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Financial constraints and firms' activities in China

By

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Abstract

The understanding the effects of financial constraints and firms' activities is an important issue from both macroeconomics and microeconomics perspectives. The recent development of the asymmetric information approach has established a link between finance and the real activity. A good understanding of the effects of financial constraints and firms' activities would provide valuable information about the mechanism through which monetary policy affects real economic activities and the understanding of the macroeconomic dynamics. From a microeconomics perspective, the study of the effects of financial constraints also contributes to the understating of firms' corporate finance behaviors and the importance of firm heterogeneity in firms' activities. This research uses two large samples of firm-level panel data from China to study the effects of financial constraints on three key firm activities.

First, using an Euler equation investment model, we empirically study the effects of financial constraints on firms' fixed investment in China over the period 1998-2005. We find strong evidence indicating there is a "lending bias" at work. Where the state-owned enterprises and collectively owned enterprises are less financially constrained that privately owned firms. The evidence also suggests that listed firms are more financially constrained than unlisted firms. Moreover, the results indicate that the presence of foreign ownership helps to reduce the level of financial constraints faced by firms.

Second, we use an error correction model augmented with cash flow to test the effects of financial constraints on firms' inventory investment in China with emphasis on the firm heterogeneity. We find that cash flow is an important determinant for inventory investment of privately owned firms, foreign owned firms, firms with no political affiliations to the central or local governments. The result also suggests that the level of financial constraints faced by firms increased over the study period.

Last, we test whether there is a link between financial factors and firms' export decisions in China. We find that firms' liquidity and leverage levels are important determinants of firm's exports participation decisions, where the effects are strongest for privately owned firms. When we focus on the exports participation decision of the private firms, we find financial factors are particular important for firms that are smaller, younger and with no political affiliations.

Acknowledgements

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Chapter 1: Introduction and Motivation of the Thesis

1.1 Introduction

The seminal work of Modigliani and Miller (1958) suggests that under perfect and complete capital market, firm's investment decisions and its financing decisions should be independent from each other. In this framework, the external finance and internal finance are perfect substitutes. Firms are able to undertake all the profitable investment opportunities. In the Modigliani and Miller's perfect capital market world, finance is irrelevant for real decisions.

However, in reality the capital markets are rarely perfect. There are a large number of factors that can lead to imperfections in capital market, such as taxes, transaction costs, and most importantly the information asymmetries between lenders and borrowers. Following the theoretical developments in information economics in the 1970s, a number of studies has shown that under the assumption of imperfect capital market internal finance and external finance are no longer perfect substitutes(Stiglitz and Weiss 1981a; Myers and Majluf 1984). Subsequently, Fazzari, Hubbard and Peterson (1988) , using a firm level data from the US, pioneered a framework to test for the financial constraints on investment behavior by looking at the sensitivity of investment to change in cash flow. Their results suggest that internal finance is an important determinant of firms' fixed investment. Now there is a large finance and macroeconomic literature have adapted Fazzari, Hubbard and Peterson's (1988) approach to test the impacts of financial constraints on investment ((Hoshi et al. 1991; Schaller 1993; Hubbard et al. 1995; Konings et al. 2003).

Recently, the literature of financial constraints have extended the study beyond fixed investment to analyze the impact of financial constraints on other activities of the firms, such as inventory investment, R&D investment, and export participation decisions.

The understanding the effects of financial constraints and firms' activities is an important issue from both macroeconomics and microeconomics perspectives. The recent development of the asymmetric information approach has established a link between finance and the real activity. A good understanding of the effects of financial constraints and firms' activities would provide valuable information about the mechanism through which monetary policy affects real economic activities and the understanding of the macroeconomic dynamics. Moreover, from a microeconomics perspective, the study of the effects of financial constraints also contributes to the understating of firms' corporate finance behaviors and the importance of firm heterogeneity in firms' activities.

Despite the importance of the study of financial constraints, the large amount of existing literature are mainly focus on developed countries such as US and UK. Only a few studies have attempted to study the impacts of financial constraints in the context of China (Chow and Fung 1998; Chow and Fung 2000; Héricourt and Poncet 2009; Guariglia et al. 2010). Most of these studies are conducted based on a small samples and focus only on the effects of financial constraints on fixed investment, with the exception of Guariglia *et al* (2010) who study the effects of financial constraints on firms' asset growth in China. The aim of this thesis is to fill this gap in the empirical literature, we explore the effects of financial constraints on three different firm activities: fixed investment, inventory investment and the exports market participation decisions.

The rest of this chapter is organized follows: in the next section, we provide the motivations of studying these three firm activities, and the specific aims of the study; then in section 1.3, we introduce the two datasets that we will use for our empirical study; last, section 1.4 presents the structure of the thesis.

1.2 Motivation and aims of the study

China's economy has experienced extraordinary growth in the past twenty year. Since its economic reform and opening in 1978, China has achieved an average of nearly double-digit growth rates in the last two decades, which helps it to overtake Japan as world's second-biggest economy in year 2011. If China can maintain its current rate of growth, China will replace the US as the world's top economy by 2020.

The reform initiated from 1978 has transformed the Chinese economy from a planned economy to a mixed economy by gradually introducing market forces into the economy. This gradualism approach produces a relatively stable and fast expansion of the economy for three decades. However, government continues to play an important role in the allocation of key resources which causes distortion in a number of key factor markets such as financial markets, which leads to a relatively underdeveloped legal and financial system, which prevents market forces to play a dominant role in resource allocation.

Given the poor state of development of the Chinese financial system, the miracle growth speed of the Chinese economy is often considered as a puzzle (Allen et al. 2005). Therefore it is interesting study whether firms are financially constrained in China, how financial constraints affects firms activities, and what types of firms are more likely to face financial constraints in the context of China by taking into account it special institutional settings.

In this thesis, we use two large panel datasets to empirically study the effects of financial constraints on firms' activities in China. Specifically, we will empirically analyze the effects of financial constraints on firms' fixed investment decisions, firms' inventory investment decisions, and firms' export decisions. We will present our motivations for choosing these three firms activities as the focus of this thesis below.

First, fixed investment is one of the main drivers of the Chinese economic growth. Song *et al* (2011) show that the Chinese economy is characterized by persistently high fixed investment rates. It is interesting to conduct an empirical study to analyze whether firms' fixed investment are financially constrained. If firms' are indeed financially constrained, it is important to identify what types of firms are financially constrained. This provides the policy makers with the necessary information about the types of firms that they can target in the process of policy design. By providing finance to those financially constrained firms would help to maintain China's high economic growth rate. Motivated by these facts, chapter 3 is devoted to study the effects of financial constraints on firms' fixed investment in China.

Our chapter 4 study based on inventory investment is motivated by the fact that inventory investment plays an important role in the explanation of the business cycle. Despite of its small magnitude relative to total production, it typically accounts for a significant proportion of the reduction in GDP during recession. Therefore it is crucial to have a better understanding of the inventory investment behaviors in China. However, there is no empirical papers has yet examine the effects of financial constraints on firms' inventory investment behavior in China. Our study intends to fill this gap in the literature. Moreover, inventory investment is typically characterized by relatively small adjustment costs compare to the large adjustment costs for fixed investment. Hence, firms tend to adjust their inventory investment first, when they are facing financial constraints. As a result, inventory investment will be more sensitive to the change of firms' cash flow. Therefore, inventory investment offers a better framework to test the hypothesis of the financial constraints.

Exports have long been perceived to be an important stimulating influence of countries' economy across the developed and developing countries. Moreover in the context of China, export is the second main drivers of the miracle growth rate of the Chinese economy. The export-led growth model of China helps it to capture the gains of its comparative advantage in abundant labour supply. The remarkable growth between 1978 and 2000 are mainly due to the early reform. But the growth in the past 10 years has been mainly driven by exports. The accession to the WTO in 2001 helps China to better integrate to the world market and further exploits its export-led growth model and speed up the process of industrialization. Exporters are typically more efficient and more profitable than non-exporters. Policy-makers around the world have devoted significant efforts into the development and implement trade promotion programs. The effectiveness of these programs depends closely on our clear understanding of the determinants of export decisions. Chaney (2005) suggests that financial constraints may be the reason that why some industry firms with high productivity do not export. A recent paper by Greenaway *et al* (2007) shows that firms' financial health is important for firms exports decisions in UK. Yet, only one paper by Li and Yu(2009)has looked at the links between financial constraints and export participation decisions in China. We extend the study of the financial constraints and export participation by taking into account a number of firm heterogeneities, such as firm size, firm age, and political affiliation etc. Through these exercise, we are able to identify some important criteria that may help export promotion policies to target firms that are most needed the help.

Moreover, given the special institutional setting in China, where lending bias and regional disparities have important roles to play in firms' activities. For all three empirical studies in this thesis, we also focus on the interactions of the effects of financial constraints with the ownership types for firms and regional disparities. We would like to see whether financial constraints have heterogeneous effects on firms' activities across ownerships and regions.

1.3 Datasets

Until recently, it is difficult assess the financial constraints on firms' activities in China. This is largely due to lack of reliable microeconomic data to test the relevant hypothesis in the context of China. In this thesis, we employ two large firm level panel datasets for our empirical study of the effects of financial constraints on firms' activities in China. In this section, we will discuss the source of the datasets and their suitability for our study.

