



# Asymmetric Information, Bank Lending and Trade Credit: Evidence from Chinese SME Data

Liu, Yajing

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博 士 論 文

平成 26 年 12 月  
神戸大学経済学研究科  
経済学専攻  
指導教員 地主 敏樹  
劉 亜静

# 博 士 論 文

Asymmetric information, Bank Lending and Trade  
Credit: Evidence from Chinese SME Data

情報の非対称性、銀行貸出と企業間信用：中国の中小企業  
データを用いた実証分析

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## **Contents**

### **Acknowledgments**

### **Introduction**

1	Motivation.....	1
2	Backgrounds.....	2
	2.1 The definition and the ownership for SMEs of enterprise in China.....	2
	2.2 The main problems related to financing for SMEs in China.....	3
3	Perspectives and approaches for this research.....	4
4	References.....	6

### **Chapter 1 Relationship Banking and SME Finance in China:**

#### **An Analysis Based on the Survey of Zhejiang Province in 2010**

1	Introduction.....	7
2	The state of SME financing and the problems faced by SMEs in China.....	8
	2.1 The definition and the ownership of SMEs in China.....	8
	2.2 Financing problems for Chinese SMEs.....	9
3	Theoretical framework and hypotheses.....	10
	3.1 Why relationship banking and what defines relationship.....	10
	3.2 Hypotheses and literature review.....	11
4	Data and methodology.....	14
	4.1 Description of the survey.....	14
	4.2 Detailed outline and key concepts.....	14
	4.3 The definition of key concepts and the summary statistics.....	15
	4.4 Methodology.....	19
5	Conclusions.....	22
6	Acknowledgments.....	23
7	References.....	23

### **Chapter 2 Trade Credit in China: Panel Evidence Based on the Survey of Industrial Enterprises**

1	Introduction.....	25
---	-------------------	----

2	Data and summary.....	29
3	Model and analyses.....	34
	3.1 Fixed effects of regression.....	34
	3.2 Granger causality test and GMM analysis.....	38
4	Conclusions.....	41
5	Acknowledgments.....	41
6	References.....	42

### **Chapter 3 The productivity of Industrial Firms and Financial Efficiency in China**

1	Introduction.....	44
2	Preparing the HUAMEI data to measure TFP and capital stock.....	46
	2.1 Detailed outline and key concepts.....	46
	2.2 Data and summary statistics.....	49
3	Model and analysis.....	50
	3.1 Regression for TFP.....	50
	3.2 Regression for profitability.....	59
4	Concretions.....	64
5	Acknowledgments.....	64
6	References.....	65

### **Conclusions for the whole paper**

1	Conclusions for the whole paper.....	67
2	References.....	69

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# Introduction to Asymmetric Information, Bank Lending and Trade Credit: Evidence from Chinese SME Data

Liu Yajing<sup>1</sup>

## 1 Motivation

There were more than 40 million small and medium-sized enterprises (SMEs) in China in 2009<sup>2</sup>, comprising 60% of the state GDP and 50% of total taxes to the state, and providing over 80% of jobs. In particular, SMEs have played a significant role in absorbing rural laborers and thus helping to maintain urban economic stability. Despite their importance, financing sources for SMEs have not been sufficient. According to the World Bank's 2003 Investment Climate Survey, compared to other Asian countries, Chinese SMEs faced many financial constraints and received less financial support from banks, with only 12% of their working capital coming from bank loans (Dollar et.al.2003)<sup>3</sup>. Compounded by the effects of the global financial crisis of 2008, SMEs in China have faced many problems, including a decline in stock prices, credit insecurity, increasing costs, and decreasing exports. As a result, many SMEs in China had fallen into a serious financial deficit situation, with some even declaring bankruptcy. These bankruptcies were caused in part by a lack of financial support. This paper discusses how to improve SMEs' financing difficulties by comparing different approaches to obtaining financial support.

It is widely recognized that the development of SMEs has a high correlation with China's overall economic growth. However, it is very difficult to observe the financial environment of SMEs, and it is also very challenging to measure the

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<sup>1</sup> Present address: Ph.D. Student, Graduate School of Economics, Kobe University, Hyogo, Japan. Email: Liu\_yajingdekiru@yahoo.co.jp

<sup>2</sup> See "The Blue Book of Small and Medium Enterprises in China: Development, Financing, Service and Policies (2010).

<sup>3</sup> Bank loans in China represent only 12% of the working capital of SMEs, while this figures is much higher in other parts of Asia (21% in Malaysia, 24% in Indonesia, 28% in the Philippines, and 26% in Korea and Thailand). See Dollar et.al. (2003), p.31.

financial efficiency of different financial sources, due to informational opacity and incomplete contracts that is typical with SMEs. This research attempts to identify a suitable financial channel for SMEs. Moreover, the way in which different financial sources affect the labor productivity of SMEs is analyzed. The financing of Chinese SMEs is analyzed in three stages.

## 2 Backgrounds

### 2.1 The definition and the ownership for SMEs of enterprise in China

There are three ways to distinguish the large, medium, and small enterprises: Ownership structure, firm size and financing category<sup>4</sup>. This paper uses firm size and ownership structure and because the data that is analyzed is for industrial enterprises, the definitions for industry firm size set by the State Statistics Bureau of China (SSBC) 2011 are used. These definitions are as follows:

Small:  $300 \leq \text{sales} < 2,000$  (10,000 CNY units) and employees  $< 300$ ;

Medium:  $2,000 \leq \text{sales} < 40,000$  and  $300 \leq \text{employees} \leq 1,000$ ;

Large: sales  $> 40,000$  and employees  $> 1,000$ .

The unit for sales is millions of yuan.

Next, the classification of industry firm ownership is introduced. Ownership definitions were first published by SSBC in 1996, and later improved in 2006. The definitions are as follows<sup>5</sup>:

F1: State Owned Enterprise

F2: Collectively Owned Enterprise

F3: Private Enterprise

F4: Joint Economy & Share Holding Enterprise

F5: Economy Funded by Foreign Entrepreneurs & Entrepreneurs from Hong

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<sup>4</sup> See Lijun Fan (2013).

<sup>5</sup> There are 7 ownership groups in the 2006 definitions of SSBC, State-owned Enterprise, Collectively Owned Enterprise, Private Enterprise, Joint Economy, Share Holding Economy, Economy Funded by Foreign Entrepreneurs & Entrepreneurs from Hong Kong, Macao and Taiwan, and Others. In order to facilitate the analysis in this paper, the 7 groups are reduced to 5 by merging Joint Economy and Share Holding Economy into one group, and dropping the Others group because there are few data points in this group.



Kong, Macao and Taiwan.

According to Li (2010)<sup>6</sup>, in 2009, there were 42.39 million SMEs, 31.96 million private enterprises (representing 75% of all enterprises), 0.49 million state owned enterprises, 0.75 million collectively owned enterprises, and 0.43 million foreign entrepreneurs. It is widely believed that state owned enterprises are large enterprises, but in reality, SMEs can also be state owned enterprises.

## 2.2 The main problems related to financing for SMEs in China

Firstly, we focus on the financial credit guarantee system for the SMEs. China has credit supplementation, but there is no sound system to ensure that SMEs obtaining financing sources from banks. After the global financial crisis in 2008, the Chinese government implemented some policies to create a more favorable financial environment for SMEs.

In the first half of 2009, the country increased the total number of loans to enterprises by with 3.9 trillion yuan, and SMEs' share of loans rose to 56.6%<sup>7</sup>. Yet this alone was not sufficient to resolve the credit constraints and the limited access to private finance. The use of formal finance is also limited. According to the All China Federation of Industry and Commerce (ACFIC) Survey of 2009, over 95% of SMEs cannot get formal financing options offered by state owned banks<sup>8</sup>. Another issue is that many start-up firms and small business use their own sources of capital as their major fanatical source, but cannot get support from formal financial sources. Although there is a clear problem of information asymmetry, practically for start-ups and small enterprises, the main problem is that China lacks a system that offers appropriate collateral and support for SMEs' repayments to banks. Furthermore, there is no credit rating system for SMEs in China. A nationwide credit assessment system for SMEs is currently being

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<sup>6</sup> See "The Blue Book of small and Medium Enterprises in China: Development, Financing, Service and Policies (2010) p.3-20.

<sup>7</sup> See Xu & Ding (2010), p.109-114.

<sup>8</sup> See "The Blue Book of small and Medium Enterprises in China: Development, Financing, Service and Policies (2010) p.11-15.

proposed to put in place before 2020<sup>9</sup>.

Secondly, there are few financing channels besides bank loans. SMEs cannot obtain financing directly from the financial market (such as the stock markets). Kanamori and Zhao (2004) find that only 6-7% of household deposits used in the stock market, fewer use for SMEs.

Finally, while this paper emphasizes external factors, that affect the financing environments for SMEs, a close examination of SMEs' internal factors reveals that these do not contribute to a very optimistic outcome, either. Poor financial performance among SMEs and bad loans raise the risks and costs for banks, which helps to explain why banks generally prefer to work with state owned or larger enterprises.

### **3 Perspectives and approaches for the this research**

Three different angles of SME financing in China are analyzed in this paper, in an attempt to find a suitable financial channel for SMEs. Moreover, the way in which different financial sources affect the labor productivity of SMEs is also examined. The analysis is divided in the following three chapters.

Chapter 1 attempts to verify the effectiveness of the business model for Chinese SMEs experiencing financial difficulties. Compared to big enterprises, the implications of financing difficulties for SMEs are more serious due to informational opacity and incomplete contracts. The main function of relationship banking is to gather soft information about firms, information that is usually difficult to access. By gathering soft information, banks are able to mitigate the demands and requirements of firms. As a result, in the long term, banks can provide constant financial support and offer advice to assist SMEs in their development. In this analysis, data from Zhejiang province in China is used to verify several hypotheses about relationship banking. It is shown that there are distinct merits of

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<sup>9</sup> See Huang (2009), p.14-16.

relationship banking, while the demerits remain unclear. Therefore, the relationship banking model may be one way to resolve the financing difficulties of Chinese SMEs.

Chapter 2 analyses a different financial channel for SMEs. If a firm's use of access to formal finance is limited, it may use trade credit as an alternative financing method with its partners. In China, there are three main modes of corporate finance: Bank loans, security issuance, and trade credit. Compared to bank loans and security issuance, trade credit between business partners is a more favored method for corporations, particularly SMEs. Using a large panel dataset of Chinese industrial firms, this study finds that SMEs, particularly small firms, are more likely to use trade credit as a financing source than formal financial channels from financial institutions. The analysis clearly distinguishes between the trade credit of suppliers and demanders, and the relationship of each group is estimated using both trade credit and financial institutions. The evidence suggests that small firms use more trade credit, and have a stronger substitute relationship with using formal financial channels from financial institutions. It is also found that the ownership structure does not affect their use of trade credit.

Chapter 3 examines the efficiency of financial sources by measuring productivity using firm-level panel data. The effect of ownership and firm size on the productivity of Chinese industrial firms is studied. Then, the relationship between productivity and the financial source is examined. There are two financial sources for enterprises in this data, trade credit, and bank loans. Long-term liabilities are used to represent bank loans, and we use accounts payable, accounts receivable and other relevant variables to represent trade credit. It is found that enterprises, experienced productivity increases, as a result of using more trade credit and less bank loans. The ownership and the size of firms in the industry are also measured, but there is no particularly powerful evidence that a firm's ownership will affect the enterprise's productivity through based on the financial source.

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# **Chapter 1**

## **Relationship Banking and SME Finance in China: An Analysis Based on the Survey of Zhejiang Province in 2010**

Liu Yajing<sup>1</sup>

### **Abstract**

This paper intends to verify the effectiveness of the relationship banking business model for financial distress to Chinese small and medium enterprises (SMEs). Compared to big enterprises, the causes of financial distress for SMEs are more serious due to informational opacity and incomplete contracts. The purpose of relationship banking is for banks to gather soft information, which is usually difficult to access, which helps to resolve these two issues. In addition, by gathering the soft information, banks are able to regulate the demands and requirements of firms. In the long term, banks can provide constant financial support. At the same time, they can offer advice to help SMEs develop. In this paper, data from Zhejiang province in China is used to verify several hypotheses about relationship banking. Through this analysis, it is shown that there are distinct merits of relationship banking, while the demerits are unclear. Therefore, the relationship banking model may be one way to resolve the financial difficulties of Chinese SMEs.

### **1 Introduction**

SMEs have played a very important role in China's impressive economic growth. But the global financial crisis of 2008 affected SMEs in China, as they faced many problems including the decline in stock prices, credit insecurity, increasing costs, and decreasing exports. As a result, many SMEs in China fell into a serious financial deficit situation, with some even declaring bankruptcy. The main reason for these SMEs' bankruptcies was the lack of financial support. In conducting this research, the aim is to provide insight into how relationship

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<sup>1</sup> Present address: Ph.D. Student, Graduate School of Economics, Kobe University, Hyogo, Japan. Email: Liu\_yajingdekiru@yahoo.co.jp

banking affects the financing for SMEs, and how SMEs can obtain financial support from banks.

Berger and Udell (2002) argue that soft information is different from hard information, and define it as unquantifiable, unverifiable and undocumentable information. Yet relationship banking can address the financial difficulties faced by SMEs through the collection of soft information by banks. Since Petersen and Rajan (1994), many researchers have measured the relationship between banks and borrowers by observing the length of the relationship, or the number of trade banks. It has become the most commonly used method for measuring relationship banking in applied empirical research on SMEs.

However, there is a lack of research about relationship banking for Chinese SMEs. In this paper, the reality of the relationship banking situation in China is presented, with a particular focus on relationship lending for SMEs. Several hypotheses are proposed about the merits and demerits of relationship banking, and data on Chinese SMEs are used to test these hypotheses. The remainder of this paper is structured as follows. Section 2 introduces the state of SME financing and the problems that they face in China. Section 3 discusses the existing literature on relationship banking. Section 4 describes the data and methodology, and Section 5 concludes.

## **2 The state of SME financing and the problems faced by SMES in China**

### **2.1 The definition and the ownership of SMEs in China**

In order to examine the effect of the firm's size and ownership structure on the relationship between firms and financial sources, the definitions for industry firm size used by the State Statistics Bureau of China (SSBC) 2011 are outlined, as follows:

Small:  $300 \leq \text{sales} < 2,000$  (10,000 CNY units) and  $\text{employees} < 300$ ;

Medium:  $2,000 \leq \text{sales} < 40,000$  and  $300 \leq \text{employees} \leq 1,000$ ;

Large:  $\text{sales} > 40,000$  and  $\text{employees} > 1,000$ .

Next, the classification of industry firm ownership is presented. Ownership definitions were first published by SSBC in 1996, and later improved in 2006. The definitions as follows<sup>2</sup>:

F1: State Owned Enterprise

F2: Collectively Owned Enterprise

F3: Private Enterprise

F4: Joint Economy & Share Holding Enterprise

F5: Economy Funded by Foreign Entrepreneurs & Entrepreneurs from Hong Kong, Macao and Taiwan.

The definitions and characteristics of Chinese SMEs are very important to note in this research, as these definitions differ from one country to the next.

## 2.2 Financing problems for Chinese SMEs

There is no sound system to ensure that SMEs obtain financing sources from banks. After the global financial crisis of 2008, the Chinese government implemented some policies emphasizing the creation of a more favorable financial environment for SMEs. In the first half of 2009, the country increased the total number of loans to enterprises by 3.9 trillion yuan, and the share of loans for SMEs rose to 56.6%. Yet this alone was not sufficient to resolve the credit constraints and the limited access to private finance. The use of formal finance is also limited. According to the All China Federation of Industry and Commerce (ACFIC) Survey of 2009, over 95% of SMEs cannot use formal financing options offered by State-Owned banks. Another issue is that many start-up firms and small businesses use self-accumulated money as their major financial source, but cannot get support from formal financial sources. Where information asymmetry exists, practically for start-ups and small enterprises, the

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<sup>2</sup> There are 7 ownership groups in the 2006 definitions of SSBC: State-Owned Enterprise, Collectively Owned Enterprise, Private Enterprise, Joint Economy, Share Holding Economy, Economy Funded by Foreign Entrepreneurs & Entrepreneurs from Hong Kong, Macao and Taiwan, and Others. In order to facilitate the data analysis, the 7 groups were reduced to 5, merging Joint Economy and Share Holding Economy, and the Others group was dropped because there were very few data points in this group.

problem in China is that there are fewer systems for SMEs to access collateral and guarantee their repayment ability to banks. Furthermore, there is no robust credit rating system for SMEs in China. A nationwide credit assessment system for SMEs is proposed to be put in place before 2020. Finally, there is a lack of market space and a mechanism for SMEs to obtain financial sources from financial markets by security issuance.

This paper investigates the reality of SMEs' financing situation in China, and the business model of relationship banking is checked to determine whether it affects financing for SMEs.

### **3 Theoretical framework and hypotheses**

#### **3.1 Why relationship banking and what defines relationship banking?**

In order to define relationship banking, it must first be shown that there is informational asymmetry in financial intermediation, which is described clearly by Diamond (1984) and by Bhattacharya and Thakor (1993). Relationship banking aims to resolve the problems of asymmetric information (Greenbaum (1998), Pertsen and Rajan (1992), Bhattacharya and Chiesa (1995), Boot (2000), Rheinbaben and Ruckes (2004)). Moreover, with SMEs, there is a lack of transparent, audited financial records, which means they are more likely to have incomplete contracts. As such, the collection of information, and particularly soft information (Boot (2000)), is very important for both banks and firms.

Most of modern research focuses on the role of banks as relationship lenders, but this research focuses on how borrowers improve the financial environment by developing closer relationships with banks over time. The definition of relationship banking is reviewed, and whether relationship banking can help when borrowers—particularly SMEs—face financial difficulties is examined.

