

Credit Constraints and Firm's Productivity: Evidence from China's Growth Enterprise Market

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Abstract Reliable and sufficient funding is essential for firms' development. But in China, massive small and medium firms (SMEs) and innovation-oriented companies are struggling because of severe credit constraints. In this paper, we study the effect that credit constraints have on firms' productivity. To do so, we collect 379 firms' data from China's Growth Enterprises Market (GEM). And we part the credit constraints into two kinds namely external and internal. Besides, some other factors, like the financial crisis happened in 2008, are also taken into account. By employing GLS and FGLS methods, we find that credit constraints do have a significant effect on firm's productivity. What's more, the experimental result shows that the 2008 Financial Crisis does change the funding situation for SMEs and innovation-oriented companies.

Keywords: credit constraints, firm's productivity, China's Growth Enterprises Market (GEM)

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1. Introduction

Credit constraints have been regarded as one of the main obstacles that restrict firm's expansion in today's society. Especially in China, because of the underdeveloped financial market, massive firms are suffering from severe credit constraints. Furthermore, it's extremely hard for SMEs and innovation-oriented companies to get enough funds because of their unpredictable future and they can only rely on the internal funding sources [1,2].

So, Second-board Market, also known as growth firms market (GEM) was launched on the Shenzhen Stock Exchange, which was meant to provide various financing channels and opportunities for SMEs and start-up firms. As a stretch of board for SMEs, it offers a platform for Chinese SMEs and innovation-oriented companies to get better access to financing. Meantime, it creates an ideal laboratory to figure out how credit constraints affect those firms' productivity.

In this paper, we discuss the direct effect that credit constraints have on firms' productivity. Our work differs from existing literatures in many aspects. First, our research focuses on China's SMEs & innovation-oriented companies. Second, we decompose credit constraints into internal and external channels. Third, we take the 2008 Financial Crisis into consideration and the change of China's financing environment and market attitude before and after this special period is analyzed.

Our data is an unbalanced panel of 379 firms in China's GEM from 2001 to 2016, collected from CSMAR database.

The experimental results show that internal financing can promote innovation-oriented companies' productivity while external financing creates a negative effect. And the financial crisis in 2008 does have a significant effect on firm-level productivity.

The reminder of this paper is structured as follows: Section 2 focuses on related literature. Section 3 explains the data and empirical model. Section 4 shows the whole empirical analysis including methods, robustness tests and results. Section 5 discusses our findings and conclusions.

2. Literature Review

2.1. Financial Development and Economic Growth

The role of financial development on economic growth has been discussed widely. Rajan and Zingales [3] emphasizes that financial development has a positive influence on the rate of economic growth by cutting external financing cost. It seems that afterwards empirical works stick with this argument. At the macro-level, Chengliang, Yue and Li [4] find out that financial development improves economic growth efficiency in China generally. In line with Zhu (2009), Cheng and Degryse [5] proved the positive link between the two. From microeconomic view, researchers use massive firm-level data to study the connection in detail. For example, Pozzolo, Schivardi and Nucci [6] use the leverage to measure financial development in their experiments, then the result implies a negative link exists between leverage and productivity based on Italian

situation. Ayyagari, Demirgüçkunt and Maksimovic [7] note that finance based on market access is the key factor that constrains the firm's growth by examining data from 62 countries across the world. And Chen, Li and Zhang [8] conclude that immature financial system does slow down the fast development pace of firms in China.

2.2. Effects of Credit Constraints on Firm-Level

A large body of literature focuses on the micro-level to figure out the connection between financial development and economic growth. Among them, credit constraints and firm productivity are the most often studied subject. Xiang and Wei [9] point out that the liquidity constraints have negative influence on firm productivity, especially for private firms, after studying 1998-2008 firm-level data in China. The following paper Zhao, Wen and Zhao [10] show that credit constraints have a significant negative influence on TFP, especially for non-stated and export firms in China. Also, Manaresi and Pierri [11] show the expansion of credit supply has a great scale and productivity effect on manufacture industry. While Regasa, Roberts and Fielding [12] reveal a different finding that the use of external finance can hinder firm's growth based on low-income country data.