The dataset used for the study of chapter 3 is drawn from the ORIANA database published by Bureau van Dijk, with financial information derived from firms' financial statements for both public and private companies in the Asia-pacific region. For the purpose of this study, we have restricted our attention to firms from China. This panel dataset covers 22,274 firms, corresponding to 114,098 observations between year 1998 and 2005. By allowing firms to entry and exit the sample, we have a large unbalanced firm-level datasets. One of the key reasons for choosing this dataset for our study of the effects of financial constraints and fixed investment in chapter 3 is because its coverage of both listed and unlisted firms. This allows us to assess whether listed firms are less financially constrained than unlisted firms. Using a unify dataset, allow us to avoid the problems that commonly arise due to gathering financial data from two different firm level datasets (such as different definition for variables, measurement errors and mistakes in combining two firm level data). This makes our empirical results more reliable.

The dataset used for the study of chapter 4 and chapter 5 is a large firm-level panel dataset produced by the National Bureau of Statistics of China (NBS). It is a survey of industrial firms conducted by NBS annually. This dataset includes all "above scale" industrial firms with sales over RMB 5million yuan. One of the unique advantages of this dataset is its coverage of all state-owned enterprises in China. There are around 1,805,803 observations for 541,436 firms for the period between 2000 and 2007 from 31 provinces operating in 49 different two-digits manufacturing industries. This dataset is particularly suitable for our study for two main reasons. First, it is one of the most representative firm level datasets for China. It would provide a very good picture of the firm behaviors in China. Second, it contains both very small firms and very large firms. This is particularly important in the study of the effects of financial constraints, as smaller firms are more likely to be financially constrained.

1.4 The structure of the thesis

In chapter 2, we provide a literature review on financial constraints and investment as a background of the empirical studies of this thesis. First, we present the intuition of the theoretical arguments that have provided the support to the capital market imperfections (financial constraints). Follow by, an overview of the interpretation of investment cash-flow sensitivities with a review of three widely used investment models in the empirical tests of financial constraints on investment. Last, we will present a brief review of the empirical evidences.

Chapter 3 is devoted to study the effects of financial constraints on firms' fixed investment in China using a specification derived from an Euler equation model. This allows us to avoid some of empirical critiques based on the Q-model approaches. Chapter 3 first provides some stylized facts and background to Chinese fixed investment using aggregate data. Then a review of the development and reform of the financial system in China is presented. We first test whether financial constraints matters for Chinese firms fixed investment for the full sample. We then study the effects of financial constraints on fixed investment by diving firms into different groups based on their ownership types or their locations. This allows us to compare the levels of financial constraints faced by firms across regions and ownership types. Last, we also use the Euler equation framework to test whether the presence of foreign ownership helps to alleviate the levels of financial constraints faced by Chinese firms.

Chapter 4 is devoted to study the effects of financial constraints on inventory investment in China. By estimating an error-correction model of inventory investment, chapter 4 first tests the effects of financial constraints on inventory investment in China based on the full sample. Given the special institution setting of the Chinese economy, we then estimate the error-correction model by taking into consideration the ownership type heterogeneity, regional disparities, political affiliations and different firm characteristics. Last, we use year 2003 as a cutoff point to assess whether the levels of financial constraints faced by firms in China has changed overtime.

Chapter 5 is devoted to study the relationship between financial health and export participation decisions in China. By estimating a random-effects probit model, chapter 5 tests how financial factors affect firms' exports participation decisions. Similar to the previous two chapters, chapter 5 then further assess whether firm heterogeneity plays an important role in the effects of financial constraints on exports participation decisions.

Finally, chapter 6 concludes the paper with a review of our empirical findings. Then a discussion of the results and relevant policy implications is provided. Last, we make some suggestions of how we can extend our research in the future.

Chapter 2: Financial constraints and investment: A literature review

2.1 Introduction

The pace and pattern of business investment in fixed capital are central to our understanding of economic activity. Business investment is one of the most important determinants of an economy's long-term growth rate and also plays a pivotal role in explaining business cycle fluctuations. It is therefore crucial for economists and policy-makers to understand the mechanisms that determine investment spending. Furthermore, it is particularly important to central banks for an effective conduct of monetary policy, because investment is believed to be a major interest-sensitive expenditure.

Despite extensive research, the explanation of investment behavior has been disappointing. Thus, researchers have started to improve the empirical specification of investment models by modifying the fundamental underlying assumptions. One of the recent progresses is by examining the implications of financial constraints caused by capital market imperfections on investment.

A positive relationship between internal funds and investment has long been documented, which can trace back to Meyer and Kuh (1957). However the analytical basis for this positive relationship has been a matter of great dispute and a largely unsolved issue. After the prominent work of Modigliani and Miller (1958)'s followers, in which they demonstrated that in perfect capital market the value of a firm is independent of its financial structure; research on how firm's financial decisions affect their investment was shelved. None of the neoclassical investment model, sales accelerator model, and the Q model which were derived during that period recognizes any role for financial variables as a determinant of investment.

After the theoretical developments in information economics in the 1970s, the literature on financial variable and investment was revived. With the theoretical arguments of asymmetric information, Modigliani and Miller's claim no longer stands. In their extensive empirical studies, Fazzari, Hubbard and Petersen (1988)[1] found that there is a positive relationship between firm's investment and cash flow. They interpreted this result as financial constraints in the sense that the firm may have to forego profitable projects due to lack of finance. They concluded that financial constraints have a significant impact on firm's behavior at least for the portion of firms that suffer from information problems.

This literature review is intended to provide an overview of the theoretical background, as well as the empirical modeling strategies of the implications of financial constraints on investment. This paper is organized as follows. In section 2.2, I present the theoretical arguments that have provided the support to capital market imperfections. In section 2.3, an overview of the interpretation of investment cash flow sensitivities and the investment cash-flow excess sensitivities in the general case, is provided. I also present a review of three widely used investment models in the empirical tests of financial

[1] FHP 1988 thereafter

constraints on investment: the Q model, the Euler equation and the error correction model. I will then discuss the problems faced by each of the models in the empirical tests. In section 2.4, I review the measurement problem of financial constraint. Specifically, I described the sample splitting criteria that are used to identify firms as financial constrained *a priori*. And some empirical evidence is also presented. Section 2.5 concludes the paper.

2.2 Theoretical backgrounds

2.2.1 Capital market imperfection

Modigliani and Miller (1958) proposed that, under a very restrictive set of assumption, the market value of an enterprise is independent of its capital structure. This proposition implies that firms' investment decisions will only depend on the expected rate of return of the projects, and should not be affected by how the investments are financed. Under the Modigliani and Miller theorem, firm's internal and external funds are perfect substitutes. Thus firm's investment decisions are independent of financing decisions.

Among the assumptions that Modigliani and Miller used to derive their theorem, perfect and complete capital market has been the most problematic one. There are a number of reasons why capital market might be imperfect. Factors such as transaction costs, flotation costs, bankruptcy costs and taxation are all contributing to the imperfect capital market. Contemporary research in investment studies has therefore appeal to the problem of asymmetric information. (FHP 1988)

Existing models of imperfect capital market focus on the problems of adverse selection and moral hazard in generating frictions in capital markets. Myers and Majluf (1984) present a model of equity finance, recognizing the problems of information asymmetry, which lead to adverse selection. They show that when outsiders (investors) have imperfect knowledge of the value of the firm, they will demand a premium to acquire the firm's shares in order to compensate the losses incurred from financing a 'lemon' firm. This premium makes the external cost of capital more expensive. To the extreme, Stiglitz and Weiss (1981) argue that informational asymmetries will lead to credit rationing in the loans market, as lenders are unable to discriminate between good and bad borrowers. In this situation, lenders will intentionally set a price that creates an excess demand of loans. Jensen and Meckling (1976) argue that due to limited liability, a moral hazard problem may arise when borrowers have the incentive to use funds on excessively risky projects. In order to compensate this potential risk, lender will demand a premium for the loan and possibly use covenants to restrict the use of funds in specific areas.

Despite the difference in details in these theoretical studies, they all provide us with the common theme that a general implication of information problems in capital market is that internal funds and external funds are no longer perfect substitutes. There is a gap between the cost of internal funds and external funds. This gap is positively related to the level of the information asymmetry which leads to an "information cost". Firms that face higher information asymmetries will tend to face a much higher cost for external funds than firms with low level of asymmetric information. Thus, it is reasonable to believe that capital markets are imperfect, and that the MM theorem no longer stands.

2.2.2 Hierarchy of finance

Based on the assumption of imperfect capital markets, firms facing information problems may only be able to obtain finance on less favourable terms in the capital markets, or may not be able to obtain any funds at all when there is credit rationing (this could be a consequence of an extremely high cost of funds). As a result, these firms' investments may be financially constrained in 'hierarchy of finance' or 'pecking order' models, in which internal funds have a cost advantage over new debt of equity finance. The "hierarchy of finance" or "pecking order" literature states that enterprises have a precise preference order with respect to the sources to finance investment (Myers and Majluf 1984). The main reason of this hierarchy is the existence of asymmetric information. Firms prefer cheap internal finance to expensive external finance. When external finance is needed for funding investment, the firm will work down the pecking order, by issuing safest debt first then move on to riskier debt and finally use equity as a last resort. Under these circumstances, firms' investment and financing decisions are interdependent, and the level of internal funding could be an important empirical determinant of investment. This concept can be illustrated with some simple graphical illustrations.