Relationship banking is defined to be not only about close bank and borrower relationships, but its potential for use as a financial intermediary is also



examined. We use the definition by Boot (2000), who considers relationship banking as the provision of a financial intermediary:

“ i ) investing in obtaining customer-specific information, often proprietary in nature; and ii ) evaluating the profitability of these investments through multiple interactions with the same customer over time or products.”

According to Berger (1999), relationship banking is present when the following three conditions are completed: The intermediary gathers readily available public information, banks gather information about borrowers over time, and the information is proprietary (soft information). Accordingly, relationship banking is defined in this paper as follows:

1. Banks invest in obtaining customer-specific information (soft information), often proprietary in nature.
2. Firms borrow from the same bank over time, obtaining favorable conditions, in exchange for providing soft information.

### 3.2 Hypothesis and literature review

In this section, the literature on relationship banking is reviewed and the hypotheses to be tested in this paper are presented. Firstly, the merits of relationship banking are surveyed. Based on the definition of relationship banking, the collection of soft information is one of the merits for relationship banking. The following hypotheses are proposed:

**Hypothesis 1:** *In a long-term relationship, lenders can collect more soft information, which mitigates the problem of information asymmetry, and as a result, borrowers, particularly SMEs, receive financial support from the banks.*

**Hypothesis 2:** *Borrowers (SMEs) can enjoy more favorable conditions from banks, including paying lower interest rates or pledging less collateral, by forming long-term relationships that ensure their trustworthiness.*

Previous research has illustrated the merits of relationship banking. Petersen and Rajan (1994) find that firms that build close ties with an institutional creditor will increase have greater access to financing. Berger and Udell (1995) establish

that the bank-borrower relationship is an important mechanism for solving the problems of asymmetric information; they also find that borrowers with longer banking relationships pay lower interest rates and are required to pledge less collateral.

Elsas and Krahen (1998) study the availability of housebanks for borrowers. Theoretically, housebanks are closely related to relationship banking, and they find that housebanks provide liquidity insurance to borrowers whose ratings have deteriorated unexpectedly. Angelini, Salvo, and Ferri (1998) investigate the effects of bank-firm relationships on the cost and the availability of credit for small firms in Italy. They find that banks that have long-term customer relationships will increase their lending rates, but local cooperative banks will not increase the lending rates for their local members. Therefore closer customer relationships with local cooperative banks can help control the cost of credit for small businesses.

Sakai, Uesugi, and Watanabe (2010) investigate how the borrowing costs of firms decrease as they age, using the same approach used to measure interest rates. They find that interest rates fall as firms age and the borrower relationship grows. Similarly, Kim, Kristiansen, and Vale (2007) use the life cycle model of borrowing firms to test how bank-borrower relationships reduce the problems of asymmetric information and how this affects interest rates. They find that banks will provide lower interest rates for younger firms, but when firms surpass the 10-year mark, the bank may increase rates. Only when the firm reaches 40 years old does the bank lower its interest again. This is because the problem of asymmetric information is different between younger and older firms. This evidence is consistent with the theory of relationship banking. However, they also show that when the firm is more than 10 years old, the interest rate also increases because of the hold-up problem. Thus, the next hypotheses relate to the demerits of relationship banking:

**Hypothesis 3:** *One of the costs of a long-term relationship is the soft-budget constraint problem. Boot (2000) describes the key question of the soft-budget constraint problem as “whether a bank could deny additional credit when a*

*borrower falls into a situation of financial difficulty and exerts insufficient effort in preventing a bad outcome from happening”.*

**Hypothesis 4:** *Another cost of relationship banking is the hold-up problem, which is caused when the borrower’s information is locked-in with lenders. Banks can take advantage of monopolistic rents from secure informational relationships.*

These two hypotheses describe the costs to firms that build long-term relationships with banks, and the theories of these demerits in relationship banking have been well documented in the literature. Greenbaum, Kanatas, and Venezia (1989) argue that banks collect soft information through the provision of financial services to firms over the long-term. The banks will then offer their expected loan rates, but for the borrower the cost increases. Sharpe (1990) finds that banks offer better-performing customers more competitive rates using an information monopoly, but at a high cost for customers. Sharpe (1990) also argues that banks will use the power of information monopoly to build their reputation, which translates into costs for customers and hold-up issues. Rajan (1992) also presents the costs of the hold-up problem. Because banks have bargaining power in a long-term borrower relationship, which can manage financial assets when the banks start with a project funding. For firms, their portfolio choice of borrowing source and the choice to manage financial assets will be costly.

Degryse and Cayseele (2000) find that firms that have longer relationships with banks pay higher loan rates, but less augment for collateral requirement with numbers of using banks. Oena and Smith (2001) compare the number of banking relationships held by firms. They find that firms that have relationships with multiple banks reduce the risk of being held up by banks, while firms who have long-term relationships with only one bank can more easily be locked in with lenders. Kano, Uchida, Udell and Watanabe (2011) use three factors—information verifiability, bank size and credit availability, and the level of competition in the banking sector—to analyze how relationship lending affects loan contract terms and credit availability. They find that in longer relationships

with small banks, firms can obtain the benefits of reduced loan interest rates and increased credit availability. However, with the improvement of financial environment of firms', the costs increase either. With additional competition in the banking sector, stronger relationships bring firms to the hold up situation more easily.

## **4 Data and methodology**

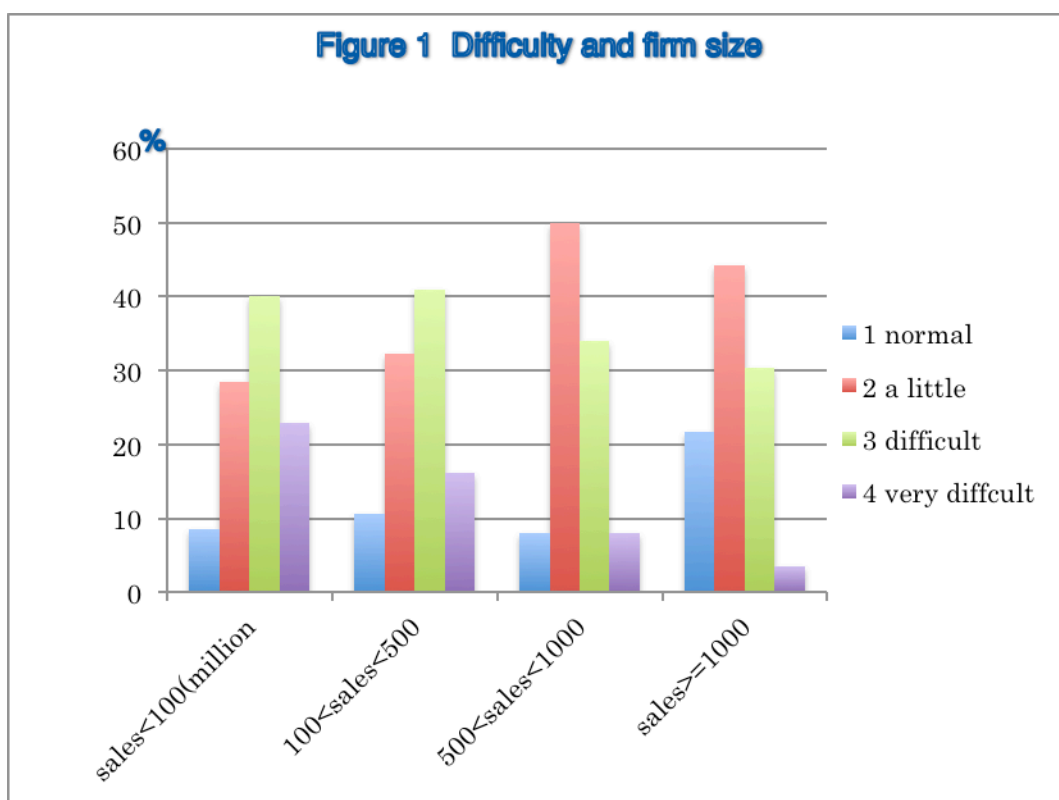
### **4.1 Description of the survey**

The data in this paper comes from a survey that examines the soft information of SMEs in Zhejiang province and their relationships with banks. The survey is part of a study about China conducted by Kato of Kobe University and Tang of Chuo University in 2010, entitled "A Study on Urbanization and Regional Economic Development." They conducted primary interviews with 183 firms, almost SMEs in the Shaoxing, Ningbo, Jiaxing, Jiashan, and Huzhou areas of Zhejiang province. These were manufacturing firms producing textiles, apparel, footwear, and hats. The survey questions were divided into five categories: i ) basic information, ii ) spatial distribution information, iii ) territory evaluation, iv ) financial accounting information, and v ) relationships with banks. Questionnaires were received with a response rate of 93.9%. The data were cleaned and the final sample size for this study is 169 firms.

### **4.2 Detailed outline and key concepts**

As mentioned in Section 3, this research aims to test the merits and demerits of relationship banking in China. Like most empirical papers, this study will measure relationship banking using the length of the bank-borrower relationship and the number of banks used by firms. One of the key questions asked in the survey is, "What do you think of the financing environment for firms and your ability to access financing?" The respondents were asked to provide an answer based on a scale of 1 to 4, with 1 representing easy access and 4 representing difficult access. Difficulty level is one of the key dependent variables in this study.

Figure 1 shows the responses to the question of access to financing by firm size (sales). Firms with sales fewer than 100 million show that access to finance is more difficult than for larger firms. Another key dependent variable is interest rate. The performance variables of other firms are used to test the effects on the level of difficulty and interest rate.



#### 4.3 The definition of key concepts and the summary statistics

Table 1 provides the definitions of variables used in this paper. The dependent variables are difficulty and interest rate. The firms' performance variables are control variables, and the key independent variables are dummy variables, one group representing the number of lending banks (i.e. the concentration of relationship banking), and the other group is bank trade years, which describes the length of a bank-borrower relationship. Table 2 presents the mean, standard deviation, and min/max values of the key variables, and Table 3 shows the predicted sign of the main variables.

Table 1 Definition of variables

Variables	Description
Difficulty	Dependent variable : Financing access difficulty level of 1~4, where 4 represents the
Interest rate	Dependent variable : Loan interest rate
Years	Operating years
Lendingbank_nums	The numbers of banks get loans
BNUM_1	Dummy variable (number of relationships with banks = 1)
BNUM_2~4	Dummy variable (bank numbers > = 2 & bank numbers < = 4)
BNUM_5	Dummy variable (bank numbers > = 5)
Pay_G	Accounts payable / sales
Growth_rate	The growth rate of sales in the last 3 years
LA	Total liability / total assets in 2009
BANK_L	Bank loan / total liability
Hypothecated_loan	Dummy variable representing whether the firm had a hypothecated demand from the
Credit_loan	Dummy variable representing whether the firm had a credit loan from the bank
Earning	Dummy variable expressing the firm's earning level from 2007~2009
E1	Dummy variable representing firms that have had profits for two years
E2	Dummy variable representing firms who had a financial deficit but began making a profit
E3	Dummy variable representing firms that had a profit but became a financial deficit
E4	Dummy variable representing firms that have had a financial deficit for 2 years
Firmsize	Dummy variable representing firm size
Firm_B	Dummy variable for large firms
Firm_M	Dummy variable for medium firms
Firm_S	Dummy variable for small firms
Bank_tradeyears	Length of service at the same bank
Under1Y	Dummy variable representing less than 1 year
Above_1y_under3ys	Dummy variable representing 1~3 years of (...)
Above_3ys_under5ys	Dummy variable representing 3~5 years
Above5ys	Dummy variable representing more than 5 years
HL	E1 * Above5ys
BL	E4 * Above5ys
GE	E1 * BNUM_1
BE	E4 * BNUM_1

Table 2 Summary statistics

<b>Variables</b>	<b>Obs</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>
Difficulty	107	2.573	0.727	1	4
Interest rate	107	5.621	0.417	4.58	7.25
Years	107	8.365	6.839	0	58
Lendingbank_nums	107	2.299	1.399	1	5
BNUM_1	107	0.368	N.A.	0	1
BNUM_2~4	107	0.456	N.A.	0	1
BNUM_5	107	0.176	N.A.	0	1
Pay_G	107	0.143	0.387	-0.174	4
Groth_rate	107	13.916	13.516	-30	100
LA	107	0.436	0.605	0	6.25
BANK_L	107	0.583	0.76	0	8
Hypothecated_loan	107	0.626	N.A.	0	1
Credit_loan	107	0.286	N.A.	0	1
E1	107	0.775	N.A.	0	1
E2	107	0.159	N.A.	0	1
E3	107	0.050	N.A.	0	1
E4	107	0.049	N.A.	0	1
Firm_B	107	0.077	N.A.	0	1
Firm_M	107	0.582	N.A.	0	1
Firm_S	107	0.341	N.A.	0	1
Under1Y	107	0.076	N.A.	0	1
Above_1y_under3ys	107	0.171	N.A.	0	1
Above_3ys_under5ys	107	0.188	N.A.	0	1
Above5ys	107	0.565	N.A.	0	1
HL	107	0.465	N.A.	0	1
BL	107	0.024	N.A.	0	1
GE	107	0.280	N.A.	0	1
BE	107	0.033	N.A.	0	1

Table 3 Predicted signs of the main variables

Variables	Hypothesis 1	Hypothesis 2	Hypothesis 3		Hypothesis 4	
	Difficulty	Interest	Difficulty	Interest	Difficulty	Interest
Years	–	–	Control	Control	Control	Control
Lendingbank_nums	+	+				
BNUM_1	–	–				
BNUM_2~4	+	+				
BNUM_5	+	+				
Pay_G	–	–				
Growth_rate	–	–				
LA	+	+				
BANK_L	–	–				
Hypothecated_loan	–	–				
Credit_loan	–	–				
E1	–	–				
E2	–	–				
E3	+	+				
E4	+	+				
Firm_B	–	–				
Firm_M	–	–				
Firm_S	+	+				
Under1Y	+	+				
Above_1y_under3ys	+	+				
Above_3ys_under5ys	–	–				
Above5ys	–	–				
HL	No	No	Control	Control	+	+
GE			+	+		
BL			–	–	Control	Control
BE			–	–		

Notes: HL,BL,GE,BE are cross variables to check Hypothesis 3 and Hypothesis 4. If the coefficients of BL and BE are negative and significant, it may indicate the soft-budget problem. If HL and GE are positive and significant, it may show the hold-up problem. Description of the variables are shown in Table 1.



#### 4.4 Methodology

This section describes the models used to analyze the effects of relationship banking on the level of difficulty to access financing and interest rate. The production function is given by:

$$\begin{aligned} \text{Difficulty} = & \beta_0 + \beta_1 \text{Years} + \beta_2 \text{Lendingbank\_nums} + \beta_3 \text{Pay\_G} + \beta_4 \text{Grothrate} \\ (\text{Interest}) & + \beta_5 \text{LA} + \beta_6 \text{Bank\_L} + \beta_7 \text{Hypothecated\_loan} + \beta_8 \text{Credit\_loan} \\ & + \beta_9 \text{HL} + \beta_{10} \text{BL} + \beta_{11} \text{GE} + \beta_{12} \text{BE} + \pi_i \text{Earning} + \alpha_i \text{Firmsize} \\ & + \theta_i \text{Bank\_tradeyears} + u_i \end{aligned}$$

Where the difficulty is an index to show the firm's financing environment and its level of difficulty to access financing, on a scale of 1 to 4. The interest rate shows the cost of bank loans. The relationship characteristics are the two groups of dummy variables, lending bank numbers and bank trade years. The other firm characteristics are controlled by the regression. This model is used to run the regression on our data, and the results are summarized in Tables 4 and 5.

Firstly, we focus on Table 4 that shows the estimation using the ordered logistic model on the Difficulty variable. A positive and significant coefficient is found for the number of lending banks used by firms. A larger number of lending banks shows weaker relationships between banks and firms, and the weaker the relationships, the more likely the financing environment becomes difficult. The coefficient for trade year group is negative and significant, which proves that the longer the relationships between banks and firms, the better the financing environment becomes. These results are consistent with Hypothesis 1.

Next, the cross variables are checked for Hypothesis 3 and Hypothesis 4. The definitions of the cross variables are reviewed here. Where HL is defined as the most profitable firms, multiplied by the longest relationships. BL is defined as firms with the largest financial deficits, multiplied by the longest relationships. GE is defined as the most profitable firms, multiplied by the number of banks get loans just for one. Similarly, BE is defined as firms with the largest financial

deficits, multiplied by the number of banks get loans just for one. If the coefficients of BL and BE are negative and significant, it can be speculated that firms with poor financial performance still can obtain financing because of their long term relationships thus indicating the soft-budget problem. On the other hand, if the coefficients of HL and GE are positive and significant, it can be speculated that a hold-up problem may exist. This could be problematic, as well-performing firms may find it difficult to obtain bank loans.

