition.

This suggests that, e.g., in the construction industry, the limited liability effect dominates and high competition leads to high debt.

3.2. Non-parametric analysis

Thus far, we have employed casual observation of the descriptive statistics to put forward some tentative conclusions regarding leverage and product market competition across our sample of Chinese industries. Now, we turn to more rigorous empirical methods in order to test the hypotheses that we presented in the previous section.

In this section, we employ a non-parametric method (Kruskal–Wallis test) in order to test our first two hypotheses; that is, whether there are differences in capital structure and product market competition between industries. The figures in Tables 4 reveal that there are significant differences in the debt ratios and Tobin's Q across the different industries, which supports our Hypotheses 1b and 2b.

3.3. Alternative measure of the degree of product competition

Tobin's Q can be thought of as an *outcome* of the competitive nature of the market (the more competitive the market, the lower the firms' value-adding capabilities, and hence the lower is Q). In order to increase the robustness of our analysis, we now consider an alternative competition measure, the Herfindahl–Hirschman Index (HHI). In contrast to Tobin's Q, the HHI is a measure of the competitive *structure* of the product market. The HHI measures the degree of market concentration in a given industry. It is calculated as follows:

$$\mathrm{HHI}_i = \sum (x_j / \sum_{j=1}^{n} x_j)^2.$$

x_j denotes the sales of firm j, and i denotes the industry type. A lower (higher) HHI represents a stronger (weaker) product competition in the industry. We calculate the HHI of different industries in China, and present the results in Table 5**.**

Table 5 provides further support to Hypothesis 2b that there are differences in product market competition across Chinese industries. In Table 5, we rank the industries in descending order of degree of product market competition and report the manufacturing industry to be the most competitive and the mining sector to be the least competitive.

3.4. Correlation analysis

Table 6 provides the Pearson correlation matrix for the main variables used in the analysis. We observe that the signs of the correlation coefficients between the dependent variable and independent variables are generally consistent with predicted signs as discussed earlier. Furthermore, there are significant correlations at the 1% significance level between the debt ratio and most of the independent variables.

Table 4
Non-parametric analysis (Kruskal–Wallis test).

Variables	Chi-square (χ^2)	F-value	p-value
DR	489.5604	44.75862318	3.17E−96
Q	242.5713	24.21205071	5.03E−50
ROA	246.8801	14.92062388	3.37E−29
SIZE	443.4543	50.65752177	2.1E−109
CVA1	1019.64	102.6151689	5.8E−223
CVA2	373.2412	30.58249082	2.26E−64
GR_TA	26.24408	2.83497734	0.001042
GR_OI	60.52708	1.07492425	0.377127
NDTS	2768.609	193.6378368	0.00000
UNIQ	911.8476	1.983159269	0.025958
CGIR	556.7071	46.44525101	5.3E−100
CR	419.2392	14.1898003	1.42E−27

Table 5
Measurement of product market competition.

Industries*	Sample size	HHI	Tobin's Q	Debt ratio
C	5916	0.001174	2.187608	0.467929
M	821	0.003545	2.563916	0.518165
H	906	0.007052(1)	2.142266	0.522378
K	336	0.007263(1)	2.622724	0.404621
J	457	0.007915(1)	2.077094	0.548173
D	417	0.013817(2)	1.974538	0.42589
A	238	0.014261(2)	2.093753	0.455164
E	173	0.015193(2)	1.895728	0.602798
L	96	0.019159	3.429917	0.395572
F	377	0.020647(3)	2.178301	0.411584
G	561	0.020846(3)	2.560475	0.485539
B	118	0.171707	2.277859	0.376543

(1), (2), (3) denote the different groups with the similar HHI level, respectively.
* The listed industries are sorted according to HHI in an ascending order.

3.5. Regression analysis

We now turn to the consideration of the relationship between industry product market competition and the use of corporate debt (Hypotheses 3a and 3b). Particularly, we ask whether any relationship exists. If it does, is it positive (limited liability effects), negative (predation effects), or non-linear (combination of limited liability and predation effects)?

Our dependent variable is leverage ratio (DR). The explanatory variables are; product market competition (Q), profitability (ROA), firm size (SIZE), collateral value of assets (CVA1 or CVA2), growth rate (GR-TA or GR-OI), non-debt tax shields (NDTS), uniqueness of assets (UNIQ), capability of generating internal resources (CGIR), and liquidity (CR). Therefore, our empirical model is as follows:

$$\mathrm{DR}_{it} = \alpha + \sum_{k=1} \delta_k X_{k,it} + \mu_{it}. \quad (1)$$

In model (1), [i] denotes individual firms; [t] denotes years; α denotes the intercept; [X] is the kth explanatory variable, k ranging from 1 to 9; δ_k are estimable coefficients on the explanatory variables; and [μ_{it}] is the error term. The value of k becomes 10 or 11 when we consider respectively a parabolic (Q, Q^2) and cubic relationship (Q, Q^2, Q^3) between debt ratio and product market competition. It should be noted that regression results below are robust to unbalanced nature of panel data set.