2.2.3 Hierarchy of finance: A graphical illustration

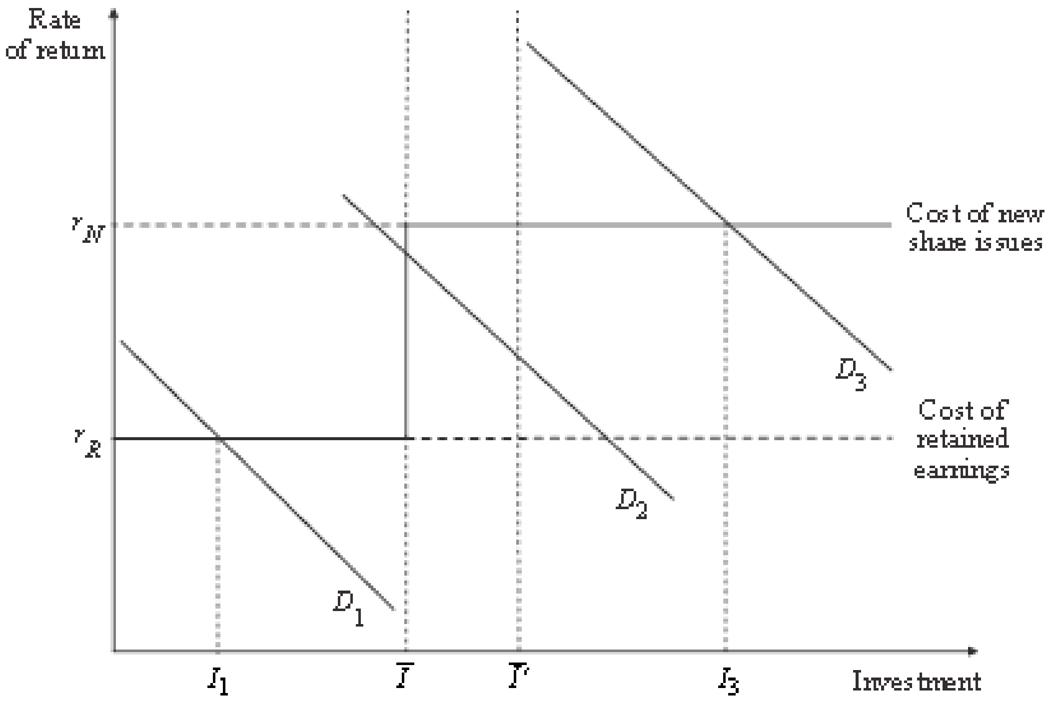

Figure 2.1 The hierarchy of finance model with no debt finance
Source: Bond and Meghir (1994)

Figure 2.1 above presents the hierarchy of finance model with no debt finance. The rate of return r_R shows the cost of internal funds (which is the required rate of return on internal funds). The rate of return r_N shows the cost of external finance, such as new share issues. The downward sloping schedules (D_1 , D_2 and D_3) show three different possible investment opportunities available to a given firm, relating the required rate of return to the feasible level of investment.

Let $\bar{I}$ be the maximum level of investment that can be finance with the firm's internally available funds. If the firm has relatively limited investment opportunities (D_1 curve), then the firm can finance all of its desired investment from internal funds. Therefore, the firm's investment level would occur at I_1 and is not likely to be affected by the fluctuations in its internal funds. If the firm has relatively large investment opportunities (D_3 curve), then it would find it worthwhile to make use of external funds, despite the higher costs of such funding. Its investment level would be at I_3, which again is unaffected by the fluctuations in internal fund around the level corresponding to $\overline{I}$.

The more interesting case is the intermediate case, which is illustrated by the curve D_2, where financial constraints affect the firm's investment spending. This firm has sufficiently profitable investment opportunities, which lead it to exhaust all its internal funds. However, the level of investment above $\overline{I}$ is not attractive enough for the firm to resort to the more costly external funds. The investment spending of such firm is limited to the level that can be financed from its internal funds, namely $\overline{I}$. A rise in retained earnings to $\overline{I}'$ would shift the maximum level of investment that can be financed internally, so that there also would be an increase in the investment of constrained firms. Thus, a 'financially constrained' firm can be thought of as a firm whose investment spending would rise (fall) if its retained earnings increased (decreased).

Debt finance is normally a cheaper source of finance than equity finance, because debt holders have prior claim on firm's assets in the event of bankruptcy. Incorporating debt finance into the hierarchy of finance model complicates the story but offers us richer insights on firm's investment behaviour. Assuming that the cost of debt finance rises with the amount raised (as the risk of default increases with leverage), the supply schedule for external funds has a kink at the its level of internal funds $\overline{I}$, see figure 2. The implications for firms with demand schedule D_1 and D_3 are basically the same as in the hierarchy of finance model without debt finance. However, firms with D_3 demand schedule can now finance investment with a mix of debt and equity.

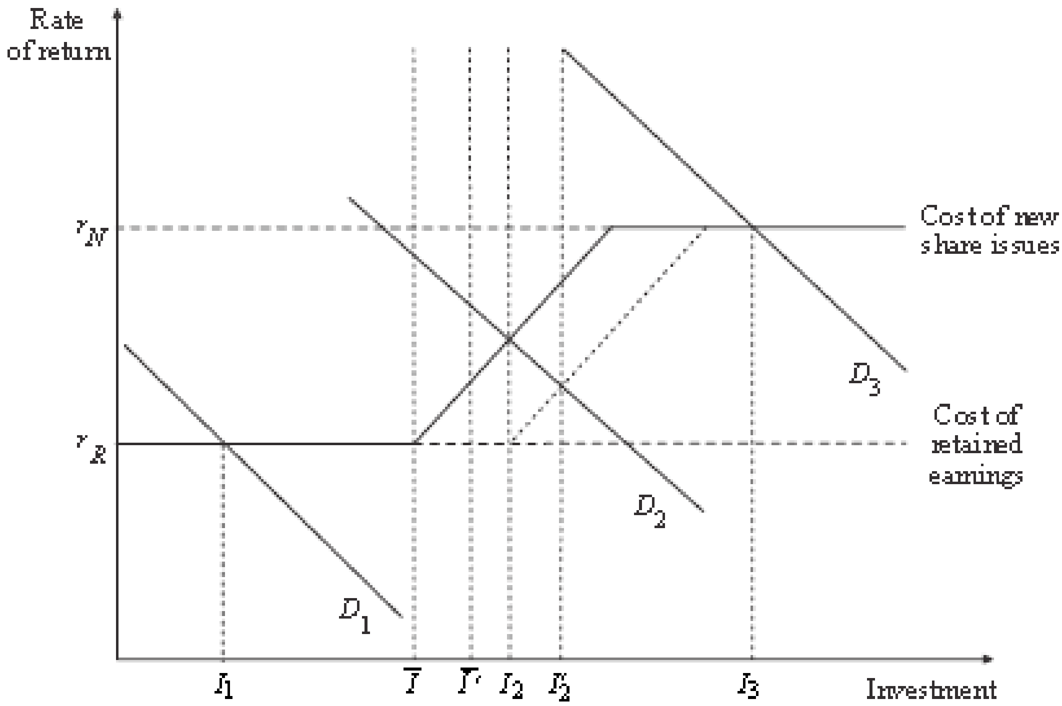

Figure 2.2 The Hierarchy of finance model with debt finance
Source: Bond and Meghir (1994)

Firms with demand schedule D_2 can increase their level of investment to I_2, since they can finance higher investment through debt to the extent that they find it worthwhile to bear in the increasing cost of fund. However, these firms are still financially constrained, for example an increase in internal funds from $\overline{I}$ to I_2 would increase their investment level to $I_2^{'}$. The investment level of these firms is still limited by the availability of internal finance, even though now they can finance their investment from debt.

Moreover, as discussed in section 2.1, due to asymmetric information, lenders will demand a cost premium to compensate for information costs. The slope of the loan supply schedule reflects the information costs in uncollateralized debt. The higher is the marginal cost the steeper is the upward-sloping portion of the loan supply schedule. Thus, for firms facing little or no information costs, the slope of the loan supply schedule is relatively flat. An increase in net worth independent of changes in investment opportunities has little or no effect on investment. For firms facing high information costs, an increase in internal fund would lead to greater investment, given that all else being equal.

2.2.4 Summary

Given asymmetric information problems, there is a wedge between the costs of internal funds and external funds, which implies that unless external funds can be fully collateralized they will be more costly than internally generated funds. Thus, financially constrained firms will rely on their level of internal funds in order to invest. Moreover, firms facing high asymmetric information will be more sensitive to internal funds. These three implications of financial constraints and capital market imperfection imply that it may be necessary to include a measure of internal funds (such as cash flow) in the model of investment spending. In the next section, we will look at how financial constraints can be empirically tested, and also the difficulties in testing these implications.

2.3 Financial constraints and investment: intuition and investment model

2.3.1 Financial constraints and investment

In an influential paper by Fazzari, Hubbard and Petersen (1988), using a panel of U.S manufacturing firms, they empirically test the relationship between investment and internal funds by augmenting the Q model of investment with cash flow, which acts as proxy to measure internal funds. They then divide the sample using a priori classifications of firms' financing constraints such as dividend pay-out ratios, and compare the investment cash flow sensitivities of the different sub-samples. In this extensive empirical research, , they find that even after controlling for investment opportunities using Tobin's Q, cash flow is still a significant determinant of firm's investment spending. And the sub-sample classified as financially constrained is more sensitive to the availability of internal funds. They interpret this as evidence of financial constraints.