Table 4 Results of the order logistic regression with the Difficulty variable

Variables	Ordered logistic											
	Difficulty											
	Coef.	S.E	Coef.	S.E	Coef.	S.E	Coef.	S.E				
<i>Years</i>	-0.094	**	0.041	-0.096	**	0.041	-0.097	**	0.042	-0.097	**	0.042
<i>Lendingbank_nums</i>	0.664	***	0.225	0.680	***	0.229	0.593	**	0.308	0.645	**	0.315
<i>Pay_G</i>	-0.668		1.076	-0.426		1.114	-0.523		1.066	-0.289		1.106
<i>Growth_rate</i>	0.031	*	0.016	0.036	**	0.017	0.022		0.019	0.028		0.019
<i>LA</i>	-0.027		0.368	-0.016		0.360	-0.052		0.386	-0.029		0.371
<i>BANK_L</i>	-0.204		0.253	-0.184		0.257	-0.188		0.256	-0.162		0.259
<i>Hypothecated_loan</i>	-1.034	*	0.564	-0.955	*	0.580	-1.158	**	0.591	-1.080	*	0.610
<i>Credit_loan</i>	-1.493		0.587	-1.435	**	0.606	-1.551	***	0.615	-1.490	**	0.633
<i>E1</i>	(Omitted)			(Omitted)			(Omitted)			(Omitted)		
<i>E2</i>	1.070	*	0.704	1.521	*	0.853	0.924		0.790	1.488	*	0.943
<i>E3</i>	1.967		1.038	3.017	**	1.319	1.879	*	1.119	3.040	**	1.410
<i>E4</i>	1.521		0.798	0.691		1.235	3.214	**	1.635	2.369		1.985
<i>Firm_B</i>	-16.730		1416.1	-16.034		987.15	-17.071		1586.20	-17.076		1601.30
<i>Firm_M</i>	-0.953		0.506	-0.973		0.513	-1.006		0.514	-0.989	*	0.519
<i>Firm_S</i>	(Omitted)			(Omitted)			(Omitted)			(Omitted)		
<i>Above5ys</i>	-2.195	**	0.965	-3.707	**	1.576	-2.222	**	1.000	-3.738	**	1.595
<i>Above_3ys_under5y</i>	-1.615	*	1.010	-1.667	*	1.030	-1.573	*	1.037	-1.621	*	1.054
<i>Above_1y_under3ys</i>	-2.007	**	1.037	-2.154	**	1.054	-2.087	**	1.069	-2.197	**	1.083
<i>Under1Y</i>	(Omitted)			(Omitted)			(Omitted)			(Omitted)		
<i>HL</i>				1.528		1.290				1.584		1.303
<i>BL</i>				3.055	*	1.920				2.855	*	1.984
<i>GE</i>							-0.126		0.779	0.024		0.783
<i>BE</i>							-2.424		1.950	-2.094		1.968
Pseudo R2	0.240		0.253		0.247		0.260					
OBS	107		107		107		107					

Notes: Standard errors in behind, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. The dependent variables in all the regressions are dummy variables.

All the regressions use the ordered logistic model. Description of the variables are shown in Table 1. OBS is the number of samples. Pseudo R2 measures the model's goodness of fit.

According to the explanation of cross variables, the results in Table 4 are not consistent with the hypothesis about the demerits of relationship banking. Although the coefficients of BL are significant, the signs are opposite from the conjecture. Table 5 reports the OLS regression on interest rate.

Table 5 The results of OLS regression with Interest

Variables	OLS							
	Interest							
	Coef.	S.E	Coef.	S.E	Coef.	S.E	Coef.	S.E
Years	0.005	0.005	-0.002	0.006	-0.002	0.006	-0.002	0.006
Lendingbank_nums	-0.053 *	0.033	-0.049 *	0.033	-0.076 *	0.044	-0.069 *	0.045
Pay_G	-0.271 *	0.174	-0.262 *	0.175	-0.262 *	0.176	-0.255	0.177
Groth_rate	0.003	0.003	0.004	0.003	0.002	0.003	0.003	0.003
LA	0.008	0.054	0.001	0.055	0.006	0.054	-0.001	0.055
BANK_L	0.052	0.046	0.053	0.047	0.049	0.047	0.049	0.047
Hypothecated_loan	-0.044	0.080	-0.023	0.082	-0.055	0.083	-0.034	0.085
Credit_loan	0.067	0.082	0.084	0.084	0.059	0.084	0.076	0.085
E1	(omitted)		(omitted)		(omitted)		(omitted)	
E2	-0.033	0.112	-0.018	0.142	-0.075	0.125	-0.057	0.155
E3	0.009	0.169	0.058	0.211	-0.024	0.176	0.024	0.218
E4	0.408 ***	0.143	0.192	0.236	0.403	0.281	0.184	0.346
Firm_B	0.047	0.161	0.035	0.162	0.031	0.163	0.022	0.164
Firm_M	0.186 **	0.083	0.172 **	0.084	0.174 **	0.085	0.162 *	0.086
Firm_S	(omitted)		(omitted)		(omitted)		(omitted)	
Above5ys	-0.074	0.171	-0.136	0.249	-0.108	0.178	-0.158	0.253
Above_3ys_under5ys	-0.231	0.185	-0.217	0.189	-0.261	0.191	-0.244	0.195
Above_1y_under3ys	0.044	0.190	0.044	0.190	0.017	0.194	0.022	0.195
Under1Y	(omitted)		(omitted)		(omitted)		(omitted)	
HL			0.061	0.198			0.053	0.200
BL			0.420	0.338			0.399	0.343
GE					-0.096	0.120	-0.083	0.121
BE					-0.069	0.345	-0.043	0.347
Constant	5.631 ***	5.200	5.606 ***	0.202	5.775 ***	0.272	5.731 ***	0.276
Pseudo R2 / R <sup>2</sup>	0.270		0.136		0.275		0.287	
Observations	107		107		107		107	

Standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

The coefficients on lending bank numbers are negative and significant, suggesting that the more lending banks are used, the easier it is for firms to obtain financing from them. This may support bank competition theory in the banking sector, but is not consistent with the hypothesis in this paper. Likewise, the results from the cross variables are inconsistent with the hypothesis.

## **5 Conclusions**

This paper aimed to verify the effectiveness of the relationship banking business model for Chinese SMEs in financial distress. Data from Zhejiang province in China was used to verify four hypotheses:

Hypothesis 1: Using long-term relationships, lenders can collect more soft information, which mitigates the information asymmetry problem and achieves a higher lending performance for borrowers (particularly SMEs).

Hypothesis 2: Borrowers (SMEs) can enjoy more advantageous conditions from banks, including lower interest rates and less collateral, by using long-term relationships which assures their trustworthiness.

Hypothesis 3: One of the costs of long-term banking relationships is the soft-budget constraint problem. Boot (2000) describes the key question of soft-budget constraints as whether a bank could deny additional credit when a borrower falls into financial difficulty and exert insufficient efforts to prevent a bad outcome.

Hypothesis 4: Another cost of relationship banking is the hold-up problem, which is caused by information lock-in with lenders. Banks can enjoy the advantageous monopolistic rents from secure informational relationships.

This study found that there are clear merits to relationship banking, and thus relationship banking is an effective method for SMEs to raise capital in China. Therefore, it is recommended that relationship banking be promoted more heavily. A future topic of study would be to examine how to improve the demerits of relationship banking in China.

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## **Chapter 2**

### **Trade Credit in China:**

#### **Panel Evidence Based on the Survey of Industrial Enterprises**

Yajing Liu<sup>1</sup>

#### **Abstract**

Firms use trade credit with their partners more frequently as a financing method than other options with financial institutions<sup>2</sup>. In China, there are three main modes for corporate finance: Bank loans, security issuance, and trade credit. Compared to bank loans and security issuance, trade credit between business partners is a more important method for corporations, particularly small and medium enterprises (SMEs). Using a large panel dataset of Chinese industrial firms, this study finds that SMEs, and particularly small firms, are more likely to use trade credit as a financing source than formal financial channels from financial institutions. A clear distinction is made between the trade credit of suppliers and demanders, and the relationship of each group is estimated using both trade credit and bank loans. If the coefficient of the variable is negative and significant, it will suggest that there is a substitute relationship between trade credit and bank loans. And if the coefficient is positive and significant, it suggests that there is a complementary relationship between trade credit and bank loans. The evidence suggests that small firms use more trade credit, and have a stronger substitute relationship with using financial institutions. It is also found that ownership may not affect the use of trade credit.

### **1 Introduction**

Trade credit is a useful financial resource for enterprises, particularly for SMEs in China<sup>3</sup>. But what is the relationship between trade credit and bank loans? When enterprises are unable to obtain external financing from banks, will they increase trade credit with their business partners? Or, if they are unable to obtain bank loans,

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<sup>1</sup> Graduate School of Economics, KOBE University. Liu\_yajingdekiru@yahoo.co.jp

<sup>2</sup> Theories based on Petersen and Rajan (1997).

<sup>3</sup> See Ge and Qiu (2007), which describes the reality of trade credit in China.

will they also have difficulty in obtaining trade credit? Alternatively, are enterprises obtaining financing from banks and simultaneously extending trade credit? There are many theoretical explanations concerning trade credit. This paper focuses on the relationship between trade credit and formal financing channels.

This study begins with a general survey of the literature on substitution hypotheses for trade credit and bank loans. Trade credit may provide better access to capital for firms than formal financial channels. In this case, it can be said that trade credit and bank loans have a substitute relationship, in particular for firms with weak banking relationships (Petersen and Rajan (1997)). Melzer (1960) shows that when firms cut back on their spending, these firms, particularly the larger ones, may use a credit policy as an alternative to direct price reductions, in order to increase their sales. Danielson and Scott (2004) provide evidence that firms will increase their reliance on trade credit when banks do not provide loans. Niskanen, J., and Niskanen, M. (2006) find that larger and older firms, and firms with strong internal financing sources, have a lower propensity to use trade credit, but that small firms and younger medium-sized firms with high growth rates tend to rely more heavily on trade credit. Guariglia and Matent (2006) use a panel of UK firms to test whether the trade credit channel offsets the credit channel. They find that both trade credit and credit are being used, and they also test operate as well as firms' coverage ratio, but find that it does not affect inventory investments that are made using trade credit. Their results are consistent with Kaplan and Zingales (1997) and Cleary (1999). Bougheas, Mateut, and Mizen (2009) examine a ten-year dataset of UK industrial firms. They find that short-term bank loans have a direct negative effect on trade credit. Molina and Preve (2012) analyze how financial distress affects firms' decisions to use trade credit with their suppliers. Their results show that firms in financial distress will use trade credit more frequently with their suppliers, which is expensive and adds to their costs of financial distress.

Next, this study examines whether firms can obtain loans from banks while also using trade credit, in other words, whether the two modes have a complementary relationship.



Cook (1999) analyzes data from a survey of 352 firms in Russia, and finds that firms who use trade credit also have a higher probability of obtaining bank credit. Giannetti, Burkart, and Ellingsen (2011) analyze trade credit to develop the characteristics and aspects of bank-firm relationships. They find that trade credit is most likely facilitated by uninformed lenders, and firms prefer to accept cheaper trade credit for longer periods. They also conclude that suppliers prefer short-term contracts in order to give incentives (for example, provide discounts, give a low cost contract. act.) to firms. This finding also provides insight about the asymmetric information between banks and firms, which can be alleviated by trade credit by incorporating into the lending relationship private information held by suppliers about the firms' customers. This is also consistent with Biais and Gollier (1997).

There are also other theoretical explanations about substitution and complementation hypothesis between trade credit and bank loans. Gana, Mateus, and Teixeira (2008) use a panel dataset of Portuguese and Spanish SMEs to test the hypothesis of whether trade credit could be a substitute or a complementary resource to bank credit. They find that trade credit complements bank credit. Further, they show that younger and smaller firms have a greater tendency to access more credit, because trade credit makes private information about suppliers available to the bank, which allows the bank to have more intelligence about their customers, which in turn helps them make their credit decisions. However, they also point out that although the substitution result is proven by their dataset, the substitution and complementation hypothesis will be different based on the firms' attributes. Alphonse, Ducret, and Séverin (2006) test whether bank debt and trade credit exist as two complementary sources of financing. Their results show that trade credit and bank debt have a negative correlation in accordance with substitution hypothesis. This is also consistent with Berger and Udell (1998). But their results also prove that trade credit can signal a firm's quality, and this may help firms obtain more bank loans.

In addition, Love, Preve, and Sarria-Allende (2007) discuss the effects of financial crises on trade credit. They find that firms increase their use of trade credit right after

a financial crisis in order to delay their repayment periods. But this trend declines in the two years following the crisis. The reason may be associated with trade credit suppliers who are unable to obtain loans from banks as a result of the crisis. They suggest that more attention should be paid to the “redistribution view” of the supplier of trade credit, rather than conducting a simple analysis of substitution and complementation hypothesis between trade credit and bank loans. Fisman and Love (2003) use data for 37 industries in 43 countries to estimate each industry’s dependence on external finance. They find that industries are more dependent on trade credit in countries where financial institutions are less developed.

Finally, there are studies on trade credit in China. Brandt and Zhu (2000) examine three features of China’s economic reform, namely economic decentralization, the government’s commitment to the state sector, and the credit plan and credit control. They note that the Chinese government helps inefficient state firms by providing them with cheap credit. They also show that when the government continues to support inefficient state enterprises, these enterprises become weak, which leads to an inflation problem.

Cull and Xu (2003) discuss the determinants of the distribution of credit, which is provided by state owned banks to state owned enterprises. They find a positive relationship between bank financing and the profitability of state owned enterprises. They also show that from the 1980s to the 1990s, this relationship weakened because state owned enterprises used bank credit instead of getting direct support from the government. Franklin (2005) provides a comparison between formal and non-formal financing approaches of state owned firms and non-state owned firms in China, concluding that non-formal financing approaches sustain the growth of non-state owned firms in China. Ge and Qiu (2007) focus on non-state owned firms in China, particularly those with limited support from banks. By comparing the use of trade credit by state owned firms and non-state owned firms in China, they find that the latter use trade credit more often. This suggests that non-formal financing channels support the growth of non-state firms. Cull, Xu, and Zhu (2009) use a large dataset of Chinese industrial firms and show that unprofitable state owned firms are

more likely to obtain formal credit, although with a poorly performing. These state owned firms may then provide trade credit to their customers who are unable to access formal credit or bank loans. The authors also point out that a biased and inefficient banking system may be the main reason for the increased substitution of trade credit. However, they do not find strong evidence that trade credit has a significant impact on the growth of China's enterprises.

Building on these studies about the substitution and complementation hypothesis between trade credit and bank loans, this paper offers the advantage of using unbalance panel data for China. This study also contributes to the literature by dividing the analysis by trade credit supplier and trade credit demander. These groups are then applied to estimate the relationship between using trade credit and using financial institutions. Finally, this research also conducts a time series analysis over a five-year period.

The remainder of this paper proceeds as follows. Section 2 presents the data and the basic information about the panel data. Section 3 discusses the empirical evidence of testing the substitution and complementation hypothesis between trade credit and bank loans. Section 4 presents the conclusions and the implications of these results, along with some ideas for future research.

## **2 Data and summary statistics**

This dataset is drawn from the annual accounting reports provided by HUAMEI Enterprise of Statistics of China. This survey provides industrial enterprise surveys covering state owned firms and non-state owned firms from 2004 to 2008. All firms with sales lower than 1,000 yuan were dropped from the sample, so that firms cannot show negative values for sales. The total number of key variables is around 330,000.

Table 1 provides the definitions of the key variables used in this paper. The dependent variable is trade credit. Accounts payable and accounts receivable are used to represent trade credit, and these trade credit values are divided by the groups

of suppliers and demanders, respectively. Thus, the accounts payable variable represents the demanders of trade credit (i.e. the firm's customers), while the accounts receivable variable represents the suppliers of trade credit to the firm. Long-term liability is used to represent bank loans. Moreover, in order to avoid economies of scale, the ratio of all dependent variables and long-term liability is taken over total sales, and the ratio of all dependent variables and long-term liability is taken over total assets.

In order to examine the effect of firm size and ownership structure on productivity and financial sources, dummy variable groups are created. First, the definitions for industry firm size used by the State Statistics Bureau of China (SSBC) 2011 are presented, as follows:

Small:  $300 \leq \text{sales} < 2,000$  (10,000CNY units) and  $\text{employees} < 300$ ;

Medium:  $2,000 \leq \text{sales} < 40,000$  and  $300 \leq \text{employees} \leq 1,000$ ;

Large:  $\text{sales} > 40,000$  and  $\text{employees} > 1,000$ .

Second, the classification of industry firm ownership is introduced. Ownership definitions were first published by SSBC in 1996, and later refined in 2006. The HUAMEI dataset in this paper uses the 2006 definitions. The enterprise database is divided into the following five ownership groups<sup>4</sup>:

F1: State Owned Enterprise

F2: Collectively Owned Enterprise

F3: Private Enterprise

F4: Joint Economy & Share Holding Enterprise

F5: Economy Funded by Foreign Entrepreneurs & Entrepreneurs from Hong Kong, Macao and Taiwan.

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4 There are 7 ownership groups in the 2006 definitions of SSBC: State-owned Enterprise, Collectively Owned Enterprise, Private Enterprise, Joint Economy, Share Holding Economy, Economy Funded by Foreign Entrepreneurs & Entrepreneurs from Hong Kong, Macao and Taiwan, and Others. In order to facilitate the data analysis, the 7 groups were reduced to 5, merging Joint Economy and Share Holding Economy, and dropping the Others group because of the database had very few data points in this group.