The regression results in Tables 7 and 8 are based on model (1). In these tables, we use both OLS and fixed effects (FE) estimation techniques to control for unobservable firm-specific factors. Depending on the estimation method, we include in model (1) time or industry dummy variables. The estimations further examine the presence of a non-linear association between Tobin's Q and leverage.

The left panel of Table 7 presents the linear regression results using the OLS and FE methods. The findings show that the magnitude and significant levels of coefficient estimates are in some cases sensitive to the choice of econometric method. For instance, while the OLS results reveal that Tobin's Q and leverage are unrelated, the FE shows that the coefficient on Q is positive and significant at the 1% level. The latter implies that there is an inverse relationship between the use of corporate debt and degree of product market competition, which supports the predation models. Both OLS and FE results suggest that higher profitability (ROA) and liquidity (CR) lead to lower leverage and larger firms (SIZE) and firms with higher collateral (CVA2) tend to prefer debt over equity. Another common finding implies that capability of generating internal resources (CGIR) does not influence debt ratios of Chinese firms.

Asset uniqueness (UNIQ) and non-debt tax shields (NDTS) have different implications on debt ratio, depending on the estimation methods. Nevertheless, the negative coefficients on NDTS seem to

Table 6
Correlation matrix.

	Expected sign	DR	Q	ROA	SIZE	CVA1	CVA2	GR_TA	GR_OI	NDTS	UNIQ	CGIR
Q	+/−	−0.2191***										
ROA	+/−	−0.3980***	0.1778***									
SIZE	+/−	0.1741***	−0.4640***	0.1025***								
CVA1	+	0.0541***	−0.1832***	0.0269**	0.2330***							
CVA2	+	0.0025	−0.0493***	0.1076***	0.1193***	0.1521***						
GR_TA	+	0.0402***	0.0119*	0.3105***	0.1219***	0.0080	0.0519***					
GR_OI	+	−0.0108	−0.0055***	0.0008	−0.0031	−0.0147*	0.0016	−0.0071				
NDTS	−	−0.1047***	−0.0696***	−0.0282**	0.1698***	0.3600***	0.0439***	−0.1085***	−0.0018			
UNIQ	−	0.0310***	0.0187*	−0.0974***	−0.0387***	−0.0266**	−0.0533***	−0.0494***	0.0015	−0.0423***		
CGIR	+/−	−0.1189***	0.0103	0.2691***	0.1734***	0.1701***	−0.0340***	−0.0337***	−0.0111	0.2690***	−0.0169*	
CR	+/−	−0.5463***	0.1517***	0.2035***	−0.1328***	−0.1962***	0.1052***	0.0057	0.0017	−0.0503***	−0.0039	−0.0258**

See Table 2 for variables definitions. ***, **and *denote significance levels of 1%, 5% and 10%, respectively.

confirm the theory proposed by DeAngelo and Masulis (1980). As for the firm growth factor (GR-TA or GR-OI), the results are sensitive to the alternative definitions rather than the estimation method.

3.6. Non-linear regression analysis

We have so far only considered the linear nature of the relationship between product market competition and leverage. This enabled us to consider whether Chinese companies are generally more subject to the limited liability effect (negative relationship between debt and Tobin's Q) or the predation effect (positive relationship between debt and Tobin's Q). Linear regression does not allow us to consider whether these industries are subject to a combination of the limited liability and predation effects. According to Ammermann and Patterson (2003), non-linearity is found to be a cross-sectionally universal phenomenon, existing within all the capital market studies, and it appears to be an inherent feature of financial behavior. In order to consider this, we need to employ non-linear models to analyze the relationship between product competition and capital structure. In the right panel of Table 7, the models include squared (Q^2) and cubed (Q^3) terms of Tobin's Q as the proxy variables for product competition. The other control variables remain as they are in the linear regression analysis.

The findings tend to suggest that leverage and product market competition are not non-monotonously integrated. The only exception to this generalization is one group of OLS findings where the coefficients on Q and Q^2 are significant at the 10% level. The coefficient estimates on other variables are mostly unchanged in terms of sign and significance.

Table 7
Capital structure and product market competition in China: OLS and fixed effects regressions.