The assumption of representative firms is common to the early research on investment, where the same empirical model applies to all firms regardless of the specification. Therefore, these tests fail to identify whether the observed empirical sensitivity of investment to financial variables differed in different kinds of firms. Thus the representative firm paradigm limited the explanations that could be provided for financial effects. Fazzari et al (1988) is the first paper that abandons the representative firm framework and uses panel data to study financial constraints in relation to firm heterogeneity. Their findings, show significant different investment cash flow sensitivities between groups of firms that have been split based on some a priori measure of information costs or access to external capital markets (for example dividend payout behavior, size). This new insight illustrates the importance of firm heterogeneity with respect to the costs of internal and external finance. Using firm-level panel data allows a researcher to examine how information and incentive problems vary across firms and over time, and how they affect investment spending of firms with different characteristics. Using firm-level data, a large number of papers following FHP's (1988) methodology find similar relationships between investment and cash flows (Hoshi et al. 1991; Oliner and Rudebusch 1992; Whited 1992; Bond and Meghir 1994), and confirm the effects of financial constraint on firm's investment spending[2].

The fundamental empirical strategy of FHP (1988) and their followers, described above, is to assess whether the neoclassical investment models derived under the assumption of perfect capital markets hold for firms facing low information costs, but fails to hold for firms with higher information costs. Furthermore, they tend to measure how changes in net worth affect investment for firms with high information costs. There are two major challenges in this

[2] see Hubbard RG. (1998). "Capital-Market Imperfections and Investment." Journal of Economic Literature 36, 193-225. for a survey

type of empirical tests. First, it is crucial important to accurately measure firms' investment opportunities. In order to interpret investment cash flow sensitivities as evidence of financial constraints, we need to fully control for investment opportunities, so that the significance of cash flow is not reflecting future profitability but the effects of information problems. The existing literature builds on three investment models: the Q model, the Euler equation and the error correction model. The second challenge is measuring financial constraints. In order to measure the cross-sectional differences in the effects of cash flow on the investment of firms facing different level of information problem, we need to find some proxy, which reflects the level of information asymmetry faced by firms, which can be used to partition samples a priori as financially constrained and not financially constrained. These proxies are commonly known as sample splitting criteria in the literature. Finding suitable sample splitting criteria is not an easy task. Empirical evidences show that size, age and affiliation to industry groups are good proxies, but the usefulness of these proxies is not robust and they tend to vary across datasets and countries.

The rest of this section will be organised around the two challenges described above. In section 2.3.2 we will briefly review the three widely used investment models and how to incorporate them with financial factors to test for financial constraints. Then their merits and shortcomings will be addressed. In section 2.3.3, we will first review the sample splitting criteria used in the literature and the rationale for choosing them to partition the samples. The empirical evidence related to them will then be provided.

2.3.2 Investment models

One of the earliest empirical investment models is the accelerator model, which explains investment using current and lagged changes of sales growth. This type of model performs quite well empirically, but it lacks a convincing theoretical background. The neoclassical investment theory closes this gap. It views investment as a choice variable for managers, whose aim is to maximize the firm's value for shareholders. The first neoclassical model is developed by Jorgenson (1971), which specifies that the investment rate is determined by the user cost of capital (the return required by firms in order to undertake an investment). Despite the simplicity and intuitiveness of this model, it fails to establish its validity in empirical tests using aggregate investment data. One explanation to this empirical failure is that Jorgenson's neoclassical model of investment is formulated assuming static expectations, but investment is forward-looking behaviour and so expectations will be a crucial determinant of investment decisions. As a result a dynamic investment model, the Q theory, is developed by introducing convex adjustment cost of capital into the neoclassical investment model.

2.3.2.1 The Q model

Assume that a firm maximizes its value, which is a function of the capital stock from previous period. The firm's problem can be summarized as follows:

$$V_t(K_{t-1}) = \max\{R(K_t, L_t, I_t) + \beta E_t[V_{t+1}(K_t)]\} \qquad (1)$$

Where $V_t(K_{t-1})$ is the firm's current period value function, β is a discount factor, and E_t is the expectation operator based on all the information available on time t, and $R(K_t, L_t, I_t)$ is the net revenue function:

$$R(K_t, L_t, I_t) = p_t F(K_t, L_t) - p_t C(K_t, I_t) - w_t L_t - P_t^I I_t \qquad (2)$$

In the revenue function (2), F(.) is a production function and C(.) is the adjustment cost function. K, L, and I stand for capital, labor and investment respectively, w_t is the wage rate, p_t is the price of the firm's product and P_t^I is the price of investment goods. The firm's infinite horizon optimization problems can be reduced to a two-period problem. At the beginning of the period the firm chooses how much capital it wants to install, which becomes operative immediately. Capital formation follows the following rule:

$$K_t = (1-\delta)K_{t-1} + I_t \qquad (3)$$

where δ is a constant depreciation rate. We further assume that the firm faces convex adjustment costs. The higher the investment in proportion to its existing capital stock the higher the adjustment costs will incur. In order to derive an expression for investment rate, we need to specify a functional form for the cost of adjustment function. It is typical in the literature to assume that both the adjustment cost function C(.) and the production function F(.) are homogeneously linear in capital. The most common form of adjustment cost function is the quadratic cost of adjustment function:

$$C(K_t, I_t) = \frac{1}{2} a K_t [(\frac{I}{K})_t - b]^2 \qquad (4)$$

The firm maximizes its value function subject to the capital formation constraint (3), so we can construct a Lagrangean equation corresponding to the firm's problem as:

$$L_t = R(K_t, L_t, I_t) + \beta E_t[V_{t+1}(K_t)] + \lambda_t[K_t - (1-\delta)K_{t-1} - I_t] \qquad (5)$$

The first order conditions for the firm's maximization problem with respect to previous period capital stock are:

$$\frac{\partial L(K_t, L_t, I_t)}{\partial K_{t-1}} = (1-\delta)\left(\frac{\partial R_t}{\partial K_t}\right) + \beta(1-\delta)E_t \frac{\partial V_{t+1}(K_t)}{\partial K_t} - \lambda_t(1-\delta) = 0 \qquad (6)$$

Equation (6) can be rewritten as follows:

$$\left(\frac{\partial R_t}{\partial K_t}\right) + \beta E_t \frac{\partial V_{t+1}(K_t)}{\partial K_t} = \lambda_t \qquad (7)$$

Equation (7) states that the shadow value of capital, i.e. the additional value for the firm from relaxing constraint (3), is equal to the discounted value of current and future revenues generated by the marginal unit of capital.

The first order condition with respect to investment is:

$$\frac{\partial L(K_t, L_t, I_t)}{\partial I_t} = \frac{\partial R_t}{\partial I_t} - \lambda_t = 0 \qquad (8)$$

Equation (8) is widely used to derive an investment equation based on average Q. (Hayashi 1982) Solve (8) for the optimal investment rate $\left(\frac{I}{K}\right)_t$:

$$\left(\frac{I}{K}\right)_{it} = b_i + \frac{1}{a}Q_{it} + \varepsilon_t \qquad (9)$$

Based on the fact that $\frac{\lambda_t}{p^I{}_t}$ is marginal q, where the market value added to the firm by an additional unit of capital divided by its replacement cost. We can replace $\frac{\lambda_t}{p^I{}_t}$ with q and rewrite equation (9) as:

$$\left(\frac{I}{K}\right)_t = b + \frac{1}{a}(q_t - 1)\frac{p^I{}_t}{p_t} + \varepsilon_t \qquad (10)$$

Incorporating the subscript i, which represents each individual firm and using average Q as a measure for the marginal q, the empirical equation linking investment to average q can be written as:

$$\left(\frac{I}{K}\right)_{it} = b_i + \frac{1}{a}Q_{it} + \varepsilon_{it} \qquad (11)$$

where ε_{it} is the sum of three mean-zero components:

$$\varepsilon_{it} = v_i + u_t + w_{it} \qquad (12)$$

Where v_i accounts for unobserved firm-specific heterogeneity, assumed to be constant over time; u_t capture the cyclical factors that have a common effect on all firms; and w_{it} is a stochastic disturbance to the firm.

Equation (10) links the investment rate to the marginal q adjusted for the relative price of investment goods. However, the marginal q is unobservable to the researcher. Hayashi (1982) shows that under the assumptions of perfect competition in the factor and product markets, homogeneity of fixed capital, linear homogeneity of technologies for production and adjustment costs, and independence of financing and investment decisions, average Q which is constructed as the ratio of the market value of the firm to the replacement value of the capital stock can be used as a proxy for marginal q. In this way unobservable expectations of the future profitability of investment activity can be captured by share prices in the stock market and incorporated explicitly into the q model of investment. In average Q, stock market valuations are used to proxy for the marginal benefits of investment, assuming a homogeneous capital stock. If an additional unit of capital increases the market value of a firm and this increase is greater than the cost of acquiring that marginal unit of capital, investment will take place. The capital stock will increase until its current replacement cost equals the market capitalization.