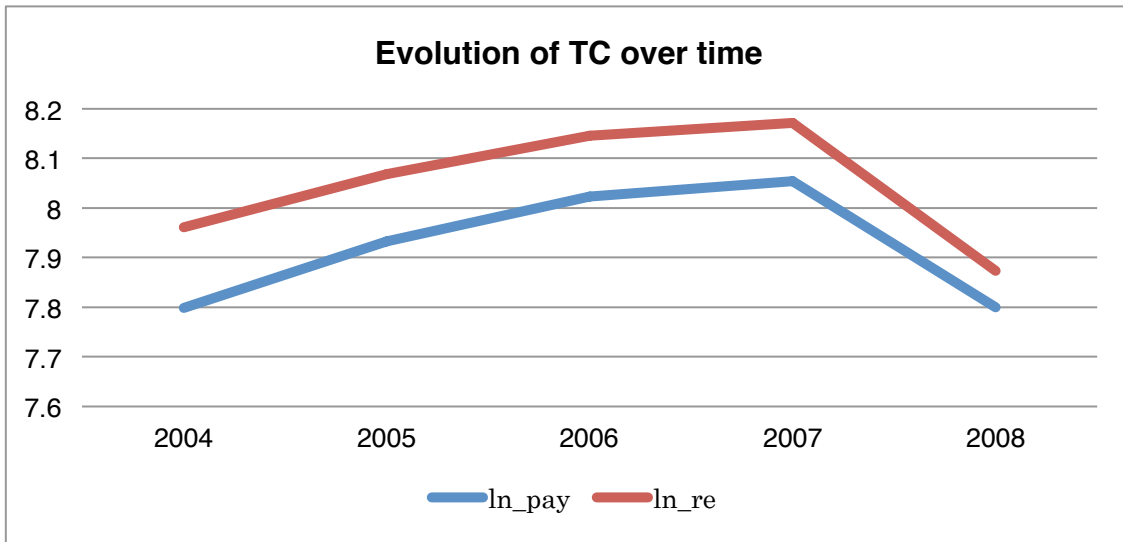
**Table1 Definition of variables**

<b>Variables</b>	<b>Description</b>
PAY_sales_ratio	dependent variable = account payable / sales
RE_sales_ratio	dependent variable = account receivable / sales
PAY_totassets_ratio	dependent variable = account payable / sales
RE_totassets_ratio	dependent variable = account payable / total assets
NET_CA	dependent variable = (account receivable - account payable) / total assets
NET_CS	dependent variable = (account receivable - account payable) / sales
Long_liability_sales_ratio	= long_term_liability / sales
Long_liability_totassets_ratio	= long_term_liability / total assets
Ln_ta	= log (total assets)
Ln_sa	= log (sales)
Ln_stock	= log (stock)
Ln_N_W	= log (number of workers)
Operating_sales_ratio	= operating profit / sales
Longlib_totlib_ratio	= long_term_liability / total liability
L_sales_S	Dummy variable = Long_liability_sales_ratio * small firm size
L_sales_M	Dummy variable = Long_liability_sales_ratio * medium firm size
L_sales_L	Dummy variable = Long_liability_sales_ratio * large firm size
L_sales_F1	Dummy variable = Long_liability_sales_ratio * firm ownership of F1
L_sales_F2	Dummy variable = Long_liability_sales_ratio * firm ownership of F2
L_sales_F3	Dummy variable = Long_liability_sales_ratio * firm ownership of F3
L_sales_F4	Dummy variable = Long_liability_sales_ratio * firm ownership of F4
L_sales_F5	Dummy variable = Long_liability_sales_ratio * firm ownership of F5
L_totasset_S	Dummy variable =Long_liability_totassets_ratio * small firm size
L_totasset_M	Dummy variable =Long_liability_totassets_ratio * medium firm size
L_totasset_L	Dummy variable =Long_liability_totassets_ratio * large firm size
L_totasset_F1	Dummy variable = Long_liability_totassets_ratio* firm ownership of F1
L_totasset_F2	Dummy variable = Long_liability_totassets_ratio* firm ownership of F2
L_totasset_F3	Dummy variable = Long_liability_totassets_ratio* firm ownership of F3
L_totasset_F4	Dummy variable = Long_liability_totassets_ratio* firm ownership of F4
L_totasset_F5	Dummy variable = Long_liability_totassets_ratio* firm ownership of F5
D_2004	Dummy variable for the year 2004
D_2005	Dummy variable for the year 2005
D_2006	Dummy variable for the year 2006
D_2007	Dummy variable for the year 2007
D_2008	Dummy variable for the year 2008

**Table 2 Summary statistics of key variables**

Type	Obs	Variable:	PAY sales	RE sales	ratio PAY totassets	ratio RE totassets	rat NET CA	NET CS	Lib sales ra	Lib totassets r	operating sale	Longlib tot	ln sa	ln ta	ln stock	ln N W		
All	325579	Mean	0.301	0.345	0.144	0.160	0.017	0.043	0.633	0.160	0.039	0.265	10.578	10.478	8.154	5.062		
		Std. Dev.	12.927	22.051	0.154	0.161	0.182	21.500	40.650	0.217	13.983	0.238	1.533	1.661	1.977	1.237		
Firm_size	Small	118545	Mean	0.590	0.693	0.153	0.178	0.025	0.103	1.347	0.179	-0.187	0.286	9.106	9.315	6.992	4.269	
		Std. Dev.	21.418	36.540	0.162	0.170	0.199	35.630	67.352	0.222	23.173	0.246	0.655	0.998	1.498	0.813		
	Medium	182377	Mean	0.138	0.149	0.140	0.155	0.015	0.011	0.224	0.150	0.044	0.258	11.083	10.782	8.465	5.286	
		Std. Dev.	0.262	0.249	0.152	0.159	0.175	0.264	0.831	0.220	0.140	0.233	0.784	1.256	1.656	1.006		
	Large	24657	Mean	0.123	0.113	0.124	0.113	-0.012	-0.010	0.230	0.138	0.063	0.222	13.924	13.816	11.444	7.211	
		Std. Dev.	0.147	0.133	0.128	0.116	0.130	0.151	0.612	0.161	0.116	0.220	0.958	1.286	1.582	1.229		
Ownership State	30713	Mean	1.471	1.680	0.111	0.101	-0.011	0.209	4.009	0.223	-0.686	0.287	10.581	11.457	8.523	5.815		
		Std. Dev.	41.716	66.569	0.138	0.111	0.147	64.985	131.746	0.316	45.171	0.256	2.251	1.974	2.467	1.536		
	Collectively	16384	Mean	0.223	0.234	0.162	0.197	0.035	0.011	0.291	0.169	0.036	0.260	10.133	9.821	7.441	4.864	
		Std. Dev.	2.557	2.407	0.181	0.181	0.220	0.681	2.907	0.214	0.193	0.240	1.249	1.266	1.723	1.048		
	Private	224435	Mean	0.161	0.198	0.141	0.164	0.023	0.037	0.260	0.154	0.037	0.265	10.477	10.223	7.940	4.900	
		Std. Dev.	1.295	9.866	0.150	0.167	0.183	9.560	3.804	0.204	1.071	0.235	1.392	1.554	1.885	1.159		
	Joint	1346	Mean	0.382	0.498	0.148	0.162	0.014	0.116	0.664	0.188	-0.468	0.275	10.461	10.531	8.094	5.064	
		Std. Dev.	2.543	5.312	0.151	0.156	0.177	3.395	7.038	0.213	12.783	0.249	1.466	1.556	1.804	1.105		
	Foreign	52701	Mean	0.239	0.221	0.167	0.167	0.000	-0.018	0.361	0.147	0.006	0.257	11.150	11.196	9.076	5.373	
		Std. Dev.	2.839	1.845	0.166	0.145	0.178	2.252	4.523	0.193	3.091	0.237	1.530	1.563	1.786	1.196		
	Year	2004	61588	Mean	0.434	0.608	0.147	0.168	0.021	0.174	1.166	0.174	-0.081	0.261	10.227	10.334	8.067	5.108
			Std. Dev.	10.990	36.384	0.164	0.158	0.190	31.902	59.932	0.213	3.842	0.236	1.528	1.637	1.926	1.245	
2005		57069	Mean	0.299	0.364	0.143	0.161	0.018	0.066	0.530	0.168	-0.014	0.266	10.479	10.494	8.177	5.167	
		Std. Dev.	5.649	20.130	0.150	0.153	0.178	19.805	9.498	0.194	1.405	0.237	1.542	1.653	1.972	1.245		
2006		57485	Mean	0.383	0.306	0.142	0.159	0.017	-0.077	0.923	0.166	-0.154	0.268	10.634	10.596	8.270	5.150	
		Std. Dev.	23.922	10.432	0.156	0.188	0.187	20.143	72.125	0.319	32.422	0.238	1.560	1.677	1.990	1.250		
2007		62492	Mean	0.269	0.338	0.141	0.159	0.019	0.069	0.411	0.157	0.004	0.268	10.803	10.638	8.299	5.091	
		Std. Dev.	13.563	27.324	0.145	0.155	0.174	25.831	12.659	0.180	4.088	0.237	1.519	1.685	2.006	1.248		
2008		86945	Mean	0.179	0.175	0.145	0.155	0.011	-0.004	0.292	0.143	0.021	0.265	10.694	10.375	8.021	4.880	
		Std. Dev.	2.945	2.924	0.154	0.155	0.179	2.189	5.405	0.169	3.665	0.240	1.475	1.639	1.976	1.188		

**Figure 1**



**Figure 2**

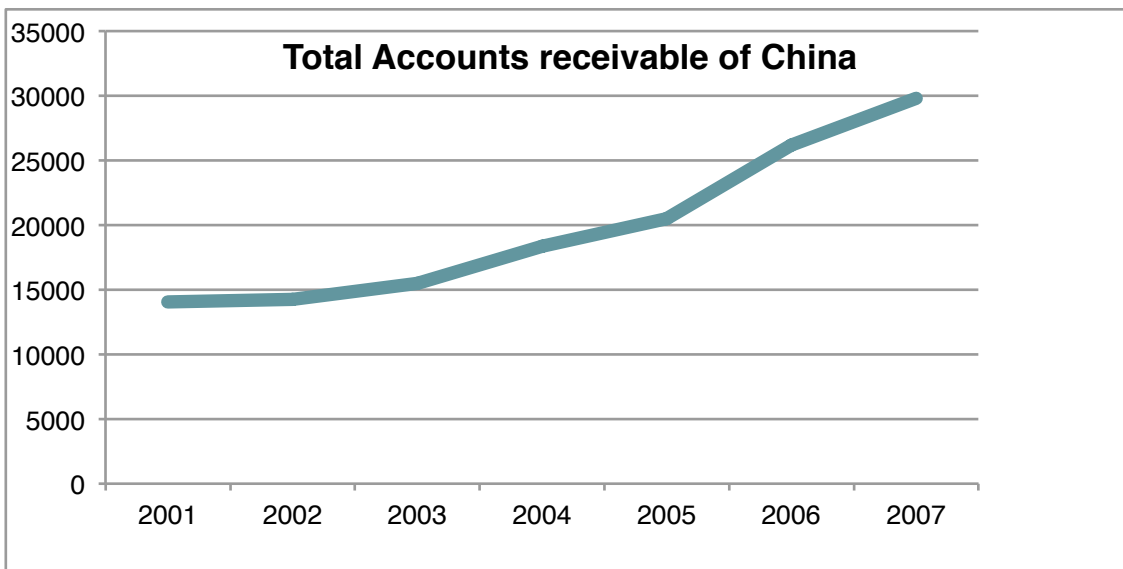


Figure 1 displays the variation in trade credit from 2004 to 2008, as represented by  $\ln\_pay = \ln(\text{accounts payable})$ , and  $\ln\_re = \ln(\text{accounts receivable})$ .

From 2004 to 2007, trade credit experienced significant growth, but fell sharply between 2007 and 2008. It is speculated that this is due to the financial crisis of 2008. This phenomenon in China is different from the research of Love, Preve, and Sarria-Allende (2007), who found that firms decreased trade credit both before and after financial crises. Figure 2 describes total accounts receivable for China as a

whole, based on data from the National Bureau of Statistics. it is consistent with the dataset of this study.

### 3 Model and analyses

#### 3.1 Fixed effects of regression

In this section, the substitution and complementation hypothesis between trade credit and bank loans is tested. The hypotheses are summarized as follows:

Hypothesis 1: Trade credit may provide better access to capital for firms than intermediate financing sources. In this case, it is said that trade credit and bank loans have a substitute relationship, in particular for firms with weak banking relationships.

Hypothesis 2: If firms can obtain loans from banks as well as trade credit, it is said that they have a complementary relationship with each other.

The two hypotheses will be tested for Chinese industry enterprises. The production function is given by:

$$\begin{aligned}
 T.C_{it} = & \alpha_{0i} + \alpha_1 \ln\_long\_liability_{it} + \alpha_2 Operating\_sales\_ratio_{it} + \alpha_3 \ln\_sales_{it} + \alpha_4 \ln\_total\_assets_{it} \\
 & + \alpha_5 \ln\_stock_{it} + \alpha_6 \ln\_N\_W_{it} + \alpha_7 \ln\_long\_liability * firm\_size_{it} \\
 & + \alpha_8 \ln\_long\_liability * firm\_ownership_{it} + \alpha_9 Year_t + \varepsilon_{it}
 \end{aligned}$$

$$(i = 1, 2, \dots, N; t = t_1, t_2, \dots, t_5) \quad (3-1)$$

Where  $T.C_{it}$  is the amount of trade credit for firm  $i$  in year  $t$ . There are four dependent variables to express  $T.C_{it}$ , namely accounts payable/sales, accounts payable/total assets, accounts receivable/sales, and accounts receivable/total assets. Where the payable group offers trade credit and the receivable group supplies trade credit,  $\alpha_{0i}$  is a firm-specific intercept. The ratio of operating profit over sales, the log value of sales, total assets, stock, and worker numbers are control variables to explain the firms' characteristics. Firm size and firm ownership are dummy variables to report the size and ownership of Chinese industrial firms. Cross terms are created to cross the



ownership dummy and the firm size dummy with the long-term liability variables, in order to find the features of Chinese industrial enterprises. Finally, the year dummy is used to control the fixed effects of other variables, as well as the year effects.

Using function (3-1), the regression is run using the unbalanced dataset group and the balanced dataset group. The regression is divided into these two groups in order to check whether the signs of the variables are consistent. The results are summarized in Tables 3 and 4.

Firstly, the demanders of trade credit are examined. Tables 3 and 4 report on the fixed effects analysis. Using the same dataset, the results from both the unbalanced and balanced groups are reported. In Table 3, Column 1 and Column 3 report the fixed effects tests on the accounts payable to sales ratio, showing that SMEs are more likely to use trade credit, and that the coefficient is negative and significant at the 1% level. This may suggest that SMEs may substitute financing sources from institutions with trade credit. On the other hand, large firms may use trade credit as a complement to bank loans, as the coefficient for large firms is positive and significant. Secondly, the suppliers of trade credit are examined. In Table 3, Column 2 and Column 4 show the results of the receivable group, which represents the suppliers of trade credit. The coefficients of the variables  $L\_totasset\_S$  and  $L\_totassets\_M$  are negative and significant at the 1% level. The signs of the coefficients for both the demanders and suppliers of trade credit confirm the theory that there may be a substitute relationship between trade credit and bank loans (Hypothesis 1).

The same results were not found for state owned enterprises or non-state owned firms. Although the results are significant, the coefficients have the opposite signs. Thus, it cannot be concluded that trade credit and bank loans have a complementary relationship based on the ownership structure of enterprises. Similar results are found with the balanced dataset group, and the results reported in Table 4. These findings suggest that SMEs use trade credit more often than bank loans. They also suggest that trade credit and bank loans have a simultaneity problem, so a Granger causality test is conducted to determine whether this is the case.

**Table 3 Fixed effect with unbalance database**

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	PAY_sales_ratio	RE_sales_ratio	PAY_totassets_ratio	RE_totassets_ratio	NET_CA	NET_CS
UNBALANCE						
Lib_sales_ratio	0.124 (0.090)	0.004 (0.340)				-0.12 (0.340)
operating_sales_ratio	-0.189*** (0.010)	-1.022*** (0.020)				-0.833*** (0.020)
ln_ta	-0.036 (0.030)	-0.068 (0.120)				-0.032 (0.120)
L_Sales_S	0.055 (0.090)	0.039 (0.330)				-0.016 (0.330)
L_Sales_M	0.006 (0.090)	0.036 (0.320)				0.030 (0.320)
L_sales_F1	0.418*** (0.020)	0.583*** (0.070)				0.165* (0.070)
L_sales_F3	-0.100*** (0.020)	-0.052 (0.070)				0.048 (0.070)
L_sales_F4	0.117 (0.070)	-0.284 (0.250)				-0.401 (0.250)
L_sales_F5	-0.063** (0.020)	0.13 (0.070)				0.193** (0.070)
Lib_totalassets_ratio			0.197*** (0.010)	0.271*** (0.010)	0.074*** (0.010)	
ln_sa			-0.001* (0.000)	0.008*** (0.000)	0.009*** (0.000)	
L_totasset_S			-0.073*** (0.010)	-0.093*** (0.010)	-0.020* (0.010)	
L_totasset_M			-0.025*** (0.010)	0.013* (0.010)	0.038*** (0.010)	
L_totasset_F1			-0.071*** (0.010)	-0.132*** (0.010)	-0.061*** (0.010)	
L_totasset_F3			0.036*** (0.010)	0.104*** (0.000)	0.068*** (0.010)	
L_totasset_F4			0.03 (0.020)	-0.036* (0.020)	-0.066** (0.020)	
L_totasset_F5			-0.026*** (0.010)	-0.085*** (0.010)	-0.059*** (0.010)	
Longlib_totlib_ratio	-0.363*** (0.070)	-0.224 (0.270)	-0.220*** (0.000)	-0.202*** (0.000)	0.018*** (0.000)	0.139 (0.270)
ln_stock	0.01 (0.010)	0.136* (0.050)	0.004*** (0.000)	-0.010*** (0.000)	-0.015*** (0.000)	0.126* (0.050)
ln_N_W	-0.067* (0.030)	-0.113 (0.110)	-0.003*** (0.000)	0.002* (0.000)	0.004*** (0.000)	-0.046 (0.110)
D_2004	-0.047 (0.030)	-0.053 (0.120)	0.004*** (0.000)	0.009*** (0.000)	0.005*** (0.000)	-0.006 (0.120)
D_2005	0.017 (0.030)	0.074 (0.110)	0.004*** (0.000)	0.006*** (0.000)	0.002** (0.000)	0.057 (0.110)
D_2006	-0.032 (0.030)	-0.074 (0.110)	0.004*** (0.000)	0.006*** (0.000)	0.002* (0.000)	-0.041 (0.110)
D_2007	0.003 (0.030)	0.06 (0.100)	0.001* (0.000)	0.005*** (0.000)	0.004*** (0.000)	0.056 (0.100)
constant	0.796* (0.340)	0.292 (1.230)	0.166*** (0.010)	0.155*** (0.010)	-0.011 (0.010)	-0.504 (1.230)
R-sqr	0.466	0.123	0.105	0.243	0.056	0.021
Number of grp_firm	163045	163045	163045	163045	163045	163045
Observations	325578	325578	325578	325578	325578	325578