	Linear				Non-linear			
	OLS-pooled		Fixed effects		OLS-pooled		Fixed effects	
Constant	−0.0280	−0.2314**	–	–	0.0135	0.0234	–	–
	(0.1047)	(0.1007)			(0.1010)	(0.1023)		
Q	0.0023	0.0023	0.0063***	0.0061***	−0.0089*	−0.0158	0.0058	0.0068
	(0.0024)	(0.0025)	(0.0019)	(0.0019)	(0.0052)	(0.0155)	(0.0060)	(0.0122)
Q2	–	–	–	–	0.0014*	0.0033	0.0001	−0.0002
					(0.0008)	(0.0037)	(0.0007)	(0.0029)
Q3	–	–	–	–	–	−0.0001	–	0.0001
						(0.0003)		(0.0002)
ROA	−0.8906***	−0.8014***	−0.5974***	−0.5364***	−0.8842***	−0.8835***	−0.5972***	−0.5973***
	(0.0701)	(0.0636)	(0.0368)	(0.0371)	(0.0686)	(0.0685)	(0.0363)	(0.0362)
SIZE	0.0296***	0.0304***	0.0724***	0.0790***	0.0283***	0.0281***	0.0723***	0.0724***
	(0.0042)	(0.0044)	(0.0069)	(0.0069)	(0.0041)	(0.0042)	(0.0069)	(0.0068)
CVA1	−0.0171	–	0.0440**	–	−0.0181	−0.0182	0.0440**	0.0440**
	(0.0275)		(0.0226)		(0.0273)	(0.0273)	(0.0225)	(0.0225)
CVA2	–	0.2062***	–	0.1539***	–		–	–
		(0.0559)		(0.0531)				
GR-TA	0.0617***		0.0389***	–	0.0618***	0.0618***	0.0389***	0.0389***
	(0.0099)		(0.0075)		(0.0099)	(0.0099)	(0.0076)	(0.0076)
GR-OI	–	−0.0010***	–	−0.0001	–		–	–
		(0.0001)		(0.0001)				
NDTS	−0.1530***	−0.1846***	−0.0543	−0.0491	−0.1526***	−0.1525***	−0.0544	−0.0543
	(0.0272)	(0.0259)	(0.0364)	(0.0368)	(0.0272)	(0.0272)	(0.0364)	(0.0365)
UNIQ	0.0014	0.0015	0.0082***	0.0081***	0.0016	0.0018	0.0082***	0.0082***
	(0.0073)	(0.0067)	(0.0024)	(0.0024)	(0.0072)	(0.0071)	(0.0024)	(0.0024)
CGIR	−0.0208	−0.0447	0.0093	−0.0053	−0.0199	−0.0194	0.0093	0.0093
	(0.0258)	(0.0267)	(0.0195)	(0.0200)	(0.0258)	(0.0258)	(0.0195)	(0.0195)
CR	−0.0655***	−0.0671*	−0.0433***	−0.0451***	−0.0654***	−0.0654***	−0.0433***	−0.0433***
	(0.0148)	(0.0146)	(0.0104)	(0.0106)	(0.0148)	(0.0148)	(0.0104)	(0.0104)
Adjusted R^2	0.4717	0.4618	0.3768	0.3639	0.4720	0.4721	0.3766	0.3767
Wald Test 1	1166***	1027***	778.3***	592***	1215***	1219***	786.6***	793.8***
Wald Test 2	266.2***	248.8***	97.94***	90.08***	246.5***	244.8***	93.05***	89.96***

The dependent variable is DR. See Table 2 for variable definitions. Standard errors robust to heteroscedasticity are in the parentheses below the coefficients. Wald Test 1 (2) test the joint significance of estimated coefficients on the main variables (dummies); asymptotically distributed as χ^2 (df) under the null of no relationship. Time and industry dummies are used for the OLS regressions; fixed effects estimates consider only time dummies (see Table 1 for industry classification). (*), (**) and (***) indicate that coefficients are significant or the relevant null is rejected at 10, 5 and 1% level, respectively. Sample size for the unbalanced panel is 10,416 observations and 1382 firms.

Table 8
Capital structure and product market competition in China: OLS regressions based on industry groups.