Equation (11) is a standard empirical formulation of the neoclassical investment model under the null of perfect capital markets. Numerous studies have used this equation to test the null against the alternative in which financial factors affect investment. The usual procedure is to augment equation (11) with a variable – typically, cash flow – that contains information about a firm's financial position. There is a distinctive advantage of this approach, since the observable, average Q, completely summarizes all the information about the expected discounted present value of additional investment. Under this theory, no other variables including financial variables such as cash flow should be a significant determinant of investment. Therefore if the augmented cash flow term turns out to be statistically significant, we would reject the frictionless Q model and interpret it as evidence for financial constraints. The heterogeneity of firms can be studied by dividing the firms into groups facing different levels of information problems a priori according to some sample splitting criteria, which we will discuss in detail in a later section. We would expect the group that classified as not financially constrained to display no significant cash flow coefficient, but the financially constrained group to display a positive and significant cash flow coefficient. The interpretation of positive and significant cash flow coefficient as evidence of financial constraints is however not undisputed. There are three alternative interpretations that have been proposed in the literature for this finding. The first and dominant interpretation is that the empirical significance of cash flow terms in Q model reflects the financial constraints faced by firms due to capital market imperfection. This is because cash flow acts as a proxy for the firm's net worth and therefore determines the external finance premium facing the firm (FHP (1988)).

An alternative explanation for the significance of cash flow is due to the Q model fails to fully capture firms' investment opportunities. In the presence of imperfect capital market or violation of other assumptions that the standard q models is based on, the equality of average and marginal q will be distorted. Since cash flow is closely correlated with future profitability and sales, it provides additional information about firm's profitability and investment opportunities in a Q model. One major measurement error can result from the measurement of market value of the firm, since the market value of the firms is derived from firms' stock prices. When the stock markets are not efficient and stock prices are driven by fads and fashion, the market value of the firm will no longer be a good proxy for its fundamentals. In this case the average Q that is used to measure and control for investment opportunities will be seriously distorted and the interpretations of sensitivities of investment to cash flow as indication of financial constraint will be invalidated. Because now cash flow reflects the investment opportunities and profitability that average Q fails to capture. Bond and Cummins (Bond and Cummins 2001) investigate how an inefficient stock market leads to the empirical failing of the Q model of investment. They find that stock market valuations tend to deviate quite persistently and significantly from fundamental values. After controlling for the misevaluation of the share price, they find no evidence of correlation between investment and cash flow. Cummins, Hassett and Oliner (2006) address the measurement error problem by using analysts' forecasts to construct a "modified Q" and use it in the place of average Q to control for future investment opportunities. They find that financial variables are no longer significant in investment equations. On the contrary, Carpenter and Guariglia (2008) introduce a new proxy for expectations reflecting the firms' insider evaluation of opportunities, i.e. the firm's contractual obligations for future new investment projects, alongside Q to provide an extra control for investment opportunities that might not be reflected by Q. Using a large UK dataset, they find that the explanatory power of cash flow falls for large firms, but remaining strong for small firms. Gilchrist and Himmelberg (1995) use a set of VAR equations to estimate the marginal Q, which they used as a measure of firm's investment opportunities instead the conventional Tobin's Q. In their studies, the cash flow effects disappears for firms that are less likely to face financial constraints, whereas the cash flow remains significant for the group of constrained firms. These results show that after fully controlling for the investment opportunities that the average Q fails to capture with additional control variables, the cash flow remains significant for the group of constrained firms which is in line with FHP's (1988) findings.

The third alternative interpretation for the significance of cash flow is that managers use free cash flow (cash flow left after investment in profitable projects has been carried out) to overinvest, i.e. these firms engage in suboptimal investment policies where they focus on firms' growth in size, which could boost their pay, status and power. In this case the Q model is not an appropriate description of firm investment behaviour (Jensen 1986). This free cash flow theory provides an alternative explanation for statistical significance of cash flow in Q models of investment. However, this theory is very difficult to test as free cash flow cannot be observed.

2.3.2.2 The Euler equation

To circumvent some of the empirical caveats of Q models, an alternative methodology, the Euler equation approach is used. The Euler equation is a different way to rearrange the first-order conditions from the same maximization problem used to derive the Q model. Following Bond and Meghir's (1994) approach, by combining (6) and (7) we can derive the Euler equation for investment:

$$\left(\frac{\partial R_t}{\partial K_t}\right)-\left(\frac{\partial R_t}{\partial I_t}\right)=-\beta(1-\delta)E_t\left(\frac{\partial R_{t+1}}{\partial I_{t+1}}\right) \qquad (13)$$

Equation (13) indicates that the marginal benefits generated by the marginal unit of capital at time t should equal to the discounted value of marginal costs for investment at time t+1, which makes the firm indifferent between investment in two adjacent periods. If the marginal benefits from the installation of an additional unit of capital at time t exceeded the marginal costs for investment at time t+1, the firm would invest more in time t and vice versa. Thus we can solve equation (13) for $\left(\frac{I}{K}\right)_{t+1}$ which will give us the inter-temporally optimal rate of investment. Using the adjustment cost function (4), and with the assumptions of perfect foresight, linear homogeneity of the production function in capital and labour and constant return to scale, the optimal rate of investment will be:

$$\left(\frac{I}{K}\right)_{t+1}=\left(\frac{b^2}{2}-b\right)\varphi_{t+1}+b+\varphi_{t+1}\left(\frac{I}{K}\right)_t-\frac{\varphi_{t+1}}{2}\left(\frac{I}{K}\right)_t^2-\frac{\varphi_{t+1}}{a}\left(\frac{CF}{K}\right)_t+\frac{\varphi_{t+1}}{a}J_{t+1}+u_{t+1}$$

(14)

where $\varphi_{t+1} = \dfrac{1+i_{t+1}{}^{e}}{(1+\pi_{t+1}{}^{e})(1-\delta)}$ is the real discount factor, adjusted for depreciation. i_t is the nominal interest rate and π_t is the inflation rate; and $J_{t+1} = E_t\left(\dfrac{p_{t+1}{}^{I}}{p_{t+1}}\dfrac{1}{\varphi_{t+1}}\right) - \dfrac{p_t{}^{I}}{p_t}$ is the user cost of capital, which equals to the expectation of the discounted relative price of net investment tomorrow minus the relative price of investment goods today. It should be noted that the cost of capital and the cash-flow term enter equation (14) with opposite sign.

The literature that uses Euler equation to analyse the importance of financial constraints is based on the idea that the error term in the Euler equation reflects expectational errors and should be orthogonal to information available in period t under the null hypothesis of symmetric information and rational expectations. However if financial constraints bind, then the Euler equation should depend on the shadow cost of external financing. The Euler equation model, such as equation (14) derived under the assumption of perfect capital market that omits the information of financial constraints would be misspecified. This misspecification will be detected by the test of overidentifying restrictions (Whited 1992; Bond and Meghir 1994;). Since the power of overidentification test may be poor in some circumstances, Whited (1992) and Bond and Meghir (1994) extend the Euler equation model by allowing the shadow cost of finance to depend on some balance sheet variables. The coefficients on these variables would measure the effects of financial constraints on the firm's discount rate. The Euler equation approach can also take explicit account of that fact that firms are heterogeneous in the fashion of the Q model approach discussed above. By dividing firms into groups of more or less likely financial constrained, we would expect to see that the Euler equation is not rejected by the overidenfiying restriction test for firms facing low information problems, but reject the Euler equation for firms facing high information problems.

The most important advantage of the Euler equation approach is that it does not rely on firms' market value to measure expected profitability. So the distortion of the stock market pricing will not affect the Euler equation to control for investment opportunities. But it still preserves the advantage of the Q model, where under the maintained structure, the model fully accounts for the effects of expectation about future investment opportunities on current investment. Moreover, in many countries, unlisted firms are the largest portion of the economy, and this is especially true for developing countries and transition economies with very small or no financial markets. The Euler equation approach provides us a framework to investigate the effects of financial constraints on investment for firms that are not listed in the stock exchange, in which information problems are likely to be particularly severe. The major shortcoming of the Euler equation approach is outlined by Zeldes (1989) in the context of liquidity constraints on consumption. The Euler equation approach may fails to detect the presence of financial constraints if the tightness of the constraints is constant over time. Then the tests of over-identifying restrictions may not be able to detect departures from the null hypothesis of no constraints. But this will be less of a problem, if we have data over a long period time which captures the changes in individual firms' financial health. It is important to note that both the Q model and the Euler equation of investment are derived from the same underlying model, based on the assumption of convex adjustment costs. If there are irreversibility constraints on investment or other forms of asymmetries in adjustment costs, then both models would be fundamentally misspecified. Therefore, other model such as the error-correction model is also used to test the hypothesis of financial constraints.

2.3.2.3 Error-correction model for investment:

Recently, the error-correction model is used as an alternative model that departs from the neoclassical models to test the hypothesis of financial constraints (Bond et al 2003; Guariglia 2006). The error-correction model for investment was first introduced into the investment literature by Bean(1981). This model specifies a long-run or 'target' level of capital stock and allows a flexible specification of the adjustment dynamics to be estimated form the data.

Assuming that in the absence of adjustment costs or barriers to immediate adjustment, the firm's desired capital stock takes the form:

$$k_{it} = s_{it} - \sigma j_{it} + v_i \qquad (15)$$

where k_{it} represents the logarithm of the firms' capital stock, s_{it} represents the logarithm of the firms' sales, and j_{it}, the real user cost of capital; and v_{it} is a firm-specific effect.