Standard errors in parentheses, \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

**Table 4 Fixed effect with balance database**

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	PAY_sales_ratio	RE_sales_ratio	PAY_totassets_ratio	RE_totassets_ratio	NET_CA	NET_CS
BALANCE						
Lib_sales_ratio	-0.324*** (0.070)	-0.096 (0.070)				0.229*** (0.050)
operating_sales_ratio	-0.252*** (0.010)	-0.507*** (0.010)				-0.255*** (0.000)
In_ta	-0.024 (0.030)	0.022 (0.020)				0.045* (0.020)
Longlib_totlib_ratio	-0.367*** (0.060)	-0.229*** (0.050)	-0.226*** (0.000)	-0.235*** (0.000)	-0.009** (0.000)	0.138** (0.040)
In_stock	0.024* (0.010)	0.004 (0.010)	0.004*** (0.000)	-0.012*** (0.000)	-0.016*** (0.000)	-0.020* (0.010)
In_N_W	-0.031 (0.030)	0.002 (0.020)	-0.002 (0.000)	0.002* (0.000)	0.003** (0.000)	0.033 (0.020)
L_sales_S	0.361*** (0.070)	0.116 (0.060)				-0.245*** (0.050)
L_sales_M	0.159* (0.070)	-0.001 (0.060)				-0.160** (0.050)
L_sales_F1	1.395*** (0.030)	0.449*** (0.020)				-0.946*** (0.020)
L_sales_F3	-0.04 (0.030)	0.058** (0.020)				0.098*** (0.020)
L_sales_F4	-0.3 (0.180)	-1.396*** (0.160)				-1.096*** (0.130)
L_sales_F5	0.047 (0.030)	0.368*** (0.020)				0.321*** (0.020)
Lib_totalassets_ratio			0.211*** (0.010)	0.329*** (0.010)	0.119*** (0.010)	
In_sa			0.0008 (0.000)	0.010*** (0.000)	0.010*** (0.000)	
L_totasset_S			-0.049*** (0.010)	-0.078*** (0.010)	-0.029** (0.010)	
L_totasset_M			-0.022** (0.010)	0.016* (0.010)	0.038*** (0.010)	
L_totasset_f1			-0.013 (0.010)	-0.095*** (0.010)	-0.082*** (0.010)	
L_totasset_f3			0.024*** (0.010)	0.081*** (0.010)	0.057*** (0.010)	
L_totasset_f4			-0.006 (0.030)	-0.039 (0.020)	-0.033 (0.030)	
L_totasset_f5			-0.037*** (0.010)	-0.109*** (0.010)	-0.072*** (0.010)	
D_2004	-0.02 (0.020)	-0.001 (0.020)	0.004*** (0.000)	0.009*** (0.000)	0.005*** (0.000)	0.019 (0.020)
D_2005	-0.01 (0.020)	-0.006 (0.020)	0.004*** (0.000)	0.007*** (0.000)	0.004*** (0.000)	0.004 (0.020)
D_2006	-0.017 (0.020)	-0.002 (0.020)	0.004*** (0.000)	0.007*** (0.000)	0.003** (0.000)	0.015 (0.020)
D_2007	-0.025 (0.020)	-0.012 (0.020)	0.001* (0.000)	0.006*** (0.000)	0.005*** (0.000)	0.012 (0.020)
constant	0.422 (0.270)	-0.052 (0.240)	0.144*** (0.010)	0.153*** (0.010)	0.009 (0.010)	-0.474* (0.200)
R-sqr	0.294	0.270	0.138	0.352	0.089	0.307
Number of grp_firm	163276	163276	163276	163276	163276	163276
Observations	58326	58326	58326	58326	58326	58326

Standard errors in parentheses, \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

### 3.2 Granger causality test and GMM analysis

The variables were not lagged initially, because although the database is very large, it only covers a 5-year span. Now the Granger causality test is used to determine whether trade credit and bank loans have a simultaneity problem. Firstly, the following regression is run to test the correlation between bank loans and trade credit.

$$\begin{aligned}
 T.C_{it} = & \alpha_{0i} + \alpha_1 \ln\_long\_liability_{i,t-1} + \alpha_2 Operating\_sales\_ratio_{i,t-1} + \alpha_3 \ln\_sales_{i,t-1} \\
 & + \alpha_4 \ln\_total\_assetes_{i,t-1} + \alpha_5 \ln\_stock_{i,t-1} + \alpha_6 \ln\_N\_W_{i,t-1} + \alpha_7 \ln\_long\_liability * firm\_size_{i,t-1} \\
 & + \alpha_8 \ln\_long\_liability * firm\_ownership_{i,t-1} + \varepsilon_{i,t-1}
 \end{aligned} \tag{3-2}$$

Then, the following regression (3-3) is run to test the correlation between trade credit and bank loans.

$$\begin{aligned}
 \ln\_long\_liability_{it} = & \alpha_{0i} + \alpha_1 T.C_{i,t-1} + \alpha_2 Operating\_sales\_ratio_{i,t-1} + \alpha_3 \ln\_sales_{i,t-1} \\
 & + \alpha_4 \ln\_total\_assetes_{i,t-1} + \alpha_5 \ln\_stock_{i,t-1} + \alpha_6 \ln\_N\_W_{i,t-1} \\
 & + \alpha_7 \ln\_long\_liability * firm\_size_{i,t-1} + \alpha_8 \ln\_long\_liability * firm\_ownership_{i,t-1} \\
 & + \varepsilon_{i,t-1}
 \end{aligned} \tag{3-3}$$

The results of the Granger causality test are reported in Table 5. It is observed that the correlation between bank loans and trade credit is almost negative and significant, but the correlation between trade credit and bank loans is also negative and significant. This may indicate a simultaneity problem. Thus, to avoid this issue, trade credit is lagged by one year. Using GMM in the following regression, the results are shown in Table 6.

$$\begin{aligned}
 T.C_{it} = & \alpha_{0i} + \alpha_1 T.C_{i,t-1} + \alpha_2 \ln\_long\_liability_{it} + \alpha_3 Operating\_sales\_ratio_{i,t-1} + \alpha_4 \ln\_sales_{it} \\
 & + \alpha_5 \ln\_total\_assetes_{it} + \alpha_6 \ln\_stock_{it} + \alpha_7 \ln\_N\_W_{it} + \alpha_8 \ln\_long\_liability * firm\_size_{it} \\
 & + \alpha_9 \ln\_long\_liability * firm\_ownership_{it} + \alpha_{10} Year + \varepsilon_{it}
 \end{aligned} \tag{3-4}$$

**Table 5 Results of the Granger causality test**

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	PAY_sales_ratio	RE_sales_ratio	PAY_totassets_ratio	RE_totassets_ratio	Lib_sales_ratio	Lib_sales_ratio	Lib_totassets_ratio	Lib_totassets_ratio
	Bank loans to trade credit				Trade credit to bank loans			
L.Lib_sales_ratio	-0.095 (0.110)	-0.07 (0.080)						
L.PAY_sales_ratio					0.072*** (0.010)			
L.RE_sales_ratio						0.150*** (0.010)		
L.PAY_totassets_ratio							-0.003 (0.000)	
L.RE_totassets_ratio								-0.008 (0.000)
L.Longlib_totlib_ratio	-0.060 (0.110)	-0.050 (0.070)	-0.006 (0.000)	-0.008* (0.000)	1.318*** (0.020)	1.308*** (0.020)		
L.operating_sales_ratio	0.102*** (0.020)	-0.230*** (0.010)			-0.053 (0.120)	-0.044 (0.120)	0.015*** (0.000)	0.015*** (0.000)
L.ln_ta	0.03 (0.050)	0.041 (0.030)			0.054 (0.050)	0.047 (0.050)		
L.ln_stock	0.011 (0.020)	0.006 (0.010)	-0.002*** (0.000)	-0.001** (0.000)	-0.032 (0.020)	-0.029 (0.020)	0.001 (0.000)	0.001 (0.000)
L.ln_N_W	-0.084 (0.050)	-0.065* (0.030)	-0.003* (0.000)	0 (0.000)	-0.132* (0.050)	-0.131* (0.050)	-0.015 (0.000)	-0.019 (0.000)
L.L_Sales_S	0.039 (0.110)	0.01 (0.070)			0.049 (0.040)	0.048 (0.040)		
L.L_Sales_M	0.038 (0.100)	0.036 (0.070)			0.047 (0.050)	0.052 (0.050)		
L.L_sales_F1	0.048 (0.040)	0.011 (0.030)			-0.150*** (0.040)	-0.148*** (0.040)		
L.L_sales_F3	0.056 (0.040)	0.027 (0.030)			0.112* (0.040)	0.107* (0.040)		
L.L_sales_F4	2.725*** (0.280)	3.466*** (0.190)			8.574*** (0.320)	8.311*** (0.320)		
L.L_sales_F5	0.055 (0.040)	0.062* (0.030)			-0.066 (0.040)	-0.084* (0.040)		
L.Lib_totassets_ratio			-0.002 (0.010)	0.006 (0.010)				
L.ln_sa							-0.019*** (0.000)	-0.019*** (0.000)
L.L_totasset_S			0.002 (0.010)	-0.001 (0.010)			-0.015* (0.010)	-0.015* (0.010)
L.L_totasset_M			0.016 (0.010)	0.007 (0.010)			0.003 (0.010)	0.003 (0.010)
L.L_totasset_F1			0.002 (0.010)	-0.004 (0.010)			0.097*** (0.010)	0.097*** (0.010)
L.L_totasset_F3			-0.002 (0.010)	-0.004 (0.010)			0.020** (0.010)	0.020* (0.010)
L.L_totasset_F4			-0.019 (0.030)	-0.005 (0.020)			0.011 (0.030)	0.011 (0.030)
L.L_totasset_F5			-0.002 (0.010)	-0.004 (0.010)			0.007 (0.010)	0.006 (0.010)
constant	0.284 (0.470)	0.118 (0.320)	0.169*** (0.010)	0.177*** (0.010)	0.78 (0.550)	0.804 (0.550)	0.352*** (0.010)	0.353*** (0.010)
R-sqr	0.002	0.016	0.001	0.001	0.145	0.145	0.012	0.012
obs	146790	146790	146790	146790	146790	146790	146790	146790
groups	68368	68368	68368	68368	68368	68368	68368	68368

Standard errors in parentheses, \* p<0.05, \*\* p<0.01,\*\*\* p<0.001

**Table 6 Results of the GMM estimation**

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	PAY_sales_ratio	RE_sales_ratio	PAY_totassets_ratio	RE_totassets_ratio	PAY_sales_ratio	RE_sales_ratio	PAY_totassets_ratio	RE_totassets_ratio
	Unbalance				Balance			
L.PAY_sales_ratio	-0.009*				-0.004			
	(0.000)				(0.000)			
L.RE_sales_ratio		0.072***				0.035***		
		(0.000)				(0.000)		
L.PAY_totassets_ratio			0.310***				0.328***	
			(0.010)				(0.010)	
L.RE_totassets_ratio				0.370***				0.396***
				(0.010)				(0.010)
Lib_totalassets_ratio			0.199***	0.064***			0.192***	0.069***
			(0.010)	(0.010)			(0.020)	(0.020)
ln_sa			0.001	0.016***			0.002	0.017***
			(0.000)	(0.000)			(0.000)	(0.000)
Lib_sales_ratio	0.051	0.018			-0.354**	-0.114*		
	(0.110)	(0.050)			(0.130)	(0.050)		
ln_ta	0.067	0.102***			-0.117**	0.025		
	(0.050)	(0.020)			(0.040)	(0.020)		
L_Sales_S	0.06	0.04			0.767***	0.308***		
	(0.100)	(0.050)			(0.080)	(0.030)		
L_Sales_M	0.081	0.011			0.754***	0.300***		
	(0.100)	(0.050)			(0.080)	(0.030)		
L_sales_F1	-0.107***	-0.078***			1.756***	0.424***		
	(0.020)	(0.010)			(0.100)	(0.040)		
L_sales_F3	0.387***	0.044***			0.302**	0.176**		
	(0.020)	(0.010)			(0.100)	(0.040)		
L_sales_F4	-0.037	-0.456***			-0.234	-1.097***		
	(0.220)	(0.110)			(0.250)	(0.090)		
L_sales_F5	-0.027	0.052***			-0.339**	-0.191***		
	(0.020)	(0.010)			(0.100)	(0.040)		
L_totasset_S			-0.041***	-0.001			-0.048***	-0.011
			(0.010)	(0.010)			(0.010)	(0.010)
L_totasset_M			-0.016	0.005			-0.026*	-0.001
			(0.010)	(0.010)			(0.010)	(0.010)
L_totasset_F1			-0.037**	-0.033**			-0.015	-0.026
			(0.010)	(0.010)			(0.010)	(0.010)
L_totasset_F3			0.015	-0.01			0.013	0.001
			(0.010)	(0.010)			(0.010)	(0.010)
L_totasset_F4			-0.075*	-0.061*			-0.072	-0.058
			(0.030)	(0.030)			(0.040)	(0.040)
L_totasset_F5			-0.041**	-0.036**			-0.041**	-0.037**
			(0.010)	(0.010)			(0.010)	(0.010)
Longlib_totlib_ratio	-0.426***	-0.082	-0.218***	-0.063***	-1.055***	-0.382***	-0.205***	-0.064***
	(0.100)	(0.050)	(0.000)	(0.000)	(0.090)	(0.030)	(0.010)	(0.000)
operating_sales_ratio	-0.473***	-0.261***	0.005	0.006	-0.448***	-0.512***	-0.001	-0.001
	(0.010)	(0.000)	(0.000)	(0.000)	(0.010)	(0.000)	(0.000)	(0.000)
ln_stock	0.019	-0.005	0.007***	-0.010***	0.046**	0.004	0.007***	-0.011***
	(0.020)	(0.010)	(0.000)	(0.000)	(0.020)	(0.010)	(0.000)	(0.000)
ln_N_W	-0.128**	-0.155***	-0.001	-0.001	0.023	-0.006	-0.001	-0.001
	(0.040)	(0.020)	(0.000)	(0.000)	(0.040)	(0.010)	0.000	0.000
D_2005	-0.035	0.013	0.006***	0.011***	0.016	0.020*	0.008***	0.011***
	(0.020)	(0.020)	(0.000)	(0.000)	(0.030)	(0.010)	(0.000)	(0.000)
D_2006	-0.03	0.017	0.004***	0.008***	-0.018	0.01	0.005***	0.009***
	(0.030)	(0.010)	(0.000)	(0.000)	(0.020)	(0.010)	(0.000)	(0.000)
D_2007	-0.038	0.002	0.001	0.006***	-0.015	0.002	0.002*	0.006***
	(0.030)	(0.010)	(0.000)	(0.000)	(0.020)	(0.010)	(0.000)	(0.000)
constant	0.072	-0.013	0.060***	0.017	0.898*	-0.091	0.039**	0.007
	(0.480)	(0.240)	(0.010)	(0.010)	(0.450)	(0.160)	(0.010)	(0.010)
Number of grp_firm	77326	77326	77326	77326	56727	56727	56727	56727
Observations	40,172	40,172	40,172	40,172	25,696	25,696	25,696	25,696

Standard errors in parentheses, \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

The data is presented in the same way, with the unbalanced and balanced groups. The results in Table 6 show that the coefficients of bank loans are almost negative and significant. Furthermore, in this model, the coefficients of `pay_sales_ratio` are also negative and significant. And the small-sized enterprises with long-term liability suggests a very strong negative effect on trade credit. In another words, this confirms the theory that trade credit and bank loans have a substitute relationship with each other (Hypothesis 1). Note that the simultaneity problem has been avoided by lagging trade credit, but the results regarding firms' ownership were still mixed. A more in-depth knowledge about formal and informal financial sources may be required as a key to understanding the determinants of how and why firms extend trade credit.

## **4 conclusions**

Using the panel dataset of Chinese industrial firms, this study finds that SMEs prefer to use trade credit over bank loans. Unlike large firms, SMEs use trade credit as a substitute for bank loans. The analysis also finds that ownership does not determine whether there is a substitution or a complementation relationship between trade credit and bank loans.

A clear distinction is made to examine trade credit by supplier and demander. However, no major differences were found between these groups. Thus, trade credit is still a very important financial source for enterprises in China. Compared to bank loans, trade credit between business partners may be more expected for SMEs.

By testing the substitution and complementation hypotheses between trade credit and bank loans with this data, it was also noted that the substitution and complementation hypotheses may be different when firms' attributes change. In the future, the determinants of trade credit should continue to be studied.

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## Chapter 3

### The productivity of Industrial Firms and Financial Efficiency in China

Liu Yajing<sup>1</sup>

#### Abstract

This paper examines the efficiency of financial sources by measuring productivity using firm-level panel data. First the effect of ownership and firm size on the productivity of Chinese industrial firms is studied. Then, the relationship between productivity and the financial source is analyzed. There are two financial sources for enterprises in our data, trade credit (TC) and bank loans. Long-term liabilities are used to represent bank loans, and accounts payable, accounts receivable and other relevant variables are used to represent trade credit. It is found that enterprises experienced productivity increases as a result of using more trade credit, but less bank loans. The ownership and size of firms in the industry were also measured, but there was no particularly powerful evidence that a firm's ownership will affect the enterprise's productivity based on the financial source.