Indus.	Constant	Q	Q2	Q3	ROA	SIZE	CVA1	GR-TA	NDTS	UNIQ	CGIR	CR	Adj.R^2	Wald
A	0.2203	−0.0009	–	–	−0.5079***	0.0176	−0.2459***	0.0683***	0.0196	0.0272***	0.0990	−0.0980***	0.647	373***
	(0.4925)	(0.0086)			(0.1484)	(0.0247)	(0.0792)	(0.0145)	(0.1475)	(0.0061)	(0.1310)	(0.0073)		
B	0.0169	0.0651*	−0.0074**	–	−1.2531***	0.0242***	−0.1519	0.2348***	−0.0329	−0.5215***	0.0010	−0.0808***	0.705	431***
	(0.1802)	(0.0352)	(0.0036)		(0.2107)	(0.0081)	(0.1317)	(0.0489)	(0.0961)	(0.2169)	(0.0802)	(0.0194)		
C	0.1251	0.0171***	−0.0017**	–	−0.7942***	0.0276***	−0.1026***	0.0534***	−0.1149***	−0.0757*	0.0336	−0.0912***	0.537	977***
	(0.1072)	(0.0061)	(0.0007)		(0.0535)	(0.0049)	(0.0249)	(0.0118)	(0.0315)	(0.0397)	(0.0368)	(0.0063)		
D	0.3474	−0.1457*	0.0347*	−0.0021*	−1.3314***	0.0233*	0.0277	0.0373*	−0.1581**	−0.2659	0.1927	−0.0771***	0.541	244***
	(0.2582)	(0.0844)	(0.0202)	(0.0012)	(0.2440)	(0.0123)	(0.0976)	(0.0207)	(0.0760)	(0.4859)	(0.1635)	(0.0097)		
E	0.2085	0.0049	–	–	−0.8115***	0.0246	−0.0823	0.0311**	−0.4566	−0.4193	−0.0907	−0.1441***	0.573	446***
	(0.3785)	(0.0092)			(0.1722)	(0.0173)	(0.0967)	(0.0123)	(0.3135)	(0.4265)	(0.0875)	(0.0315)		
F	−0.0524	−0.2639***	0.0696***	−0.0046**	−1.5381***	0.0427**	0.0228	0.0733**	−0.0637	0.0730	−0.0250	−0.0116***	0.418	151***
	(0.4097)	(0.0938)	(0.0249)	(0.0019)	(0.2518)	(0.0189)	(0.0733)	(0.0347)	(0.1187)	(0.3017)	(0.1002)	(0.0044)		
G	0.3731*	−0.0069	–	–	−0.4525***	0.0117	−0.0252	0.0380*	−0.1116	0.0658	0.0119	−0.1090***	0.578	322***
	(0.2270)	(0.0075)			(0.0922)	(0.0109)	(0.0828)	(0.0209)	(0.1344)	(0.1215)	(0.0513)	(0.0146)		
H	−0.1919	0.0410**	−0.0039*	–	−1.1184***	0.0419***	−0.0369	0.0936***	−0.5758***	0.0447	−0.0971*	−0.1217***	0.539	328***
	(0.2980)	(0.0201)	(0.0021)		(0.1234)	(0.0145)	(0.0485)	(0.0128)	(0.1777)	(0.1376)	(0.0600)	(0.0212)		
J	0.6682***	−0.0512**	0.0057*	–	−0.6863***	0.0037	0.0903	0.0630***	−0.9768***	0.0054***	−0.0443	−0.1039***	0.518	213***
	(0.2461)	(0.0260)	(0.0030)		(0.1185)	(0.0111)	(0.0707)	(0.0233)	(0.3214)	(0.0015)	(0.0564)	(0.0145)		
K	0.1599	−0.1228***	0.0163***	–	−0.9144***	0.0294	−0.0380	0.1156***	−0.4541***	−0.1089	0.0050	−0.0702***	0.546	304***
	(0.4249)	(0.0349)	(0.0039)		(0.1742)	(0.0205)	(0.0679)	(0.0240)	(0.1171)	(0.0830)	(0.0959)	(0.0094)		
L	0.4606	−0.1011***	0.0100***	–	−0.5617**	0.0145	−0.2720**	0.0644	0.3677	0.2938***	−0.1290	−0.0897***	0.618	441***
	(0.5748)	(0.0351)	(0.0032)		(0.2364)	(0.0281)	(0.1164)	(0.0426)	(0.2412)	(0.0755)	(0.1819)	(0.0154)		
M	0.3648	−0.0006	–	–	−0.7233***	0.0120	0.0865	0.0818***	−0.2785	−0.1144**	−0.1049	−0.0767***	0.415	192***
	(0.3315)	(0.0083)			(0.1204)	(0.0158)	(0.0680)	(0.0238)	(0.3037)	(0.0507)	(0.0678)	(0.0184)		

The dependent variable is DR. See Table 2 for variable definitions. Standard errors robust to heteroscedasticity are in parentheses below the coefficients. Wald statistic tests the joint significance of estimated coefficients on the variables; asymptotically distributed as χ^2(df) under the null of no relationship. Time dummies are used for all regressions. (*), (**) and (***) indicate that coefficients are significant or the relevant null is rejected at 10, 5 and 1% level, respectively. The sample size is shown as in Table 3.

3.7. Regressions based on industry classification

Table 8 reports the OLS results with respect to 12 industry classifications. The findings reveal that the nature of the relationship between the debt ratio and Q varies across industries. Regarding the industry groups of agriculture, forestry, fishing and hunting; construction; information and IT; other services, Tobin's Q has no significant influence on leverage and the relationship is not non-linear.