Recently, growing literature starts to decompose credit constraints into more specific types. M. Chen and Guariglia notes that TFP is strongly constrained by the access to internal finance, especially for foreign private firms. Allen and Qian [13] study the story behind the phenomenon that without availability of external financing Chinese firms still can grow fast. As it turns out, internal finance plays the key role. New findings from Li, Liao and Zhao [14] emphasize both external and internal financing can greatly promote firm productivity, moreover, substitution effect is found between the two.

2.3. Researches on Chinese Second-board Market

Firms in Chinese Second-board Market are mainly SMEs and innovation-oriented companies, which can be easily refused by typical banks when seeking external finance. Some characteristics they share contribute to the situation. There are plenty literatures spot on Second-board Market. Qun and Zhai [15] indicate that credit constraints have negative impact on R&D investment and firm growth in high-tech firms, which also is proven by Tong and Yao [16] using evidence from SMEs. Then Surong and Yujie [17] show that financing constraints have a certain effect on the initial science and technology firms' growth. Huo and Liu [18] add that the access to finance is essential for SMEs' growth and expansion.

In general, existing literatures mainly focus on macro-level or traditional industries when studying the link between credit constraints and firm productivity. While those concentrating on SMEs and innovation-oriented companies are more interested in discussing about issues like how credit constraints affect firms' growth ability or R&D investment. Compared to these, the contribution of our paper is threefold. First, we directly study the relationship

between credit constraints and firm productivity among SMEs and innovation-oriented companies in China, a topic barely researched by others. Second, in detail, we not only decompose credit constraint into internal and external way, but also try to figure out the independent influence of credit constraints from different sources. In the end, 2008 Financial Crisis is taken into consideration to find out the relationship between credit constraint and firm productivity using evidence from SMEs and innovation-oriented companies.

3. Data, Empirical Model and Variable Selection

3.1. Data

The data that we use in this study is collected from the CSMAR database. It covers 2401 observations of 379 small and median sized firms (SMEs) and innovation-oriented companies from 2001 to 2016 in China's GEM. The database is broadly used in researches of Chinese economy. It contains detailed firm-level information of listed SMEs and innovation-oriented companies in China including basic information (employment, location et al) and complete information on financial statements (balance sheet, income statement and cash flow statement).

3.2. Empirical Model

Inspired by Nickell and Nicolitsas [19] and He [20] who directly adds the financial constraints and other variables into the produce function, we employ a transformed model to ensure its effectiveness in our analysis. The regression model is developed as follows,

$$y_{it} = \beta_0 + \beta_1 L_{\text{bankloan}_{it}} + \beta_2 L_{\text{inner}_{it}} + \beta_3 L_{\text{turnover}_{it}} + \beta_4 L_{\text{roe}_{it}} + \beta_5 L_{\text{quick}_{it}} + \mu_{it}$$

where y_{it} is the firm i 's productivity of year t , and $L_{\text{bankloan}_{it}}$, $L_{\text{inner}_{it}}$, $L_{\text{turnover}_{it}}$, $L_{\text{roe}_{it}}$ and $L_{\text{quick}_{it}}$ are the firm i 's L_{bankloan} , L_{inner} , L_{turnover} , L_{roe} , L_{quick} of year t respectively. μ_{it} is the stochastic error. The variables selected are discussed below.

3.3. Dependent Variables

In our study, we employ firm's productivity as dependent variable. Two proxies are introduced to present labor productivity.

tfp_lp: total-factor productivity, which is calculated by using LP method posted by Levinsohn and Petrin [21]. In our study, we employ the natural logarithm form of firms' net profit (**L_netprofit**), the natural logarithm form of firms' number of employee (**L_netprofit**) and the natural logarithm form of firms' total asset (**L_totalasset**) to compute it.

L_productivity: the natural logarithm form of firms' net profit and wages per employee which offers a dynamic measure of finance growth, average output of labor, and profitability level within a corporation.

3.4. Explanatory Variables

External financing variable: we choose **L_bankloan**, the natural logarithm form of total bank loan, to demonstrate the external financing variable because all the firms are SMEs and innovation-oriented companies whose external financing is mainly from bank loan in our study

Internal financing variables: in our study, considering the size of innovation-oriented firm's net cash flow, we employ **L_inner**, the natural logarithm form of summary of net cash flow and shareholder's equity, to specify the state of firm's internal financing.