#### 1 Introduction

Financial sources and financial efficiency play a vital role in the growth of enterprises. This study focuses on how different financial sources affect the growth of enterprises.

This research relates to two threads of literature. The first one is about how different financial sources affect the growth of enterprises. It has been well established that if capital markets are not fully developed, it is very difficult for many enterprises (particularly SMEs) to accumulate sufficient capital to build up factories, purchase machinery and equipment, hire workers, expand sales, and make a profit. Accordingly, if there is not a strong financing environment, it will constrain the development of enterprises. Fisman and Love (2003) provide evidence for this. They use data for 37 industries in each of 43 countries to estimate every industry's dependence on external finance, and

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<sup>1</sup> Present address: Graduate School of Economics, Kobe University, Hyogo, Japan.  
Email: Liu\_yajingdekiru@yahoo.co.jp

they find that industries are more dependent on trade credit financing in countries where financial markets are less developed. For this reason, this study has chosen to focus on the relationships between firms' productivity and trade credit, and firms' productivity and bank loans.

The second thread of literature is about financial efficiency and enterprise productivity. There is an increasing number of studies that discuss the productivity of firms and economic growth in China over the past 30 years. Because productivity is not directly observable, many studies either measure the total factor productivity (TFP) and assess the progress of research and development (R&D), or they focus on efficiency improvement, firms' financial performances, or multifactor productivity and so on. The papers describing this topic are considerable.

Many researchers are interested in observing productivity changes in Chinese industries. For example, Chen, Wang & Zhang (1988) investigate the productivity growth of Chinese state-owned enterprises (SOEs) between 1953~1985, building on past studies which showed that the Chinese industrial sector was "zero productive". They found long-term productivity growth was 1.3% during this period. However, Woo, Hai, Jin & Fan (1994) use data on SOEs and collectively owned enterprises (COEs), which include urban collectives, county collectives, and town and village enterprises (TVEs) to measure the TFP. They find zero TPF growth in SOEs over the 1984~1988 period, and positive TFP growth in COEs over the same period.

These studies were conducted before the reform of SOEs in the late 1980s and early 1990s. The biggest change was to allow Chinese enterprises to ease into market competition. As these reform policies took place, SOEs adapted to the new environment. Chow & Lin (2002) and Chow (2008) provide evidence that Chinese TPF growth was zero in the 1952~1978 period, but rose to 2.7% after 1979. Perkins & Rawski (2008) determined TFP growth in China to be 0.5% between 1952 and 1978, and 3.8% in the 1978~2005 period. Anming Z., Yimin Z., & Zhao (2002) found that SOEs' financial performance had a significant effect on their productivity, but had a lesser impact on their profitability compared to enterprises with other ownership structures in the 1996~1998 period.

There are also some studies that discuss financing sources and firms' performances by industry (such as Long & Zhang, 2011); some estimate productivity growth and industrial transformation by measuring structural change (Chen, Jefferson & Zhang, 2010), while others assess the growth of TFP by categorizing different industry sectors (Bosworth & Collins, 2008). Most of these studies use Cobb-Douglas regressions and trans log production functions to estimate productivity. In this paper, the Cobb-Douglas and trans log production function are also used to estimate productivity. In addition, a bridge analysis will be conducted in order to link productivity and financial sources to the firms' industry characteristics. To the knowledge of the author, this is the first paper that uses a sample of firms to test the role of different financial sources on performance and productivity in China.

The remainder of this paper is organized as follows. In section 2, the methodology that is used to measure labor productivity and capital stock is explained. The data is then presented and the basic information on the panel data is provided. Section 3 explains the construction of the basic model. This is followed by a discussion of the empirical evidence from testing productivity and financial sources against the industry characteristics of the firms. Section 4 presents conclusions and the implications of these results, along with some ideas for future research.

## **2 Preparing the HUAMEI data to measure labor productivity and capital stock**

### **2.1 Detailed outline and key concepts**

As we mentioned in the first section, because productivity is not directly observable, some variants will allow us to conduct our analysis. We use real value added (RVA) to show the labor productivity, RVA is derived from the nominal value added (NVA), calculated as follows:

$$RVA = NVA / PPI \tag{2.1}$$

According to the (2.1), we need to calculate NVA and PPI, where the PPI is

the “ex-factory price indices of industrial products”<sup>2</sup>. There were sourced from the China Statistical Yearbook 2005~2008<sup>3</sup>, and are reported by sector. We merged these data into our HUAMEI industry enterprise panel database (Table 1). Our next step was to calculate the NVA. Since the NVA is based on total factory incomes of enterprises (Peter N. Gal, 2013), we use the formula:

$$NVA = Total\_factory\_income - External\_input\_cost \quad (2.2)$$

The external input cost includes the cost of raw material, basic utilities, external processing fees, transportation fees, communication fees<sup>4</sup>, etc. Using equations (2.1) and (2.2), we derive the productivity we need.

Next, we need to calculate capital stock. We use real accounts of fixed assets (RFA) to representative capital stock. We obtain the “price indices of investment in fixed assets” (FPI)<sup>5</sup> from the China Statistical Yearbook 2005~2008, and merge these data into our enterprise panel database (Table 1). Thus, we can use nominal accounts of fixed assets (NFA) divided by the FPI, in order to calculate the RFA:

$$RFA = NFA / FPI \quad (2.3)$$

Using (2.1), (2.2), and (2.3), we get the key variables. The basic information will be reported at next section.

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<sup>2</sup> The China Statistical Yearbook defines ex-factory price indices of industrial products as follows: Data that reflect the trends and degree of change in general ex-factory prices of all industrial products during a given period, including sales of industrial products by an industrial enterprise to all units outside the enterprise, as well as sales of consumer goods to residents. It can be used to analyze the impact of ex-factory prices on gross output value and value added to the industrial sector.

<sup>3</sup> Because the China Statistical Yearbook reports the previous year’s data, the 2005~2008 Yearbook is used in order to obtain data for 2004~2007.

<sup>4</sup> Since the data on external input cost includes the cost of employees, the cost of external inputs is first subtracted, then combined with workers’ wages, in order to get the data required.

<sup>5</sup> China Statistical Yearbook defines the FPI as follows: Data that reflect the trends and degree of change in prices of investment goods and projects in fixed assets during a given period. The investment in fixed assets consists of three components, namely investment in construction and installation, investment in purchases of equipment and instruments, and investment in other items. Price indices of investment in fixed assets are calculated as the weighted arithmetic mean of the price indices of the three components of investment in fixed assets.

**Table 1** FPI & PPI (The China Statistical Yearbook 2005~2008)

(preceding year=100)

Year	2004	2005	2006	2007
<b>FPI (National)</b>	<b>105.6</b>	<b>101.6</b>	<b>101.5</b>	<b>103.9</b>
<b>PPI (National)</b>	<b>106.1</b>	<b>104.9</b>	<b>103.0</b>	<b>103.1</b>
<b>PPI by Sector</b>				
Mining and Cleaning of Coal	116.8	123.2	105.0	103.8
Extraction of Petroleum and Natural Gas	119.6	129.9	122.0	102.0
Mining and Processing of Ferrous Metal Ores	145.3	112.3	96.8	110.3
Mining and Processing of Non-Ferrous Metal Ores	117.6	119.6	123.4	112.6
Mining and Processing of Nonmetal Ores	105.8	109.4	102.5	103.1
Processing of Food from Agricultural Products	114.0	101.1	100.1	113.3
Processing of Foodstuff	102.9	101.5	101.1	102.6
Manufacture of Beverages	100.6	100.6	100.5	101.2
Manufacture of Tobacco	101.1	100.9	100.5	100.4
Manufacture of Textile	104.3	100.5	102.1	100.8
Manufacture of Textile Apparel, Footwear, and Hats	100.7	99.8	100.9	100.7
Manufacture of Leather, Fur, Feather and Related Products	100.9	102.5	101.2	102.4
Processing of Timber, Manufacture of Wood, Bamboo, Rattan, Palm and Straw	102.2	101.8	102.3	103.6
Manufacture of Furniture	101.8	102.7	100.3	101.5
Manufacture of Paper and Paper Products	101.3	101.4	100.7	101.0
Printing, Reproduction of Recording Media	98.1	99.6	99.8	100.5
Manufacture of Articles for Culture, Education and Sport Activities	102.2	102.0	101.4	101.5
Processing of Petroleum, Coking, Processing of Nuclear Fuel	112.2	118.4	118.0	105.0
Manufacture of Raw Chemical Materials and Chemical Products	110.2	108.5	100.4	103.8
Manufacture of Medicines	97.8	101.6	98.6	102.1
Manufacture of Chemical Fibers	108.1	104.7	101.2	103.3
Manufacture of Rubber	101.0	104.5	104.7	103.3
Manufacture of Plastics	106.5	105.5	101.0	102.0
Manufacture of Non Metallic Mineral Products	103.3	100.6	101.5	101.3
Smelting and Pressing of Ferrous Metals	118.9	104.7	96.0	107.9
Smelting and Pressing of Non Ferrous Metals	118.9	111.7	122.5	113.9
Manufacture of Metal Products	107.4	104.0	101.0	102.6
Manufacture of General Purpose Machinery	103.1	101.8	100.2	101.3
Manufacture of Special Purpose Machinery	101.8	101.8	101.2	101.5
Manufacture of Transport Equipment	98.2	98.9	99.5	100.1
Manufacture of Electrical Machinery and Equipment	103.7	103.2	107.4	103.7
Manufacture of Communication Equipment, Computers and Other Electronics	95.1	95.3	96.6	97.5
Manufacture of Measuring Instruments and Machinery for Cultural Activities	98.5	98.7	99.2	98.9
Manufacture of Artwork and Other Manufacturing	105.7	103.9	102.5	104.3
Recycling and Disposal of Waste	116.9	105.3	103.4	104.4
Production and Supply of Electric Power and Heat Power	102.4	104.2	102.8	102.2
Production and Supply of Gas	102.5	105.2	106.8	104.8
Production and Supply of Water	104.1	104.0	106.4	104.8

## 2.2 Data and summary statistics

The database used in this empirical analysis is drawn from the annual accounting reports provided by HUAMEI enterprise statistics of China. This survey provides data on industrial enterprises as unbalance panel data, including state-owned firms and non-state-owned firms from 2004 to 2007. This period precedes the financial crisis of 2008. All firms with sales lower than 1,000 yuan were dropped, so that firms cannot show negative values of sales. The total number of key variables is around 230,000, and missing values were cleaned.

Table 2 provides the definitions of the variables that are used in this paper. The dependent variable is labor productivity; the control variable is the capital-labor ratio, and the other independent variables are the financial sources, trade credit and bank loans. Accounts payable and accounts receivable are used to represent trade credit, and the trade credit value is divided into two groups, suppliers and demanders, such that the accounts payable variable represents the demanders of trade credit, (i.e. the firm's customers), while the accounts receivable variable represents the suppliers of trade credit to the firm's. Long-term liability is used to represent bank loans. Moreover, in order to avoid economies of scale, it is taken as a ratio over total sales, and all the financial sources variables are taken as a ratio over total assets.

In order to examine the effect of the firm's size and ownership structure on productivity and financial sources, dummy variable groups are created. First, the definitions for industry firm size used by the State Statistics Bureau of China (SSBC) 2011 are introduced. These definitions are as follows:

- Small:  $300 \leq \text{sales} < 2,000$  (10,000CNY units) and  $\text{employees} < 300$ ;
- Medium:  $2,000 \leq \text{sales} < 40,000$  and  $300 \leq \text{employees} \leq 1,000$ ;
- Large:  $\text{sales} > 40,000$  and  $\text{employees} > 1,000$ .

Second, the classification of industry firm ownership is introduced. Ownership definitions were first published by SSBC in 1996, and later improved in 2006.

The HUAMEI database uses the 2006 definitions. Accordingly, the enterprises database is divided into five ownership groups<sup>6</sup>:

F1: State Owned Enterprise

F2: Collectively Owned Enterprise

F3: Private Enterprise

F4: Joint Economy & Share Holding Enterprise

F5: Economy Funded by Foreign Entrepreneurs & Entrepreneurs from Hong Kong, Macao and Taiwan.

In section 3, firm size and the cross variables of ownership in the regression model will be explained. Table 3 presents the mean, standard deviation, and min max values of the key variables.

### 3 Model and analysis

#### 3.1 Regression for labor productivity

As mentioned in the previous section, the Cobb-Douglas and logarithmic transformation production function are used to estimate productivity, with the firm level production function given by

$$\ln(Y_{it} / L_{it}) = \beta_0 + \beta_1 \ln(K_{it} / L_{it}) + \beta_2 TC_{it} + \beta_3 Bankloan_{it} + \beta_4 Year\_dummy_i + \varepsilon_{it} \quad (3.1-1)$$

While function (3.1-1) represents the basic model to be used in this analysis, it will be modified in two ways in order to observe the efficiency of the different financial sources over productivity. First, in order to observe the single financial source, the production function given by

$$\ln(Y_{it} / L_{it}) = \beta_0 + \beta_1 \ln(K_{it} / L_{it}) + \beta_2 Bankloan_{it} + \beta_3 Year\_dummy_i + \varepsilon_{it} \quad (3.1-2)$$

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<sup>6</sup> There are 7 ownership groups in the 2006 definitions of SSBC: State-Owned Enterprise, Collectively Owned Enterprise, Private Enterprise, Joint Economy, Share Holding Economy, Economy Funded by Foreign Entrepreneurs & Entrepreneurs from Hong Kong, Macao and Taiwan, and Others. In order to facilitate the data analysis in this paper, the 7 groups were reduced to 5, merging Joint Economy and Share Holding Economy, and the Others group was dropped because the database has very few data points in this group.



Where the variable *Lib\_sales\_ratio* and *Lib\_totassets\_ratio* are used for bank loans. Trade credit is also observed using the payable group and receivable group variables.

$$\ln(Y_{it} / L_{it}) = \beta_0 + \beta_1 \ln(K_{it} / L_{it}) + \beta_2 TC_{it} + \beta_3 Year\_dummy_i + \varepsilon_{it} \quad (3.1-3)$$

Finally, the regression is run using both the trade credit and bank loans variables in the equation, using function (3.1-1) to check their relationship with productivity. The regression results are reported in Tables 4 and 5.

The results from the first regression are summarized in Table 4. Columns 1 and 2 show that the coefficient of bank loans is negative and significant, which may suggest that the larger the bank loans, the lower the productivity. Columns 3 to 6 show that the payable/sales variable is negative and significant, but Columns 5 and 6 are positive and significant, so trade credit could perhaps promote greater productivity. The results in the Table 5 show that, when both the trade credit and bank loans variables are included in the model, the coefficient of bank loans presents stable negative and significant results. Although one of the payable/sales ratios is negative and significant, the other trade credit variables all show a positive and significant relationship with the dependent variable, labor productivity.

Thus it may be speculated that enterprises with more trade credit are better suited for productivity growth. It is also possible that having higher liquidity may increase the burden for enterprises to repay their debts. Moreover, the signs of the coefficients of the variables confirm the theory that trade credit and bank loans have a substitute relationship with each other (Pertersen & Rajan. 1997). In order to assess the features of Chinese industrial enterprises, interaction terms are created for the firm-size dummy and ownership dummy, and added to the basic equation (function 3.1-1). The interaction terms are calculated as bank loans multiplied by firm size, and bank loans multiplied by firm ownership. The results are shown in Table 6. The production function is given by

$$\ln(Y_{it} / L_{it}) = \beta_0 + \beta_1 \ln(K_{it} / L_{it}) + \beta_2 Bankloan_{it} + \beta_3 TC_{it} + \beta_4 Firmsize * Bankloan_{it} + \beta_5 Ownership * Bankloan_{it} + \beta_6 Year\_dummy_i + \varepsilon_{it} \quad (3.1-4)$$

**Table2** Definition of variables

<b>Variables</b>	<b>Description</b>
Ln (Y/L)	Dependent variable = $\log (RVA / \text{number of workers})$
Ln (K/L)	= $\log (\text{capital stock} / \text{number of workers})$
PAY_sales_ratio	= Accounts of payable / sales
RE_sales_ratio	= Accounts of receivable / sales
PAY_totassets_ratio	= Accounts of payable / sales
RE_totassets_ratio	= Accounts of payable / total assets
Lib_sales_ratio	= Long term liability / sales
Lib_totassets_ratio	= Long term liability / total assets
Pay_S	Dummy variable = PAY_sales_ratio * small firm size
Pay_M	Dummy variable = PAY_sales_ratio * medium firm size
Pay_B	Dummy variable = PAY_sales_ratio * large firm size
RE_S	Dummy variable = RE_sales_ratio * small firm size
RE_M	Dummy variable = RE_sales_ratio * medium firm size
RE_B	Dummy variable = RE_sales_ratio * large firm size
PAY_F1	Dummy variable = PAY_sales_ratio * firm ownership of state
PAY_F2	Dummy variable = PAY_sales_ratio * firm ownership of collectivity
PAY_F3	Dummy variable = PAY_sales_ratio * firm ownership of private
PAY_F4	Dummy variable = PAY_sales_ratio * firm ownership of joint
PAY_F5	Dummy variable = PAY_sales_ratio * firm ownership of foreign
RE_F1	Dummy variable = RE_sales_ratio * firm ownership of state
RE_F2	Dummy variable = RE_sales_ratio * firm ownership of collectivity
RE_F3	Dummy variable = RE_sales_ratio * firm ownership of private
RE_F4	Dummy variable = RE_sales_ratio * firm ownership of joint
RE_F5	Dummy variable = RE_sales_ratio * firm ownership of foreign
L_Sales_S	Dummy variable = Lib_sales_ratio * small firm size
L_Sales_M	Dummy variable = Lib_sales_ratio * medium firm size
L_Sales_B	Dummy variable = Lib_sales_ratio * large firm size
L_sales_F1	Dummy variable = Lib_sales_ratio * firm ownership of state
L_sales_F2	Dummy variable = Lib_sales_ratio * firm ownership of collectivity
L_sales_F3	Dummy variable = Lib_sales_ratio * firm ownership of private
L_sales_F4	Dummy variable = Lib_sales_ratio * firm ownership of joint
L_sales_F5	Dummy variable = Lib_sales_ratio * firm ownership of foreign
L_asset_S	Dummy variable = Lib_totassets_ratio * small firm size
L_aset_M	Dummy variable = Lib_totassets_ratio * medium firm size
L_asset_B	Dummy variable = Lib_totassets_ratio * large firm size
L_asset_F1	Dummy variable = Lib_totassets_ratio * firm ownership of state
L_asset_F2	Dummy variable = Lib_totassets_ratio * firm ownership of collectivity
L_asset_F3	Dummy variable = Lib_totassets_ratio * firm ownership of private
L_asset_F4	Dummy variable = Lib_totassets_ratio * firm ownership of joint
L_asset_F5	Dummy variable = Lib_totassets_ratio * firm ownership of foreign
D_2004	Dummy variable of the year 2004
D_2005	Dummy variable of the year 2005
D_2006	Dummy variable of the year 2006
D_2007	Dummy variable of the year 2007