On the other hand, the same relationship turns out to be in a reverse-U shape form [+Q; $-Q^2$] for the mining, manufacturing, and wholesale and retail trade industries. This parabolic relation implies that leverage and Tobin's Q are positively (negatively) associated at low (high) spectrum of Q. What is more, we report a U-shape [−Q; $+Q^2$] relation for the real estate, social services, and disseminator and culture industries. This finding means that higher Tobin's Q leads to lower (higher) debt ratios at low (high) spectrum of Q for the firms in these sectors. An interesting finding is obtained for the transportation and warehousing, and utility groups where the relationship between debt ratios and Tobin's Q is cubic [−Q; $+Q^2$;$-Q^3$]. The coefficient estimates suggest that leverage and Tobin's Q are inversely linked at low and high spectrums of Q but this association is direct at medium spectrum of Q. In other words, leverage is increased at low and high intensities of product market competition but it is reduced when the competition is at medium level. This cubic relation, although with opposite signs to our findings, is also reported by Pandey (2004) for Malaysian firms.

Among the other explanatory variables, while the influence of firm size, growth rate, liquidity and profitability on leverage is uniform across industries the other factors affect debt ratios differently depending on the industry groups. Overall, our findings indicate that there are different degrees of effects of product market competition on the capital structure of Chinese firms in different industries.

Hence, it appears that most Chinese industries are concerned with product market competition when choosing debt levels, and the non-linear relationship between Q and debt suggests that Chinese firms are subject to both the limited liability and predation effects.

3.8. Capital structure dynamics and product market competition

The previous section assumed that capital structure choice of Chinese firms is static. However, a more realistic assumption would be that managers adjust their financing mix due to internal changes or external shocks (see, e.g., Antoniou et al., 2008; Hui, Lo, & Huang, 2006). To account for such considerations, Eq. (1) can be modified to obtain the following dynamic model:

$$DR_{i,t} = \alpha + \beta DR_{i,t-1} + \sum_{k=1} \delta_k X_{k,it} + \lambda_i + \theta_t + \mu_{it}. \quad (2)$$

In model (2), [i] denotes individual firms; [t] denotes years; α denotes the intercept term; β is the coefficient on the lagged dependent variable (DR(−1)); [X] is the kth explanatory variable; δ_k are estimable coefficients on the explanatory variables; λ_i represents time-invariant but firm-variant factors; θ_t represents time-variant but firm-invariant factors; and μ_{it} is the time-variant

Table 9
Dynamic capital structure and product market competition in China: System-GMM estimates.

	Short-run			Long-run		
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	−0.0815	0.0911	0.1178	−0.2330	0.2525	0.3175
	(0.0981)	(0.1116)	(0.1165)	(0.2873)	(0.3039)	(0.3085)
DR(−1)	0.6504***	0.6390***	0.6290***	–	–	–
	(0.0325)	(0.0333)	(0.0342)			
Q	0.0080***	0.0084	0.0177	0.0228***	0.0233	0.0478
	(0.0027)	(0.0096)	(0.0193)	(0.0079)	(0.0267)	(0.0522)
Q2	–	−0.0001	−0.0041	–	−0.0003	−0.0109
		(0.0012)	(0.0053)		(0.0033)	(0.0143)
Q3	–	–	0.0003	–	–	0.0009
			(0.0005)			(0.0012)
ROA	−0.5284***	−0.5117***	−0.4660***	−1.5114***	−1.4175***	−1.2561***
	(0.0730)	(0.0715)	(0.0725)	(0.2682)	(0.2435)	(0.2284)
SIZE	0.0177***	0.0097**	0.0089**	0.0507***	0.0270**	0.0239**
	(0.0044)	(0.0048)	(0.0045)	(0.0133)	(0.0136)	(0.0117)
CVA1	−0.0182	−0.0069	−0.0354	−0.0521	−0.0190	−0.0955
	(0.0261)	(0.0261)	(0.0274)	(0.0733)	(0.0717)	(0.0708)
GR-TA	0.0621***	0.0530***	0.0531***	0.1777***	0.1468***	0.1431***
	(0.0186)	(0.0187)	(0.0169)	(0.0586)	(0.0560)	(0.0484)
NDTS	−0.1603***	−0.0913**	−0.0201	−0.4585***	−0.2529**	−0.0541
	(0.0558)	(0.0459)	(0.0690)	(0.1615)	(0.1158)	(0.1867)
UNIQ	−0.0077	−0.0015	0.0007	−0.0221	−0.0041	0.0018
	(0.0293)	(0.0297)	(0.0270)	(0.0836)	(0.0823)	(0.0728)
CGIR	−0.2644***	−0.1719**	−0.1741***	−0.7563***	−0.4762**	−0.4694***
	(0.0674)	(0.0684)	(0.0617)	(0.2033)	(0.1947)	(0.1729)
CR	−0.0494***	−0.0536***	−0.0560***	−0.1412***	−0.1484***	−0.1509***
	(0.0092)	(0.0092)	(0.0099)	(0.0177)	(0.0167)	(0.0172)
Adjusted R^2	0.7967	0.7969	0.7922	–	–	–
Wald Test 1	3036***	2847***	2844***	–	–	–
Wald Test 2	115.8***	97.91***	85.52***	–	–	–
Correlation 1	−14.54***	−13.81***	−13.69***	–	–	–
Correlation 2	−1.623	−1.523	−1.376	–	–	–
Sargan Test (p)	186.7 (*0.39*)	234.1 (*0.24*)	271.1 (*0.27*)	–	–	–