However, with the presence of adjustment costs, the firm will not be able to immediately adjust its capital stock to the target level. Thus, we need to impose a dynamic adjustment mechanism between k and s as an autoregressive-distributed model with two lags, in which equation (15) is nested as a long-run equilibrium. Assuming that all variations in the user cost of capital is captured by the time-specific components of the error term, we can obtain an expression for the logarithm of the firms' capital stock:

$$k_{it} = \alpha_1 k_{it-1} + \alpha_2 k_{it-2} + \alpha_3 s_{it} + \alpha_4 s_{it-1} + \alpha_5 s_{it-2} + v_i + v_t + v_{jt} + e_{it} \qquad (16)$$

where v_i is a firm-specific effect; v_t, a time-specific component; v_{jt}, a time-specific effect that varies across industries; and e_{it}, an idiosyncratic error term. Re-parameterising this model in an error-correction form, and impose the unit elasticity restriction i.e. that in the long run $(\alpha_3 + \alpha_4 + \alpha_5)/(1 - \alpha_1 - \alpha_2)$ is equal to 1, and using the approximation $\Delta k_{it} \approx (I_{it} / K_{it-1}) - \delta_i$, where δ_i stands for firm-specific depreciation, which is expected to be reflected in the v_i component of the error term, we can obtain the empirical specification of the error-correction model:

$$\begin{aligned} \frac{I_{it}}{K_{it-1}} &= (\alpha_1 - 1) s_{it-1} + \alpha_3 \Delta s_{it} + (\alpha_3 + \alpha_4) \Delta s_{it-1} - (1 - \alpha_1 - \alpha_2)(k_{it-2} - s_{it-2}) \\ &\quad + v_i + v_t + v_{jt} + e_{it} \end{aligned} \qquad (17)$$

It is important to note that in order to be consistent with the error-correction behaviour, the coefficient associated with $(k_{it-2} - s_{it-2})$ should be negative, i.e. if capital stock is lower than its desired or 'target' level, future investment should be higher to catch up with the desired level of capital stock and vice versa. Financial constraints are modelled by augmenting equation (17) with the cash flow to capital ratio to capture effects of financial constraints. Moreover a dummy variable such as dividend cut is also introduced to study the differential effect of cash flow on different firms. This dummy variable is interacted with the cash flow variable. Thus the coefficient on the cash flow terms by themselves will capture the responsiveness of investment to cash flow for unconstrained firms, which is expected to be small and insignificant. The responsiveness of investment to cash flow for constrained firms is then given by the combination of the coefficients of cash flow and the coefficients on the interactive variables. The coefficients on these interactive terms are expected to be jointly significant and positively signed if financially constrained firms respond more strongly to cash flow than unconstrained firms.

2.3.3 The Kaplan and Zingales critique:

The overall evidence of the empirical studies on financial constraints suggests that the sub-sample of firms thought a priori to face more severe information problems is indeed financially constrained. However, a more recent study by Kaplan and Zingales (1997) casts doubt on using investment cash flow sensitivities as evidence of the presence of financial constraints. In their study, they re-examine the sample of 49 low-dividend pay-out firms from FHP (1988) and try to find statements indicating whether or not financial constraints are a problem. Based on this information, they divide the firms in groups as: not financially constrained, possibly financially constrained, and financially constrained. They find that, in contrary to FHP‘s (1988) finding, that the financially constrained group actually displays the lowest sensitivity of investment to cash flow of the three groups. Using a larger sample, Cleary (1999) finds evidence supporting KZ (1997) by splitting US firms according to their creditworthiness that reflects financial constraints. They find that the investment decisions of firms are very sensitive to the availability of internal funds in general but less creditworthy firms are relatively less sensitive to internal fund. This apparent contradictory result led to a heated debate. ((Fazzari et al. 2000)；(Kaplan and Zingales 2000))

The conclusions from KZ's tests suffer from some problems. First, it is very difficult, if not impossible, to define so finely the degree of financing constraints, especially in such a small sample. Second, their classification is based on managers' statements, which are not necessarily reliable, since the operational definition of financial constraints is not well defined. Despite the problems associate with KZ's classification of firms, their finding is an extension to FHP's (1988). FHP (2000) note that the FHP (1988) firms-years KZ classify as "more financially constrained" are actually "financially distressed". These observations include firms that violated the debt covenants and renegotiated debt payments. Financially distressed firms are likely to be restricted by creditors from using internal funds for investment and might therefore have a relatively low responsiveness of investment to internal funds.

Allayannis and Mozumdar (2004) provide evidence on the impact of financially distressed firms on the estimate of investment cash flow sensitivities. Using a sample of overwhelmingly fragile firms, they find that the investment of those firms having negative cash flow is not sensitive to cash flow, but after excluding such firms from the sample the investment cash flow sensitivity increases for the more constrained firms.

Cleary, Povel and Raith (2007) provide a model that reconciles the puzzling results generated in the previous literature. They extended the debt contract model with three additional assumptions that are different from previous studies: 1) the firms have more than one opportunity to invest, 2) firms can have negative cash flow and 3) all the costs of raising funds are endogeneously determined. They find that, under the interaction between cost and revenue effects, firm’s optimal investment function is U-shaped over the range of feasible levels of internal funds. The cost effects occurs when higher level of investment increases the firms repayment costs and thereby raise its risk of default and liquidation, in turn raising the marginal cost of debt. When cost effects are dominant, the model predicts a positive relationship between cash flow and investment. The revenue effect occurs when higher levels of investment generate more revenue, which increases the firm’s chance of survival and lowers the marginal cost of debt finance. When the revenue effect dominates, there is a negative relationship between cash flow and investment. Cleary et al (2007) also demonstrate that as the degrees of asymmetric information increases, the investment curve becomes steeper almost everywhere, which implies that a higher level of asymmetric information leads to an increase in sensitivity of investment to cash flow. Based on these findings, they note that the measures of financial constraints can be classified into two categories: 1) internal financial constraints, which classify firms or firm-years on the basis of indicators related to the level of internally generated funds available to them, 2) external financial constraints, which classify firms using criteria such as firm size, age, dividend payout ratio. These criteria indicate the degree of asymmetric information the firms are facing. They further show that the contradictory results obtain by FHP (1988) and KZ (1997) can be explained by the different criteria utilised in their studies to partition their samples. Studies that use external financial constraints criteria, such as FHP (1988), suggest that the sensitivity of investment to cash flow tends to increase monotonically with the degree of external financial constraints. On the other hand, studies that use internal financial constraints as sample splitting criteria, i.e. the level of internal funds available to the firms, such as KZ (1997), suggest that the relationship between investment and cash flow is U-shaped and firms classified as less financially constrained is likely to display a higher investment cash flow sensitivity than financially constrained firms. Guariglia (2008) finds similar result using a panel of UK data.

2.4 Sample splitting criteria

Another essential component in the test of financial constraints hypothesis is the sample splitting criteria. By splitting firms into groups with different level of asymmetric information, we can investigate the asymmetric impact of asymmetric information and agency problems on firms with different characteristics. Using this method, we can avoid the problem of aggregation in previous studies. Moreover, as discussed in the last section, the empirical evidence of investment cash flow sensitivities tends to be quite sensitive to the choice of sample splitting criteria. In this section, we first review some general issues about the sample splitting criteria and examine the rationale for the sample splitting criteria that are widely used in the literature. The empirical evidence from the literature is also presented.

There are three general issues and problems in choosing the criteria to partition the sample into more or less likely to be financially constrained (Schiantarelli (1996). First, in the early studies, firm's status as being financially constrained or unconstrained tended to be fixed over entire sample period. However, firms tend to transit between different regimes over time, where financial constraints may be binding for some year but not in others. In more recent studies, researchers tend to assign firm-years into different groups which allow firms to transit between different financial regimes during the sample period.

The second issue that we need to pay attention to is the endogeneity problem of the sample splitting criteria. Most of the criteria, that are based on firm's characteristics tend to be endogenous, is correlated with firm-specific and time invariant component of the error term (Schiantarelli 1996). The endogeneity problem can be dealt with by using GMM procedures in estimation.

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The third issue relates to whether single or multiple indicators should be used. The decisions tend to vary with the context. The common approach in the literature is to use a single indicator to partition the sample into groups. Multiple indicators could also be used to partition the sample. However as the number of indicators increases, the numbers of parameters to be estimated increases rapidly as well, which can be particularly problematic in small samples. Generally, most of the studies are in favour of using a single indicator. Now we will move on to look at the most commonly used criteria in the literatures.

2.4.1 Dividend pay-out ratio

The use of the dividend payout ratio was first proposed by Fazzari, Hubbard and Petersen (1988). The rationale behind the dividend payout ratio is that firms with low dividend pay-out ratio are likely to be firms that have exhausted their internally generated funds and are forced to use the more expansive external funds. Based on this sample splitting criteria, FHP (1988) found that firms with low dividend payout ratio display higher sensitivities of investment to cash flow than firms with high dividend payout ratio. In the context of the Euler equation, Hubbard, Kashyap and Whited (1995) using average pay-out ratio as sample splitting criterion, find that the Euler equation model is rejected for the low dividend payout firms, but not for the high dividend payout firms.

2.4.2 Affiliation to the industrial group

Being part of industrial groups, firms have access to the internal capital market created by the group. Industrial groups are particular effective in dealing with information and contract enforcement problems within the groups. When a firm needs external finance it can obtain funds at a relative lower cost. Therefore it is expected that firms who have affiliation to industrial groups will have lower investment cash flow sensitivities than firms who are not part of an industrial group, because of the reduction in information costs for being part of the group and the access to the internal capital group. Moreover, this sample splitting criterion is particularly desirable, because the status of affiliation to industrial groups tends to be fixed, which avoids the problem of endogeneity. The evidence of investment cash flow sensitivities tend to be quite robust with the affiliation to the industrial group as a sorting criterion. Hoshi, Kashyap and Scharfstein (1991), using dataset from Japan, find that firms that are part of the industrial groups display lower cash-flow sensitivities. Evidence from other countries such as Korea (Shin and Park 1999), Canada (Schaller 1993; Chirinko and Schaller 1995) also found supporting results for the idea that affiliation to industrial groups helps to reduce information asymmetries and to relax financial constraints.