Asset turnover: considering that a firm's total capital turnover rate is an important factor to evaluate its profitability in the expectable future, so we add **L_turnover**, the natural logarithm form of total asset turnover rate, into our model.

Return on equity: we take **L_roe**, the natural logarithm form of ROE, into consideration because ROE is significant to measure how well a company uses investments to generate earnings growth.

Quick ratio: regarded as a tool for assessment of liquidity position of firms, **L_quick**, the natural logarithm of quick ratio, is also included in our model.

A summary of the variables we use in our analysis is presented in [Table 1](#). The descriptive statistics of the variables is reported in [Table 2](#).

Table 1. Description of Variables.

Variable	Description
L_productivity	log (net profit + wages/employee)
tfp_lp	total-factor productivity by LP method
L_bankloan	log (bank loan)
L_inner	Log (net cash flow + equity)
L_turnover	log (total capital turnover)
L_roe	log (return on equity)
L_quick	log (quick ratio)

Table 2. Descriptive Statistics of Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
L_productivity	1454	11.06557	1.139393	3.406271	15.50282
tfp_lp	1454	13.44839	9.188582	0.080704	110.8473
L_bankloan	815	17.98782	2.005046	10.69533	24.31622
L_inner	2,157	20.79752	.945596	15.01094	25.29738
L_turnover	1537	-0.9048	0.784062	-8.97923	0.709476
L_roe	1454	-2.64189	0.913857	-7.79935	1.781544
L_quick	1545	1.038041	1.157599	-7.30674	5.573797

4. Estimation Procedure, Results and Discussions

Our aim is to quantify the effect of credit constraint on firm's productivity. The dataset presents an unbalanced panel structure due to missing observations for some firms and years. As the panel bears the feature that N (cross-sectional dimension) is much bigger than T (time dimension), we use Feasible Generalized Least Squares estimation method (FGLS) with a heteroscedastic error term. We also include time dummies to the FGLS estimations to increase the likelihood of no correlation across individuals in the idiosyncratic disturbances' assumption to hold. Ordinary Least Squares (OLS) method is also used as a robustness check.

We extended our analysis by adding the effect of financial crisis. The regression results are presented in [Table 3](#).

4.1. How Does External Financing Affect the Productivity of SMEs and Innovation-Oriented Companies?

In terms of total bank loan, our findings show that it does have some negative effects on firm's productivity. As the development of society, technology renews much faster than before, and the innovation-oriented growth companies face many impediments. As we mentioned before, usually these innovation-oriented companies' business cycle is relatively longer than other firms and the investments therefore come with more risk. Because of this, commercial banks are not willing to lend.

In order to look closer to the effect of external financing shock, we employ another variable **constraint** which is equal to one when firms' bank loan lies under the lowest one third quartile of bank loan interval. And the relevant results are demonstrated in [Table 4](#).

As [Table 4](#) displays, there is a significant negative relationship between **tfp_lp** and **constraint**. The results illustrate that the larger the firm external financing supply, the lower productivity. In other word, high productivity doesn't necessarily come from large amount of external financing supply. This is mirrored in reality that innovation-oriented companies are not that easy to get bank loans as they don't quite match the strict standards of bank lending. Most of these firms have to resort to venture capitals or other financial institutions to liquidate their business operations.

4.2. How Does Internal Financing Affect SMEs and Innovation-oriented Companies' Productivity?

Internal financing is found to be positively related to its productivity. It implies that internal financing is vital for SMEs and innovation-oriented companies as external financing served as a weaker channel. This result is in accordance with the finding by the previous literature such as Xiang and Wei [9]. OLS regression results also supported above analysis so we believe our results are robust.

Table 3. Regression Results

Variables	GLS		FGLS	
	tfp_lp	L_productivity	tfp_lp	L_productivity
L_bankloan	-0.214 (0.196)	-0.0360 (0.0285)	-0.0765 (0.0938)	-0.00710 (0.0113)
L_inner	1.494** (0.760)	0.129* (0.0768)	2.174*** (0.232)	0.169*** (0.0291)
L_turnover	0.584 (0.412)	-0.157** (0.0741)	-0.239 (0.240)	-0.295*** (0.0391)
L_roe	4.655*** (0.568)	0.591*** (0.0767)	5.657*** (0.151)	0.663*** (0.0258)
L_quick	0.665 (0.471)	0.341*** (0.0661)	1.282*** (0.199)	0.437*** (0.0218)
constant	-0.843 (15.04)	9.866*** (1.560)	-17.34*** (4.816)	7.890*** (0.676)

Notes: ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively. Robust standard errors in parentheses.