The dependent variable is DR. See Table 2 for variable definitions. Standard errors robust to heteroscedasticity are in parentheses below the coefficients. Wald Test 1 (2) test the joint significance of estimated coefficients on the main variables (dummies); asymptotically distributed as χ^2(df) under the null of no relationship. Correlation 1 and 2 are first and second order autocorrelation of residuals, respectively; which are asymptotically distributed as N(0,1) under the null of no serial correlation. Sargan Test is the test of over identifying restrictions, asymptotically distributed as χ^2(df) under the null of instruments' validity. Time and industry dummies are used in all models. (*), (**) and (***) indicate that coefficients are significant or the relevant null is rejected at the 10, 5 and 1% level, respectively. Sample size for the unbalanced panel is 10,416 observations and 1382 firms. Long-run and short-run test diagnostics are, by definition, the same.

error term which is serially correlated with mean zero and a constant variance.

In order to estimate (2), one needs to consider more advanced econometric methods. The use of OLS would be inappropriate due to the inclusion of the lagged dependent variable as an explanatory factor. In addition, using fixed effects method would potentially control for the unobservable firm-specific factors (λ_i) but it would not alleviate the endogeneity problem that could arise because of the correlation between the contemporaneous error term and past values of the lagged dependent variable. What is more, the review article by Istaitieh and Rodriguez (2006) implies the relevance of endogeneity, simultaneity and causality issues for studies that examine capital structure and factor-product markets. Therefore, we introduce the use of system-GMM estimation technique that can mitigate the distortions caused by fixed effects, simultaneity and the endogeneity problems. The model is estimated simultaneously in both levels and first differences under this GMM technique.[3]

In model (2), a partial adjustment model is implied. In this framework, it is assumed that firms adjust their capital structure through time and the speed of adjustment, which is measured by $[1-\beta]$, depends on whether rebalancing capital structure towards target levels is too costly. Higher adjustment costs would lead to slower adjustment speed. If the coefficient estimate on the lagged dependent variable (β) is significantly different from zero and between the range of zero and one, one then can contend that target capital structure exists.[4]

Table 9 shows the system-GMM regression results regarding the relation between the product market competition and dynamic capital structure.[5] The left panel is based on running Eq. (2) which includes the lagged dependent variable as an explanatory factor and thus provides 'short-run' estimations. The short-run association of capital structure with its determinants can be different from their long-run relationship. The right panel considers this possibility and estimates dynamically Eq. (2). The long-run coefficients on the explanatory variables are obtained by the ratio of $[\delta_k/1-\beta]$. Furthermore, the adjustment time in years can be measured by $[1/(\delta_k/1-\beta)]$.

The estimated coefficients on the lagged debt ratio are significant at the 1% level and are within [0, 1] range in all short-run models. These findings imply the presence of dynamic capital structure in China. In other words, Chinese managers react to internal or external changes to maintain their target financing mix. The adjustment speeds for models 1, 2 and 3 are 0.35, 0.36 and 0.37, respectively.[6] Hence, it takes approximately 2 years and 9 months for Chinese managers to achieve their target capital structure.

In Table 9, we consider whether the leverage ratio and product market competition have a parabolic (model 2) or cubic (model 3) relation. The long or short-run GMM estimates in the table do not favor such non-linear associations. Therefore, assuming next linearity in variables (model 1), our results reveal that Tobin's Q and debt ratio are positively and significantly correlated. This finding strongly supports the predation model which contends that a highly-levered firm is threatened by a low-levered firm to decrease its indebtedness. This assertion is stronger with long-run results where the concerned coefficient is about three times higher. In the previous section, the OLS and fixed effects methods yielded different results. The system-GMM results based on dynamic capital structure analysis settle this contradiction.

As for the other explanatory variables, higher debt ratio is associated with lower levels of profitability, non-debt tax shields, liquidity, capability of generating internal resources. These results are consistent in terms of sign and significance in all six estimations and some of the results are similar to what Huang and Song (2006) reported. The same consistency applies for the growth rate and firm size factors that have a direct and significant influence on leverage. The only control variables that are statistically non-influential are asset uniqueness and asset tangibility.

3.9. Sub-sample analyses: size, growth and debt ratio classifications

In this section, we undertake a deeper examination by considering regressions based on different classifications: estimations involving groups with high and low leverage, groups with high and low product market competition or growth, and groups with large and small firm size. All of the results are reported in Table 10.

First, the debt ratio classification reveals that Tobin's Q is significant only for firms with relatively low leverage. The positive sign of the coefficient supports the predation hypothesis. On the other hand, the influence of product market competition on debt ratio is insignificant for firms with relatively high leverage. This finding is surprising because according to the predation effects it would be more appropriate to see a positive link for the high-levered group. On another matter, we did not identify any non-linear relation for this classification.