2.4.3 Size

Firm size has been the most widely studied sample splitting criterion. It is expected that size is closely correlated to the probability of being financially constrained. Small firms are likely to be young firms; they have little or no track records, which lead to high information asymmetry costs, but as they grow bigger and have a longer operating period, the costs of information asymmetry are expected to decrease. Moreover, the collateral value of assets is highly correlated to firm size, where large firms tend to have lower unit bankruptcy costs. Finally, it is likely that transaction costs for new share or bond issues is high for small firms and these costs will decrease as firms grow larger. Based on the above arguments, it is believed that large firm will be less likely to be financially constrained. On the other hand, size may be inversely related to the concentration of ownership, where firms with high concentrated share ownership are likely to have low agency problems between managers and investors. If the sample of study involves only relative large quoted firms, then we need to pay extra attention to this issue.

The evidence from studies using size to partition sample is mixed. In general, the results tend to suggest that smaller firms display significantly higher investment cash flow sensitivities (see FHP (1988); Hu and Schiantarelli (1998); Jaramillo (Jaramillo et al. 1996)). On the other hand, Devereux and Schiantarelli (Devereux and Schiantarelli 1990), using a sample of relatively large quoted firm from UK, find that large firms are more sensitive than small firms to cash-flow fluctuations. This is probably due to the ownership argument we discussed above. Moreover Chow and Fung (1998), using firm-level data from a survey of manufacturing sector investment in Shanghai, find that large firms are more financially constrained than small firms. They suggest three reasons for this unusual finding: 1) Collectively-owned enterprises which are managerial efficiency dominate the small firm classes, they have greater capacity in generating large enough cash flow in financing their fixed investment; 2) the presence of heavy indebtedness of large state-owned enterprises may deprive them of sufficient cash available for investment decision; 3) Small firms in non-state sectors can rely on borrowing from the informal credit market although they can only obtain very limited bank credit from the formal banking institutions.

2.4.4 Bond Ratings

Bond rating is a popular choice in recent studies. It provides a better, exogenous proxy for splitting the sample to reflect differences in information available to external lenders. Firms that have their corporate bonds rated by a bond rating agency are considered less likely to be financially constrained, since bond rating provide extra information to lenders about the quality of the rated firms' investment opportunities. Moreover, if firms do not have a bond rating, it indicates that they do not participate in the corporate bond market. Whited (1992) find that the effect of financial constraints appears to be stronger for firms that do not have bond rating than firms have a bond rating.

2.4.5 Leverage ratio

Another criterion used in testing for financial constraint is the leverage ratio which is constructed as total debts divide by total assets. It is believed that firms with high leverage may be expected to meet higher agency costs. These agency costs can arise from 'moral hazard' generated by the firms' managers by making an excessively risky investment. The reason for this risky behaviour is that with high leverage the firms may retain most of the profit from any success but lenders incur most of the losses from failure due to the limited liability nature of debt contracts. Agung (2000), using data from Indonesia, find that high leverage firms display higher investment cash flow sensitivities than low leverage firms.

2.4.6 Coverage ratio

The coverage ratio is defined as the ratio between firms' total profits before tax and before interest and their total interest payments. It indicates the availability of internal funds that firms can use to finance their real activities. If a firm can generate sufficient internal funds, it will not have great need to borrow and will not be likely to run up against its debt limit. The coverage ratio is widely used in the literature on the effects of financial constraints on firms' activities ((Guariglia 1999; Guariglia 2000; Guariglia and Mateut 2006)and Whited, 1992). Based on the model develop by Cleary, Povel and Raith (2007), coverage ratio can be seen as a measure of internal financial constraint. Guariglia (2008), using a large UK data, finds that relationship between investment and cash flow is U-shaped.

2.4.7 Cash flow

Cash flow itself can also be used as a sample splitting criterion. It is generally used as a proxy for internal funds and internal financial constraints. One distinctive advantage of cash flow is that it can take negative values, which is important in the model proposed by Cleary etl al's (2007) as discussed in the last section. It is for those firms whose internal funds are sufficiently negative, that the revenue effect dominates, leading to a negative relationship between investment and internal funds. A major drawback for using cash flow as a measure for internal funds is that it is a flow variable, which ignores the stock of funds accumulated in the past. Using cash flow as a sample separation criterion, Cleary *et al* (2007) and Guariglia (2008) find that, when including negative cash flow, the relationship between investment and cash flow is U-shaped.

2.4.8 Summary for sample split criteria

Sample splitting criteria are used as a proxy for the level of information asymmetries and agency costs that a firm faces. Firms are divided into groups of *a priori* more or less likely financially constrained. From the brief review above, we can see that most sample splitting criteria, which are currently used in the existing literatures, are imperfect and subject to a number of problems. Nonetheless, these sample splitting criteria offer us some insights about the relationship between firms' characteristics and their behaviour. This provides us a framework to study firm heterogeneity.

2.5 Conclusions

In this literature review, we have looked at the key components of the tests for financial constraint. We investigated how alternative investment model specifications (the Q model, the Euler equation and the error-correction-model) were used to control for investment opportunities. Then we examined the commonly used sample splitting criteria that were used to identify firms as more or less likely to be financially constrained. Empirical evidence has generally supported the financial constraints hypothesis, across different countries and different firm characteristics. On the other hand, some empirical evidence casts doubts about the interpretation of investment cash flow sensitivities as evidence of financial constraints, these criticisms are mainly relying on that the Q model failed to properly control of investment opportunities. In order to fully understand the effects and implication of financial constraints, further research is necessary.

Chapter 3: Ownership, Financial Constraints and Investment: Evidence from China

3.1 Introduction

The pace and pattern of business investment in fixed capital are central to our understanding of economic activity. Business investment is one of the key determinants of an economy's long-term growth rate and also plays a pivotal role in explaining business cycle fluctuations. It is therefore crucial for economists and policy-makers to understand the mechanisms that determine investment spending. Furthermore, it is particular important to central banks for an effective conduct of monetary policy, because investment is believed to be a major interest-sensitive expenditure.

Despite the extensive research, the explanation of investment behaviour has been disappointing. Thus, researchers start to improve the empirical specification of investment models by modifying the fundamental underlying assumptions. One of the recent progresses is by examining the implications of financial constraints caused by capital market imperfections on investment.

Financial constraints have long been cited as the major obstacle for business. And this is particular true for transition economies like China, which has a relatively less developed financial market and a state-dominated financial system. Investment has been the key drivers of China's economic growth in recent years. And private firms are considered to be the engine of growth for the Chinese economy in the future. However, recent surveys indicate that private firms in China have continuously cited failing to obtain finance as the major obstacles for their growth and development. Recent studies suggest that capital and resources are possibly misallocated across firm ownership. In particular there is a lending bias in China's financial system which gives preferential access to finance to state-owned firms and creates political induced obstacles for private firms to obtain finance. Huang (2003), in his popular book "Selling China", characterised this type of policy induced liquidity constraints for different ownership as a "political pecking order" for finance.

This paper is intended to study the relationship between financial constraints and investment in China. In particular, we will focus on the impact of ownership on the level of financial constraints. We will also explore whether regional disparities have an impact on the level of financial constraints. Last, China has been one of the biggest FDI recipients in the World. We would also like to test whether foreign investment helps to alleviate the level of financial constraints.

The rest of the paper proceeds as follow. Section 3.2 presents a brief review of financial constraints and investment[3]. Section 3.3 provides some stylized facts and background to Chinese fixed investment in the past 10 years using aggregate data. Section 3.4 discusses the development and reform of the financial system in China, and develops the hypothesis related to the financial constraints in China to be tested with our empirical model. Section 3.5 presents the estimation framework and presents the empirical model to be tested in this chapter. Section 3.6 describes the data used in this study and provides the

[3] A more comprehensive literature review of financial constraints and investment is provided in chapter 2 of this thesis.

descriptive statistics of the sample data. Section 3.7 discusses the empirical results. Section 3.8 concludes the paper and provides some policy implications.

3.2 Literature Review

3.2.1 Theory of financial constraints

Modigliani and Miller's (1958) seminal work suggests that under perfect and complete capital markets, firms' investment decisions and their financing decisions should be independent from each other. In this framework, the external finance (debt and new equity issues) and internal finance (retained earnings) are perfect substitutes. Firms are able to undertake all the profitable investment opportunities.

However, in reality capital markets are rarely perfect. There are a number of factors that lead to imperfections in capital market, such as taxes, transaction costs, and most importantly information asymmetries between lenders and borrowers. These lead external finance to be more expensive than internal finance. Moreover, external finance may not be available at all for some firms. This implies that internal finance provide a cheaper source of financing, thus an increase in the level of internal finance increase the desired level investment spending. As a result, the level of internal fund could be an important determinant of investment empirically.