**Table 3** Summary statistics of firm-level variables in regression

<b>Variables</b>	<b>Obs</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>
In(Y/L)	238357	2.742	0.646	0.646	10.535
In(K/L)	238115	0.376	1.310	0.000	9.740
PAY_sales_ratio	238634	0.346	14.995	0.000	5098.200
RE_sales_ratio	238634	0.406	25.696	0.000	7073.786
PAY_totassets_ratio	238634	0.143	0.154	0.000	12.922
RE_totassets_ratio	238634	0.162	0.164	0.000	26.508
Lib_sales_ratio	238634	0.758	47.368	0.000	14882.200
Lib_totassets_ratio	238634	0.166	0.232	0.000	54.225
Pay_S	238634	2.568	3.433	0	13.716
Pav_M	238634	4.542	4.312	0	14.505
pav_B	238634	0.841	2.993	0	16.935
RE_S	238634	2.636	3.506	0	12.464
RE_M	238634	4.626	4.380	0	13.745
RE_B	238634	0.825	2.939	0	17.455
PAY_F1	238634	0.935	2.766	0	16.640
PAY_F2	238634	0.427	1.766	0	14.901
PAY_F3	238634	4.972	3.997	0	16.935
PAY_F4	238634	0.038	0.560	0	15.179
PAY_F5	238634	1.440	3.357	0	16.546
RE_F1	238634	0.928	2.737	0	15.757
RE_F2	238634	0.443	1.824	0	14.849
RE_F3	238634	5.085	4.056	0	17.455
RE_F4	238634	0.038	0.566	0	14.305
RE_F5	238634	1.450	3.375	0	16.244
L_sales_S	238634	0.606	0.179	0	21.946
L_sales_M	238634	0.134	0.659	0	85.524
L_sales_B	238634	0.018	47.365	0	14882.200
L_sales_f1	238634	0.496	47.270	0	14882.200
L_sales_f2	238634	0.016	0.476	0	171.333
L_sales_f3	238634	0.179	2.454	0	965.517
L_sales_f4	238634	0.003	0.530	0	242.254
L_sales_f5	238634	0.059	1.734	0	673.296
L_asset_S	238634	0.070	0.169	0	29.166
L_aseet_M	238634	0.086	0.193	0	54.225
L_asset_B	238634	0.010	0.057	0	1.311
L_asset_f1	238634	0.025	0.130	0	29.166
L_asset_f2	238634	0.010	0.066	0	8.346
L_asset_f3	238634	0.103	0.194	0	54.225
L_asset_f4	238634	0.001	0.020	0	1.657
L_asset_f5	238634	0.024	0.097	0	7.242
D_2004	238634	0.258	0.438	0	1
D_2005	238634	0.239	0.427	0	1
D_2006	238634	0.241	0.428	0	1
D_2007	238634	0.262	0.440	0	1

**Table 4** Results of using only trade credit or only bank loans

Equations	(3.2)		(3.3)			
	Ln(Y/L)					
Variables						
In_K_L	0.226*** (0.002)	0.226*** (0.002)	0.226*** (0.002)	0.226*** (0.002)	0.227*** (0.002)	0.232*** (0.002)
lib_sales_ratio	-0.000815*** (0.000)					
lib_asset_ratio	-0.0580*** (0.009)					
PAY_sales_ratio	-0.000621*** (0.000)					
RE_sales_ratio	-0.0000475 (0.000)					
PAY_totassets_ratio	0.0732*** (0.013)					
RE_totassets_ratio	0.249*** (0.015)					
D_2005	0.0849*** (0.003)	0.0844*** (0.003)	0.0850*** (0.003)	0.0849*** (0.003)	0.0847*** (0.003)	0.0845*** (0.003)
D_2006	0.192*** (0.003)	0.191*** (0.003)	0.192*** (0.003)	0.192*** (0.003)	0.192*** (0.003)	0.191*** (0.003)
D_2007	0.348*** (0.003)	0.346*** (0.003)	0.348*** (0.003)	0.348*** (0.003)	0.348*** (0.003)	0.346*** (0.003)
Constant	2.671*** (0.002)	2.680*** (0.003)	2.670*** (0.002)	2.670*** (0.002)	2.660*** (0.003)	2.633*** (0.003)
Observations	237838	237838	237838	237838	237838	237838
Number of grp_firm	115257	115257	115257	115257	115257	115257
R-squared	0.210	0.210	0.210	0.210	0.210	0.212

Notes: The model is estimated using fixed effect.

Standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Table 5** The results from including both trade credit (TC) and bank loans in the equation

VARIABLES	Lib_sales_ratio & TC				Lib_totassets_ratio & TC			
	Dependent variable = ln (Y/L)							
ln (K/L)	0.226*** (0.002)	0.226*** (0.002)	0.227*** (0.002)	0.233*** (0.002)	0.226*** (0.002)	0.226*** (0.002)	0.227*** (0.002)	0.232*** (0.002)
Lib_sales_ratio	-0.000822*** (0.000)	-0.000866*** (0.000)	-0.000815*** (0.000)	-0.000813*** (0.000)				
Lib_totassets_ratio					-0.0580*** (0.009)	-0.0580*** (0.009)	-0.0558*** (0.009)	-0.0542*** (0.009)
PAY_sales_ratio	0.0000126 (0.000)				-0.000619*** (0.000)			
RE_sales_ratio		0.0000621 (0.000)				-0.0000475 (0.000)		
PAY_totassets_ratio			0.0732*** (0.013)				0.0696*** (0.013)	
RE_totassets_ratio				0.249*** (0.015)				0.247*** (0.015)
D_2005	0.0849*** (0.003)	0.0849*** (0.003)	0.0847*** (0.003)	0.0845*** (0.003)	0.0845*** (0.003)	0.0844*** (0.003)	0.0843*** (0.003)	0.0841*** (0.003)
D_2006	0.192*** (0.003)	0.192*** (0.003)	0.192*** (0.003)	0.191*** (0.003)	0.191*** (0.003)	0.191*** (0.003)	0.191*** (0.003)	0.190*** (0.003)
D_2007	0.348*** (0.003)	0.348*** (0.003)	0.347*** (0.003)	0.346*** (0.003)	0.346*** (0.003)	0.346*** (0.003)	0.346*** (0.003)	0.345*** (0.003)
Constant	2.671*** (0.002)	2.671*** (0.002)	2.661*** (0.003)	2.634*** (0.003)	2.681*** (0.003)	2.680*** (0.003)	2.671*** (0.003)	2.643*** (0.004)
Observations	237838	237838	237838	237838	237838	237838	237838	237838
Number of grp_firm	115257	115257	115,257	115,257	115,257	115,257	115,257	115,257
R-squared	0.21	0.21	0.21	0.212	0.21	0.21	0.21	0.212

Notes: The model is estimated using fixed effects. Standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Table 6** The results from using the interaction terms (bank loans with firm size, ownership)

VARIABLES	Lib_sales_ratio * firm size and ownership dummy				Lib_totassets_ratio*firm size and ownership dummy			
	dependent variable = ln (Y/L)							
ln_K_L	0.227*** (0.002)	0.227*** (0.002)	0.228*** (0.002)	0.234*** (0.002)	0.226*** (0.002)	0.226*** (0.002)	0.226*** (0.002)	0.232*** (0.002)
lib_sales_ratio	-0.0223** (0.010)	-0.0223** (0.010)	-0.0221** (0.010)	-0.0218** (0.010)				
lib_asset_ratio					0.293*** (0.042)	0.293*** (0.042)	0.296*** (0.042)	0.289*** (0.042)
PAY_sales_ratio	-0.000470* (0.000)				-0.000591*** (0.000)			
RE_sales_ratio		0.000034 (0.000)				-0.0000446 (0.000)		
PAY_totassets_ratio			0.0713*** (0.013)				0.0672*** (0.013)	
RE_totassets_ratio				0.246*** (0.015)				0.240*** (0.015)
L_sales_S	0.0108 (0.010)	0.0107 (0.010)	0.0106 (0.010)	0.0104 (0.010)	-0.443*** (0.034)	-0.443*** (0.034)	-0.443*** (0.034)	-0.438*** (0.034)
L_sales_M	-0.00539 (0.010)	-0.00541 (0.010)	-0.00548 (0.010)	-0.00549 (0.010)	-0.174*** (0.033)	-0.174*** (0.033)	-0.175*** (0.033)	-0.173*** (0.033)
L_sales_f1	0.0114*** (0.002)	0.0112*** (0.002)	0.0112*** (0.002)	0.0111*** (0.002)	0.0587** (0.030)	0.0587** (0.030)	0.0567* (0.030)	0.0601** (0.030)
L_sales_f3	0.00511** (0.002)	0.00506** (0.002)	0.00511** (0.002)	0.00506** (0.002)	-0.0799*** (0.028)	-0.0800*** (0.028)	-0.0785*** (0.028)	-0.0735*** (0.028)
L_sales_f4	0.0273 (0.021)	0.027 (0.021)	0.027 (0.021)	0.0265 (0.021)	0.0949 (0.098)	0.0948 (0.098)	0.0921 (0.098)	0.1 (0.098)
L_sales_f5	0.00939*** (0.002)	0.00941*** (0.002)	0.00944*** (0.002)	0.00937*** (0.002)	-0.144*** (0.037)	-0.144*** (0.037)	-0.142*** (0.037)	-0.133*** (0.037)
D_2005	0.0844*** (0.003)	0.0844*** (0.003)	0.0842*** (0.003)	0.0840*** (0.003)	0.0821*** (0.003)	0.0821*** (0.003)	0.0819*** (0.003)	0.0817*** (0.003)
D_2006	0.191*** (0.003)	0.191*** (0.003)	0.191*** (0.003)	0.190*** (0.003)	0.187*** (0.003)	0.187*** (0.003)	0.187*** (0.003)	0.186*** (0.003)
D_2007	0.347*** (0.003)	0.346*** (0.003)	0.346*** (0.003)	0.345*** (0.003)	0.340*** (0.003)	0.340*** (0.003)	0.340*** (0.003)	0.339*** (0.003)
Constant	2.675*** (0.002)	2.675*** (0.002)	2.666*** (0.003)	2.638*** (0.003)	2.681*** (0.003)	2.681*** (0.003)	2.672*** (0.003)	2.644*** (0.004)
Observations	237838	237,838	237,838	237,838	237,838	237,838	237,838	237,838
Number of grp_firm	115257	115,257	115,257	115,257	115,257	115,257	115,257	115,257
R-squared	0.211	0.211	0.211	0.213	0.213	0.213	0.213	0.215

Notes: The model is estimated using fixed effects. Standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Table 6 reports the estimates on productivity by different financial sources based on firm size and ownership of the enterprise. The results show that the interaction terms for SMEs have a negative impact on firm productivity. This is consistent with the theory that states that, compared with big enterprises, SMEs face difficulties in obtaining bank loans in China (Ge & Qiu, 2007). The findings also show that the interaction terms for state-owned enterprises all have a positive effect on labor productivity. This is also consistent with the situation in China, whereby state-owned enterprises are more reliant on bank loans (Long & Zhang, 2011). Furthermore, it is noted that the signs in F3 (private firms) and F5 (economy funded by foreign entrepreneurs) show both positive and negative signs. This is a topic to explore in a future study. Finally, the last set of dummy variables (trade credit multiplied by firm size and firm ownership) are analyzed. Using the same method as the last set of variables, interaction terms are created by using the accounts payable and accounts receivable variables. The firm level production function is thus given by

$$\ln(Y_{it} / L_{it}) = \beta_0 + \beta_1 \ln(K_{it} / L_{it}) + \beta_2 \text{Bankloan}_{it} + \beta_3 \text{TC}_{it} + \beta_4 \text{Firmsize} * \text{TC}_{it} + \beta_5 \text{Ownership} * \text{TC}_{it} + \beta_6 \text{Year\_dummy}_i + \varepsilon_{it} \quad (3.1-5)$$

The results are reported in Table 7. These results show that many variables affect the labor productivity. First, all of the signs for bank loan are negative and significant, and trade credit (with the exception of PAY\_sales\_ratio), as well as the other trade credit variables, are all positive and significant. This suggests that trade credit is a very useful financial source for enterprises. However, the variable for SMEs with accounts payable suggest a very strong negative effect on the growth of labor productivity. Despite the sign being significant, it may be speculated that SMEs use a lot of trade credit in their businesses. Another observation from the results in Table 7 is that all of the signs of ownership with trade credit are positive and significant, and that trade credit is frequently used as a financial source, not by the demander, but by the supplier.

**Table 7** The results from using the interaction terms (TC\_PAY with firm size, ownership)

VARIABLES	TC * firm size and ownership dummy				TC * firm size and ownership dummy			
	Dependent variable = ln (Y/L)							
ln_K_L	0.226*** (0.002)	0.229*** (0.002)	0.226*** (0.002)	0.234*** (0.002)	0.226*** (0.002)	0.229*** (0.002)	0.225*** (0.002)	0.234*** (0.002)
lib_sales_ratio	-0.000664*** (0.000)	-0.000644*** (0.000)	-0.000702*** (0.000)	-0.000663*** (0.000)				
lib_asset_ratio					-0.0518*** (0.009)	-0.0489*** (0.009)	-0.0505*** (0.009)	-0.0482*** (0.009)
PAY_sales_ratio	0.0000339 (0.000)				-0.000476*** (0.000)			
PAY_totassets_ratio		0.150*** (0.015)				0.147*** (0.015)		
RE_sales_ratio			0.0000561 (0.000)				-0.0000329 (0.000)	
RE_totassets_ratio				0.320*** (0.016)				0.319*** (0.016)
PAY_S or RE_S	-0.0261*** (0.001)	-0.0282*** (0.001)	-0.0244*** (0.001)	-0.0281*** (0.001)	-0.0261*** (0.001)	-0.0283*** (0.001)	-0.0244*** (0.001)	-0.0282*** (0.001)
Pay_M or RE_M	-0.00643*** (0.001)	-0.00811*** (0.001)	-0.00516*** (0.001)	-0.00835*** (0.001)	-0.00646*** (0.001)	-0.00813*** (0.001)	-0.00519*** (0.001)	-0.00837*** (0.001)
PAY_F1 or RE_F1	0.00724*** (0.002)	0.00364** (0.002)	0.00901*** (0.002)	0.00232 (0.002)	0.00713*** (0.002)	0.00357** (0.002)	0.00888*** (0.002)	0.00221 (0.002)
PAY_F3 or RE_F3	0.00590*** (0.001)	0.00240** (0.001)	0.00723*** (0.001)	0.000829 (0.001)	0.00576*** (0.001)	0.00232** (0.001)	0.00713*** (0.001)	0.000755 (0.001)
PAY_F4 or RE_F4	0.0116*** (0.004)	0.00831** (0.004)	0.0126*** (0.004)	0.00707** (0.004)	0.0115*** (0.004)	0.00829** (0.004)	0.0125*** (0.004)	0.00703** (0.004)
PAY_F5 or RE_F5	0.00772*** (0.002)	0.00348** (0.002)	0.0110*** (0.002)	0.00294* (0.002)	0.00749*** (0.002)	0.00333** (0.002)	0.0108*** (0.002)	0.00283* (0.002)
D_2005	0.0766*** (0.003)	0.0763*** (0.003)	0.0763*** (0.003)	0.0760*** (0.002)	0.0762*** (0.003)	0.0759*** (0.003)	0.0759*** (0.003)	0.0756*** (0.003)
D_2006	0.177*** (0.003)	0.177*** (0.003)	0.177*** (0.003)	0.177*** (0.003)	0.177*** (0.003)	0.176*** (0.003)	0.176*** (0.003)	0.176*** (0.003)
D_2007	0.324*** (0.003)	0.324*** (0.003)	0.324*** (0.003)	0.323*** (0.003)	0.323*** (0.003)	0.323*** (0.003)	0.323*** (0.003)	0.322*** (0.003)
Constant	2.731*** (0.008)	2.751*** (0.008)	2.709*** (0.008)	2.736*** (0.008)	2.741*** (0.008)	2.760*** (0.008)	2.718*** (0.008)	2.745*** (0.009)
Observations	237838	237,838	237,838	237,838	237,838	237,838	237,838	237,838
Number of grp_firm	115257	115257	115257	115257	115257	115257	115257	115257
R-squared	0.219	0.22	0.219	0.221	0.219	0.22	0.219	0.221

Notes: The model is estimated using fixed effect. Standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.