Second, according to the firm size classification, it seems product market competition is not pivotal in deciding the financing mix of the relatively small Chinese companies. On the other hand, there appears to be a cubic relation between leverage and Tobin's Q for large firms. The results suggest that at low and high end of product market competition, leverage is increased with lower competition, which is in line with the predation effects hypothesis; and at medium intensity of competition, leverage and product market competition move together, which is consistent with the limited liability hypothesis.

Third, with respect to the growth classification, we again detect a cubic relation as just explained earlier, this time for the firms with low growth opportunities. For Chinese firms with high growth prospects, more intense product market competition seems to lead to lower debt ratios.

Examining the coefficient estimates on the lagged dependent variable, one can see that lagged debt ratios affect positively and significantly current debt ratios in all cases. Therefore, we can argue that Chinese firms adopt target debt ratios, irrespective of whether they are small, have low growth options or employ low debt in their capital structure. However, the speed of adjusting the capital structure varies across these classifications. Specifically, the swiftest firms in rebalancing their financing mix are the ones with low leverage $[1-\beta=0.50]$ and the slowest ones are the firms with already high leverage $[1-\beta=0.30]$.

To shed some light on the implications of the control variables, the influence of profitability and liquidity (growth rate) is uniform across all groups as they have an inverse (direct) relation with Tobin's Q. Another uniformity comes from the asset tangibility and asset uniqueness factors which have no influence on the financing mix decisions of Chinese managers. However, firm size, non-debt tax shields and capability of generating internal resources interact differently with the debt ratios, depending on the classifications.

In summary, the relationship between debt ratio and product market competition is noticeably different when considering the various classifications.

[3] This paper does not aim to explain in detail the econometric model comparisons, which is already discussed elsewhere. The readers are suggested to see Aggarwal and Kyaw (2010), Antoniou, Guney, and Paudyal (2006), Blundell and Bond (1998) and Miguel and Pindado (2001), among others, for full details.

[4] See Antoniou et al. (2008), Hovakimian, Opler, and Titman (2001), and Miguel and Pindado (2001), among others, for a discussion of target capital structure.

[5] For GMM results to be reliable and consistent, two diagnostics should be fulfilled. First, as expected, the test results show the presence of first-order autocorrelation and absence of second-order autocorrelation. Second, the p-values of Sargan tests confirm the validity of the instrument set. We investigated whether the explanatory variables are endogenous, exogenous, or pre-determined. For this, we followed the procedure adopted by Blundell, Bond, Devereux, and Schiantarelli (1992). We find that the variables "Tobin's Q, CVA1, ROA, GR-TA, UNIQ, CGIR" are endogenously determined. These variables were instrumented at dated time t-2 and with further lags.

[6] These findings are comparable to Antoniou et al. (2006, 2008), Frank and Goyal (2004), and Miguel and Pindado (2001) and are in line with the trade-off theory.

Table 10
Dynamic capital structure and product market competition in China: leverage, size and growth classifications.

	Low-leverage	High-leverage	Small firms	Large firms	Low growth	High growth
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	−0.1965	0.2948**	−0.2366	−0.0980	−0.2356*	−0.0582
	(0.1306)	(0.1247)	(0.2410)	(0.1915)	(0.1265)	(0.1634)
DR(−1)	0.4990***	0.6995***	0.6591***	0.6026***	0.6742***	0.6430***
	(0.0392)	(0.0363)	(0.0410)	(0.0496)	(0.0489)	(0.0357)
Q	0.0093***	−0.0022	0.0071	0.0507**	0.2079***	0.0064**
	(0.0032)	(0.0039)	(0.0046)	(0.0242)	(0.0699)	(0.0031)
Q2	–	–	–	−0.0109*	−0.0907***	–
				(0.0064)	(0.0329)	
Q3	–	–	–	0.0008**	0.0131***	–
				(0.0004)	(0.0050)	
ROA	−0.4067***	−0.6399***	−0.6055***	−0.8085***	−0.5884***	−0.7263***
	(0.0769)	(0.0907)	(0.0933)	(0.1297)	(0.1178)	(0.0849)
SIZE	0.0253***	−0.0007	0.0252**	0.0180*	0.0162***	0.0166**
	(0.0062)	(0.0051)	(0.0118)	(0.0095)	(0.0053)	(0.0076)
CVA1	−0.0353	0.0050	−0.0461	0.0089	0.0225	−0.0242
	(0.0304)	(0.0304)	(0.0326)	(0.0333)	(0.0325)	(0.0343)
GR-TA	0.0850***	0.0725***	0.0882***	0.0695***	0.0688**	0.1012***
	(0.0256)	(0.0197)	(0.0297)	(0.0195)	(0.0284)	(0.0226)
NDTS	−0.2205***	−0.0303	−0.0731	−0.0995**	−0.1598***	−0.0760
	(0.0510)	(0.0509)	(0.0849)	(0.0497)	(0.0611)	(0.1067)
UNIQ	−0.0531	0.0219	0.0019	0.0266	0.0078	−0.0136
	(0.0339)	(0.0322)	(0.0430)	(0.0285)	(0.0202)	(0.0470)
CGIR	−0.2083***	−0.2194***	−0.0508	−0.1031	−0.1129	−0.1156*
	(0.0603)	(0.0769)	(0.0711)	(0.1141)	(0.0744)	(0.0655)
CR	−0.0552***	−0.0560***	−0.0475***	−0.0516***	−0.0370***	−0.0440***
	(0.0079)	(0.0213)	(0.0111)	(0.0132)	(0.0133)	(0.0109)
Adjusted R^2	0.5766	0.7264	0.8253	0.7790	0.8199	0.8195
Wald Test 1	1356***	1416***	1668***	2055***	1801***	1545***
Wald Test 2	118***	101.3***	47.47***	63.33***	64.14***	72.47***
Correlation 1	−8.459***	−9.443***	−8.207***	−9.419***	−8.549***	−9.953***
Correlation 2	−1.334	−1.062	−0.819	−0.958	−1.071	−1.398
Sargan Test (p)	171.5 (0.71)	190.1 (0.33)	181.5 (0.49)	268.2 (0.14)	243.8 (0.50)	188.7 (0.35)