Table 4. Regression Results (with constraint)

Variables	GLS		FGLS	
	tfp_lp	L_productivity	tfp_lp	L_productivity
constraint	0.774*	0.0530	0.565***	0.0400*
	(0.444)	(0.0489)	(0.0710)	(0.0218)
L_inner	1.294***	0.140***	1.726***	0.149***
	(0.428)	(0.0390)	(0.149)	(0.00955)
L_turnover	0.368	-0.159***	0.00154	-0.229***
	(0.408)	(0.0513)	(0.172)	(0.0200)
L_roe	6.068***	0.685***	7.194***	0.782***
	(0.445)	(0.0455)	(0.114)	(0.0122)
L_quick	0.639**	0.237***	0.831***	0.317***
	(0.286)	(0.0268)	(0.0853)	(0.00809)
constant	0.213	9.167***	-7.195**	8.542***
	(9.170)	(0.814)	(2.890)	(0.303)

Notes: ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively. Robust standard errors in parentheses.

4.3. Does the 2008 Financing Crisis Constrain the Firm's Productivity and Financial Status?

After the 2008 financial crisis, Chinese government immediately issued many policies to stimulate the economy such as the famous stimulus package which resulted in loosening the bank lending to SMEs. In our analysis we generate a dummy variable called **crisis** to check whether it has a significant impact on firm's productivity.

From the regression results in Table 5, crisis has a positive influence on innovation-oriented companies' productivity. This further proves that these stimulus policies including increasing the financing sources for SMEs and innovation-oriented companies worked quite well. Financial crisis in 2008 did not harm firm's productivity in China. On the contrary, it helped SMEs and innovation-oriented companies to grow by giving access to funds and liquidities.

Table 5. Regression Results (with crisis)

Variables	GLS		FGLS	
	tfp_lp	L_productivity	tfp_lp	L_productivity
L_bankloan	-1.250**	-0.0818	-0.759	-0.119
	(0.529)	(0.0609)	(0.708)	(0.131)
L_inner	1.473*	0.128*	2.194***	0.168***
	(0.759)	(0.0769)	(0.229)	(0.0287)
L_turnover	0.549	-0.159**	-0.242	-0.302***
	(0.452)	(0.0744)	(0.239)	(0.0390)
L_roe	4.710***	0.594***	5.664***	0.662***
	(0.577)	(0.0785)	(0.149)	(0.0245)
L_quick	0.695	0.342***	1.296***	0.438***
	(0.475)	(0.0665)	(0.198)	(0.0212)
crisis	-19.51*	-0.512	-12.02	-1.111
	(10.03)	(1.376)	(12.75)	(2.338)
crisis_effect	1.088*	0.0482	0.714	0.118
	(0.564)	(0.0672)	(0.713)	(0.131)
constant	17.83	10.70***	-5.678	9.853***
	(16.42)	(1.898)	(13.24)	(2.399)

Notes: ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively. Robust standard errors in parentheses.

5. Conclusions

In this paper, we examine the role of credit constraints to productivity of firms based on GEM. Our sample consists of panel data of 379 Chinese firms for a period of 2001-2016. We employ two econometric techniques to test the credibility of our results, namely GLS and FGLS.

We obtain a full picture of credit constraints in Chinese Growth Firm Market from our experiment. Our results show that SMEs and innovation-oriented companies are mainly depending on internal funding which generated by firm's operations. Since SMEs and innovation-oriented companies could seem generate more risks than traditional firms, these firms can hardly get financed by banks, which also explains the negative effect that external funding has on firms' productivity.

Our analysis also suggests that the 2008 financial crisis does have an impact on credit constraints and the funding structure. The crisis has a positive influence on SMEs and innovation-oriented companies' productivity. Before the crisis, external funds mainly come from banks, but main external funding is provided by financial institutions after the crisis.

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