### 3.2 Regression on profitability

In order to check the regression results with labor productivity, profitability ratio is introduced as another dependent variable, measured as the operating profitability / total sales (OSR). The same model as the labor productivity regressions is used, only with a different depended variable. First the basic model is given by

$$OSR = \beta_0 + \beta_1 TC_{it} + \beta_2 Bankloan_{it} + \beta_3 Year\_dummy_i + \varepsilon_{it} \quad (3.2-1)$$

Where the OSR is defined by the ratio of operating profitability over total sales. The difference with (3.1-1) is that in this equation, the labor capital ratio is dropped. Because a Cobb-Douglas regression is not used, it is not necessary to add the labor capital ratio to the function. The purpose of this section is to check the effects of the two financial sources, bank loans and trade credit, not on labor productivity, but on the profitability of enterprises. Because there may be negative growth for firms' net profitability, the ratio of operating profitability over total sales is used to check the different financial sources. If the regression results is same or similar to the regression results with TFP, it will be strong evidence to support the theory of productivity. This is because profitability delegate the growth of enterprises, similar to productivity.

First, the efficiency of single financial sources over the ratio of operating profitability to total sales (OPR, below) is observed, following (3.2-1). The results are reported in Table 8. All the signs of the coefficients are negative, and in some cases, bank loans are significant. This suggests that each of these types of liabilities, when used independently, are not very useful in increasing the profitability of enterprises. This may be change when the bank loans and trade credit are used together. This regression also follows the model (3.2-1), and the results are reported in the Table 9. The results show that the signs of most of the coefficients did not change. Some of the signs of the coefficients became positive, but are not significant. Following the same process as the labor productivity regression, the dummy variables for firm size and ownership are added, and bank loans are listed first, so this function is given by

$$OPR = \beta_0 + \beta_1 \ln(K_{it} / L_{it}) + \beta_2 Bankloan_{it} + \beta_3 TC_{it} + \beta_4 Firmsize * Bankloan_{it} + \beta_5 Ownership * Bankloan_{it} + \beta_6 Year\_dummy_i + \varepsilon_{it} \quad (3.2 - 2)$$

The results are reported in Table 10.

**Table 8** The results of using only trade credit or only bank loans

Indepen Variable: Protibility/Total sales						
VARIABLES	With Bank loans		With Trade credit			
lib_sales_ratio	-0.212*** (0.001)					
lib_asset_ratio		-0.0668 (0.059)				
PAY_sales_ratio			-0.197*** (0.001)			
RE_sales_ratio				-0.0433*** (0.000)		
PAY_totassets_ratio					-0.104 (0.083)	
RE_totassets_ratio						0.0661 (0.093)
D_2005	-0.0233* (0.013)	-0.0312* (0.016)	-0.0096 (0.014)	-0.0218 (0.015)	-0.0305* (0.016)	-0.0306* (0.016)
D_2006	-0.0345*** (0.013)	-0.0521*** (0.017)	-0.0306** (0.015)	-0.0457*** (0.016)	-0.0507*** (0.017)	-0.0510*** (0.017)
D_2007	-0.0326** (0.014)	-0.0410** (0.017)	-0.0149 (0.015)	-0.0284* (0.017)	-0.0390** (0.017)	-0.0392** (0.017)
Constant	0.123*** (0.009)	-0.0185 (0.016)	0.0215** (0.010)	-0.0192* (0.011)	-0.0158 (0.016)	-0.0412** (0.019)
Observations	238634	238634	238634	238634	238634	238634
Number of grp_firm	115572	115572	115572	115572	115572	115572
R-squared	0.365	0.100	0.240	0.098	0.023	0.024

Notes: The model is estimated using fixed effect  
Standers errors in partentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 9** The results of using both Trade Credit and Bank loans

Dependent Variable: Profitability/Total sales								
VARIABLES	Lib_sales_ratio & Trade Credit				Lib_totassets_ratio & Trade Credit			
Lib_sales_ratio	-0.176*** (0.001)	-0.197*** (0.001)	-0.212*** (0.001)	-0.212*** (0.001)				
Lib_asset_ratio					-0.0513 (0.052)	-0.067 (0.056)	-0.0702 (0.059)	-0.0659 (0.059)
PAY_sales_ratio	-0.0617*** (0.001)				-0.197*** (0.001)			
RE_sales_ratio		-0.0183*** (0.000)				-0.0433*** (0.000)		
PAY_totassets_ratio			-0.124* (0.066)				(0.108)	-0.0833
RE_totassets_ratio				0.002 (0.074)				0.064 (0.093)
D_2005	-0.018 (0.013)	-0.0201 (0.013)	-0.0231* (0.013)	-0.0233* (0.013)	-0.0101 (0.014)	-0.0224 (0.015)	-0.0311* (0.016)	-0.0312* (0.016)
D_2006	-0.0310** (0.013)	-0.0334** (0.013)	-0.0342*** (0.013)	-0.0345*** (0.013)	-0.0314** (0.015)	-0.0467*** (0.016)	-0.0518*** (0.017)	-0.0520*** (0.017)
D_2007	-0.0261* (0.014)	-0.0285** (0.014)	-0.0324** (0.014)	-0.0326** (0.014)	-0.0162 (0.015)	-0.0301* (0.017)	-0.0409** (0.017)	-0.0410** (0.017)
Constant	0.113*** (0.009)	0.117*** (0.009)	0.140*** (0.013)	0.122*** (0.015)	0.0307** (0.014)	-0.00714 (0.015)	-0.00256 (0.020)	-0.029 (0.022)
Observations	238634	238634	238634	238634	238634	238634	238634	238634
Number of grp_firm	115572	115572	115572	115572	115572	115572	115572	115572
R-squared	0.378	0.381	0.365	0.365	0.240	0.098	0.023	0.024

Notes: The model is estimated using fixed effect

Standers errors in partentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 10** The results by interaction terms (Bank\_loans with Firm size, ownership dummy)

VARIABLES	Dependent Variable: Profitability/Total sales							
	Lib_sales_ratio * firm size and ownership dummy				Lib_totassets_ratio * firm size and ownership dummy			
lib_sales_ratio	0.0982*	0.0918*	0.0966*	0.0974*				
	(0.050)	(0.050)	(0.051)	(0.051)				
lib_asset_ratio					0.097	0.218	0.242	0.245
					(0.235)	(0.256)	(0.269)	(0.269)
PAY_sales_ratio	-0.0359***				-0.197***			
	(0.001)				(0.001)			
RE_sales_ratio		-0.0162***				-0.0433***		
		(0.000)				(0.000)		
PAY_totassets_ratio			-0.057				-0.107	
			(0.064)				(0.083)	
RE_totassets_ratio				0.093				0.062
				(0.071)				(0.093)
L_Sales_S	-0.122**	-0.121**	-0.128**	-0.128***	-0.171	-0.32	-0.352	-0.352
	(0.050)	(0.049)	(0.050)	(0.050)	(0.191)	(0.208)	(0.219)	(0.219)
L_Sales_M	-0.0978**	-0.0989**	-0.0991**	-0.0996**	-0.0983	-0.161	-0.173	-0.174
	(0.049)	(0.048)	(0.049)	(0.049)	(0.182)	(0.199)	(0.209)	(0.209)
L_sales_f1	-0.192***	-0.196***	-0.208***	-0.208***	-0.00812	-0.0403	-0.0327	-0.0351
	(0.009)	(0.009)	(0.009)	(0.009)	(0.167)	(0.182)	(0.192)	(0.192)
L_sales_f3	-0.00542	0.00564	-0.00699	-0.00697	-0.0338	-0.051	-0.065	-0.0609
	(0.010)	(0.010)	(0.010)	(0.010)	(0.158)	(0.172)	(0.181)	(0.181)
L_sales_f4	-3.388***	-3.391***	-3.411***	-3.411***	-0.0256	-0.054	-0.0586	-0.0605
	(0.100)	(0.099)	(0.100)	(0.100)	(0.550)	(0.599)	(0.631)	(0.631)
L_sales_f5	0.0308***	0.0337***	0.0325***	0.0325***	0.059	0.027	0.0185	0.025
	(0.010)	(0.009)	(0.010)	(0.010)	(0.206)	(0.224)	(0.236)	(0.236)
D_2005	-0.0142	-0.0141	-0.0166	-0.0166	-0.0107	-0.0236	-0.0325**	-0.0326**
	(0.012)	(0.012)	(0.012)	(0.012)	(0.014)	(0.015)	(0.016)	(0.016)
D_2006	-0.0172	-0.0176	-0.0178	-0.0179	-0.0325**	-0.0487***	-0.0541***	-0.0543***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.015)	(0.016)	(0.017)	(0.017)
D_2007	-0.0103	-0.00954	-0.0122	-0.0123	-0.0178	-0.0333**	-0.0446**	-0.0446**
	(0.013)	(0.013)	(0.013)	(0.013)	(0.015)	(0.017)	(0.018)	(0.018)
Constant	0.0814***	0.0794***	0.0913***	0.0679***	0.0294**	-0.0111	-0.00611	-0.0324
	(0.009)	(0.009)	(0.013)	(0.015)	(0.015)	(0.016)	(0.021)	(0.023)
Observations	238634	238634	238634	238634	238634	238634	238634	238634
Number of grp_firm	115572	115572	115572	115572	115572	115572	115572	115572
R-squared	0.420	0.428	0.416	0.416	0.240	0.098	0.236	0.235

Notes: The model is estimated using fixed effect

Standers errors in partentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 10 shows that all of the bank loans variables have positive effects on profitability, but bank loans to SMEs have a negative effect on their profitability. Some of the sings of the coefficients of trade credit is positive, but still not significant. Moreover, the effect of trade credit based on firm size and ownership dummy are evaluated. The production function is given by

$$OSR = \beta_0 + \beta_1 \ln(K_{it} / L_{it}) + \beta_2 Bankloan_{it} + \beta_3 TC_{it} + \beta_4 Firmsize * TC_{it} + \beta_5 Ownership * TC_{it} + \beta_6 Year\_dummy_i + \varepsilon_{it} \quad (3.2 - 3)$$

Results are shown in Table 11. The coefficient for small sized enterprises is

positive and significant, but almost all the other signs of the coefficients are negative. Therefore, the analysis of firms' productivity yielded mixed signs for both bank loans and trade credit. It is recommended that other approaches be tested in order to prove the theory set out in this paper.

**Table 11** The results by interaction terms(Trade Credit with Firm size, ownership Dummy)

Dependent Variable: Profitability/Total sales								
VARIABLES	Payable * firm size and ownership				Receivable * firm size and ownership			
lib_sales_ratio	-0.176*** (0.001)	-0.212*** -0.000797			-0.197*** (0.001)	-0.212*** (0.001)		
lib_asset_ratio			-0.046 (0.052)	-0.063 (0.059)			-0.060 -0.0564	-0.059 (0.059)
PAY_sales_ratio	-0.0617*** (0.001)		-0.197*** (0.001)					
PAY_totassets_ratio		-0.126* (0.074)		-0.098 (0.093)				
RE_sales_ratio					-0.0183*** (0.000)		-0.0433*** (0.000)	
RE_totassets_ratio						0.032 -0.0821		0.051 (0.103)
Pay_S	0.00770* (0.005)	0.00810* (0.005)	-0.002 (0.005)	-0.0202*** (0.006)				
Pay_M	0.002 (0.004)	0.002 (0.004)	0.001 (0.004)	-0.005 (0.005)				
PAY_F1	-0.005 (0.008)	-0.008 (0.008)	0.014 (0.009)	0.007 (0.010)				
PAY_F3	-0.003 (0.005)	-0.003 (0.005)	0.0103* (0.006)	0.009 (0.007)				
PAY_F4	0.006 (0.018)	0.005 (0.019)	0.020 (0.020)	0.019 (0.023)				
PAY_F5	-0.005 (0.008)	-0.007 (0.008)	0.014 (0.009)	0.012 (0.011)				
RE_S					0.006 (0.005)	0.006 (0.005)	-0.0131** (0.006)	-0.0181*** (0.006)
RE_M					0.001 (0.004)	0.001 -0.00386	-0.002 (0.005)	(0.004) -0.00485
RE_F1					-0.003 (0.008)	-0.006 (0.008)	0.013 (0.010)	0.008 (0.010)
RE_F3					-0.003 (0.005)	-0.006 (0.005)	0.0108* (0.006)	0.009 (0.007)
RE_F4					0.010 (0.018)	0.008 (0.018)	0.026 (0.022)	0.024 (0.023)
RE_F5					-0.009 (0.008)	-0.013 (0.008)	0.0171* (0.010)	0.015 (0.010)
D_2005	-0.015 (0.013)	-0.020 (0.013)	-0.012 (0.014)	-0.0381** (0.016)	-0.017 (0.013)	-0.020 (0.013)	-0.0281* (0.015)	-0.0379** (0.016)
D_2006	-0.0262** (0.013)	-0.0292** (0.013)	-0.0360** (0.015)	-0.0643*** (0.017)	-0.0287** (0.013)	-0.0292** (0.014)	-0.0571*** (0.016)	-0.0641*** (0.017)
D_2007	-0.019 (0.014)	-0.0244* (0.014)	-0.0232 (0.016)	-0.0608*** (0.018)	-0.021 (0.014)	-0.0242* (0.014)	-0.0466*** (0.017)	-0.0600*** (0.018)
Constant	0.108*** (0.040)	0.139*** (0.041)	-0.052 (0.045)	0.010 (0.053)	0.124*** -0.0412	0.148*** (0.042)	-0.049 (0.051)	-0.026 (0.054)
Observations	238634	238634	238634	238634	238634	238634	238634	238634
Number of grp_firm	115572	115572	115572	115572	115572	115572	115572	115572
R-squared	0.378	0.365	0.24	0.012	0.381	0.365	0.098	0.023

Notes: The model is estimated using fixed effect.

Standers errors in partentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## 4. Conclusions

It is well known that financial sources and financial efficiency play a vital role in the growth of enterprises. This study was conducted in order to better understand how different financial sources can affect the growth of enterprises. There is a large body of research on productivity and financial sources concerning Chinese industry enterprises, but there are few studies that link them together.

An unbalance panel database of China industry enterprises was used to find an efficient bridge to link productivity and financial efficiency. The results show that enterprises using trade credit can increase labor productivity more than these enterprises using bank loans. The study also found that large enterprises or state-owned enterprises can increase their labor productivity using bank loans more than trade credit. But if large enterprises or state-owned enterprises are treated as the suppliers of trade credit, these enterprises may supply trade credit by collecting funding from bank loans.

The same models were also used to check the effects of two financial sources—bank loans and trade credit—on the profitability of enterprises, in order to support the productivity theory of bank loans and trade credit. However, there is no a strong evidence for it. These discrepancies in the results suggest that future studies should continue to find stronger evidence to support the findings in this study.

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## **Conclusions for the whole paper**

This research attempts to identify a suitable financial channel for SMEs and shed some insight on how to improve their access to financing sources by comparing the different financing approaches and analyzing how the different financial sources affect the productivity of SMEs.

Chapter 1 focused on relationship banking and SME finance. This study finds that the merits of relationship banking are clearly exist. It is concluded that relationship banking is an effective method for SMEs seeking to raise capital in China.

Chapter 2 examined another finance approach - trade credit - and compared it with the bank loans. Unlike large enterprises, the SMEs more prefer to use trade credit as a substitute for bank loans.

Chapter 3 analyzed a different point of view by measuring the effect of different financing approaches on a firm's labor productivity. It is found that enterprises experienced productivity increases when they used trade credit more heavily.

It is widely recognized that the financing environment for SMEs needs to be improved. It is worth conducting further investigation in order to identify suitable financing meatheads for Chinese SMEs. This research suggests that SMEs' financing difficulties cannot simply be overcome, but that a careful analysis of various approaches needs to be carried out in order to identify the best approach that is suited to SMEs' needs. In doing so, the following should be considered:

i ) The financial information collection system for SMEs can be improved. Because there are no special organizations that gather financial information from SMEs, the asymmetric information problem cannot fundamentally be corrected until such a system is built. Until then, the relationship banking model may be one way to resolve the financing difficulties of Chinese SMEs by enabling the collection of soft information. Moreover, if SMEs are unable to gain financial

support by on their own, they may be able to use other financial intermediaries to obtain loans. According to Fan (2013), a successful financial intermediary business model exists in Qingdao, Shandong province, and built since 2005, named called “fu yuan yun tong”. It is a private enterprise that specializes in addressing the financing difficulties of SMEs. If the Chinese government could use the “fu yuan yun tong” business model as a reference, it may present a viable solution for the problem of asymmetric and help to resolve the financing difficulties of SMEs.

ii) Small and medium-sized financial institutions for SMEs can be improved. According to the All China Federation of Industry and Commerce (ACFIC) Survey of 2009, over 95% of SMEs cannot access bank loans from state-owned banks. The needs of SMEs are very different from large or state-owned enterprises, and they have internal factors that prevent them from obtaining loans from state-owned banks. Therefore, establishing the small and medium-sized financial institutions that cater to SMEs may allow firms to build long-term borrower relationships with these banks, and thus resolve the problem of asymmetric information. Kano, Uchida, Udell, and Watanabe (2011) find that relationship lending costs are high for SMEs at large banks, while the benefits from relationship banking are greater at small banks.

iii) A broad variety of financial approaches for SMEs should be encouraged. If access to formal financing is limited for SMEs, other financing approaches should be encouraged. According to Chapter 2 and 3, trade credit may be a good way to resolve the financing difficulties of SMEs.

To summarize, improving the access to financing sources for SMEs is not a simple matter, and will take a long time, particularly in developing countries where financial institutions are less developed. Government support is also important for the development of SMEs. It will be worthwhile to study the effects of Chinese monetary policy on SMEs financing in the future.

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