The dependent variable is DR. See Table 2 for variable definitions. Standard errors robust to heteroscedasticity are in parentheses below the coefficients. Wald Test 1 (2) test the joint significance of estimated coefficients on the main variables (dummies); asymptotically distributed as χ^2(df) under the null of no relationship. Correlation 1 and 2 are first and second order autocorrelation of residuals, respectively; which are asymptotically distributed as N(0,1) under the null of no serial correlation. Sargan Test is the test of over identifying restrictions, asymptotically distributed as χ^2(df) under the null of instruments' validity. Time and industry dummies are used in all models. (*), (**) and (***) indicates that coefficients are significant or the relevant null is rejected at 10, 5 and 1% level, respectively. Sample size for the unbalanced panel is 10,416 observations and 1382 firms.

4. Conclusions

In this paper, we have studied an unbalanced panel dataset which includes a sample of 10,416 Chinese listed firm-year observations in 12 industries from 1994 to 2006. Using non-parametric methods, we firstly examined whether there were differences across industries relating to debt ratios and product market competition (proxied by Tobin's Q). Using the HHI index, we measured the product market competition in each industry. Next, we tested the relationship between debt and product market competition in Chinese industries, using multiple linear and non-linear regression models using the fixed effect and OLS methods. This study further considered the presence of target financing mix adopted by Chinese managers. To account for this, we employed a dynamic capital structure analysis and used the recently developed system-GMM regression method. Finally, we performed regressions according to the different classifications, i.e., lower vs. higher leverage; lower vs. higher product market competition, and larger vs. smaller firm size.

Based on the univariate analyses and regressions, this study reported significant differences across various industry groups regarding the association of debt ratios with product market competition.

In general, the regression results are sensitive to the estimations methods and the choice between linear and non-linear relationship regarding the debt ratios and Tobin's Q. For instance, the pooled-OLS regressions assuming linearity detect no significant relation between leverage and product market competition whereas using OLS and assuming non-linearity produces a parabolic relationship that favors both limited liability and predation effects hypotheses. On the other hand, fixed effects method obtains a significant and positive relation between leverage and Tobin's Q only in case of the linearity, which supports the predation effects model.

We further considered the system-GMM method that accounts for unobservable firm-specific characteristics and the endogeneity problem. The GMM results for the whole sample suggest that leverage and Tobin's Q are linearly linked and the latter positively and significantly affects the former, which favors the predation effects model. We also find that Chinese managers seem to attempt to rebalance optimally their financing mix in order to be on target.

We conduct additional regressions for the sub-samples. The GMM findings imply that there is no non-linearity for the debt ratio classification and low-levered firms increase their debt ratios in case of low product market competition. However, firms with low growth prospects and large firms in China seem to adopt a cubic relationship between leverage and Tobin's Q, which lends some support for both alternative hypotheses.

More future theoretical and empirical work is needed to examine the sensitivity of the nature of the relationship between leverage and product market competition to different industry groups. Another exciting area of future research would be to consider how the unique Chinese institutional factors combined with product market competition affect external financing decisions of Chinese firms.

Acknowledgment

The authors would like to thank the participants at the meeting of Global Finance Association in Hangzhou, China, for their useful comments. Ling Li acknowledges the financial support from the "Project

211" (Phase-3) Fund of the Central University of Finance and Economics and the Beijing Municipal Commission of Education "Joint Construction Project".

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