Existing models of imperfect capital market focus on the problems of adverse selection and moral hazard in generating frictions in capital markets. Myers and Majluf (1984) present a model of equity finance, recognizing the problems of information asymmetry, which lead to adverse selection. They show that when outsiders (investors) have imperfect knowledge of the value of the firm, they will demand a premium to acquire the firm's shares in order to compensate the losses incurred from financing a 'lemon' firm. This premium makes the external cost of capital higher. To the extreme, Stiglitz and Weiss (1981b) argue that informational asymmetries will lead to credit rationing in the loans market, as lenders are unable to discriminate between good and bad borrowers. In this situation, lenders will intentionally set a price that creates an excess demand for loans. Jensen and Meckling (1976) argue that due to limited liability, a moral hazard problem may arise when borrowers have the incentive to use funds on excessively risky projects. In order to compensate this potential risk, lender will demand a premium for the loan and possibly use covenants to restrict the use of funds in specific areas.

Despite the difference in details in these theoretical studies, they all provide us with the common theme that a general implication of information problems in capital market is that internal funds and external funds are no longer perfect substitutes. There is a gap between the cost of internal funds and external funds. This gap is positively related to the level of the information asymmetry which leads to an "information cost". Firms that facing higher level of information asymmetries will tend to face a much higher cost for external funds than firms facing low level of asymmetric information. These firms' investment will tend to be financially constrained and could not achieve the optimal investment level.

3.2.2 Investment Cash-Flow sensitivities and financial constraints

Empirically, financing constraints could be identified through sensitivity of investment with respect to internal funds[4]. The concept of financial constraints can be understood from the graphical illustration of figure 3.1 below.

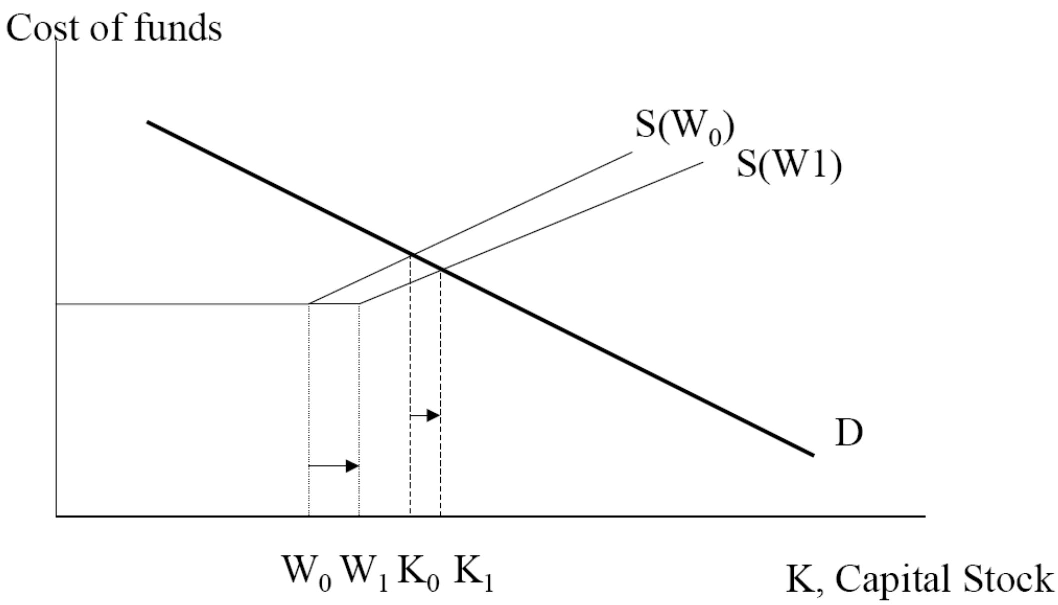

Figure 3.1: investment and net worth in imperfect capital market.
Adapted from Hubbard (1998) .

In the context of perfect capital market, there is no asymmetric information, so both insiders and outsiders have the same information. Thus, the cost of external funds always equals to the opportunity cost of internal funds. Firms will be able to obtain external finance for the gap between internal

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[4] Internal finance is typically proxy by the level of cash-flow in the empirical literatures.

finance and external finance to achieve the optimal investment level at the opportunity cost of internal funds. Therefore internal funds have no effects on investment, and underinvestment will not occur.

Figure 3.1 illustrates the demand for capital and the supply of funds in the presence of information asymmetries. The curve *S(W)* represents the supply of funds, where W is the level of internal funds of the firm. Recall from the discussion from the last section, information asymmetry will lead outsiders to demand a premium of external funds, therefore for funds above the level of internal funds is represented by an upward sloping supply curve, where the firm will face higher costs of capital. Now consider a firm with net worth of W_0 and investment demand curve D, due to imperfect capital market, the firm will only invest up to the point K_0 which is much less than its optimal investment level in perfect capital market. This illustrates the important impact of financial constraints of investment, where lack of finance will cause the firm to fail to achieve its optimal investment level.

An increase in net worth (or internal funds) from W_0 to W_1 in the financially constrained firms will lead to an increase in investment from K_0 to K_1, holding the investment opportunities unchanged, as illustrated in Figure 3.1. This increase in internal funds which are independent of the investment opportunities helps to alleviate the problems of financial constraints and leads to an increase in investment and the level of capital stock. The slop of the *S(W)* curve is typically determined by the level of information problems a firms faced. For firms that are facing high information problems, the *S(W)* curve tend to be much steeper, on the other hand well established firms facing low information problems ten to have a flatter *S(W)* curve which indicates that the costs of external funds is close to their internal funds. This provides a justification for the investment cash-flow sensitivities studies, where higher sensitivity of investment to cash-flow suggests the presence of financing constraints.

3.2.3 Empirical evidence on financing constraints

3.2.3.1 Empirical evidence on developed countries and developing countries

The effect of financial constraints on investment is essentially an empirical problem. Generally, there are two main approaches to test the sensitivity between investment and cash flows. The first approach is based on the Q theory of investment developed by Tobin (1969). The seminal paper of Fazzari, Hubbard and Petersen (1988) (hereafter "FHP") used it as the base model to investigate the presence of financing constraints. By including a measure of internal funds (Cash flow) as an explanatory variable in the reduced form q-model, they divide the sample using *a priori* classifications of firm's financing constraints (dividend policy) and then compare the investment-cash flow sensitivities of the different sub samples. They interpreted the higher sensitivities of cash flows for the sub-sample of *a priori* more constrained firms as evidence of financial constraints. FHP argue that firms facing higher financial constraints find external finance much more expensive and have to depend on their internal finance for expanding investment. Therefore, these firms should demonstrate a high sensitivity between investment and cash-flows.

There has been a large literature using similar methodologies that confirms findings in the FHP's (1988) seminal paper. Hoshi, Kashyap and Scharfstein(1991) compare Japanese manufacturing firms which are members of a keiretsu and those who are not. They find that the latter are more sensitive to internal funds than the former and conclude that membership of keiretsu reduces the likelihood of being financially constrained. Oliner and Rudebush (1992) find that investment-cash flow sensitivity is higher for young firms, whose shares are traded over-the-counter, than other firms.

An alternative approach to tests for the hypothesis of financial constraints is based on Euler investment equation. Whited (1992) find that Euler investment equation fits well for firms with bond ratings but it is rejected for firms without bond ratings. Similarly, Hubbard, Kashyap and Whited (1995) report that the standard Euler equation models is rejected for firms with low dividend pay-out ratios, but not for firms with high dividend pay-out ratios. Both papers suggest that exogenous financial constraints are particularly binding for constrained firms, which supports the FHP (1988) results.

The Euler equation approach is the preferred model for this study. We will provide the basic derivation of the Euler equation investment model from firm's optimal problems in section 5 and its empirical specification for the econometric tests.

3.2.3.2 Empirical evidence on China

Despite the important role of fixed investments plays in the Chinese economy and China's phenomenal economic growth in the past three decades, very little empirical research has been conducted on the relationship between fixed investment and financial constraints in the context of China. One of the main reasons is due to the lack of good quality micro level data on Chinese firms.

Using data for Shanghai's manufacturing sector between 1989 and 1992, Chow and Fung (1998) study the relationship between investment and ash flow. They estimate a sales accelerator model and confirm that the investment of manufacturing enterprises in Shanghai is constrained by cash flow. Furthermore, their evidence indicates that private firms are more financially constrained than state-owned enterprises (SOEs), which support the existence of a "lending bias" where the banking sectors have a preference to lend to SOEs over private firms. They also find evidence that international joint ventures are the least financially constrained. Using the same dataset and empirical specification, Chow and Fung (2000) find that small firms display lower level sensitivities of investment to cash flow than large firms, which is in contrast to those findings from the developed countries. They argue this finding is due to the fact that small firms are successful and fast growing, which allows them to smooth their fixed investment with working capital adjustment.

Using firm-level data on 1300 China's domestic firms over the period 2000-2002, Héricourt and Poncet (2009) estimate a dynamic investment model to study the presence of financing constraints for domestic firms in China. Their study suggests a significant difference between the credit constraints faced by private firms and state-owned firms. Moreover, by focusing on the effects of FDI inflows, Héricourt and Poncet (2009) find the FDI inflows seem to reduce the level of financial constraints of private firms in China.

3.3 Stylized facts and trends of fixed investment in China

Fixed investment has long been identified as one of the key drivers of China's rapid economic growth in the last three decades. In order to understand China's phenomenon growth speed, it is important to gain a good understanding of its fixed investment. This section aims to look at the stylized facts and trends of fixed asset investment in China from 1995 to 2006 from the aggregate data. In particular, we would like to focus on how the investments are financed and which ownership types are investing. This provides us some backgrounds for our empirical investigation of the effects of financial constraints on investment for different ownership groups.

3.3.1 Investment growth and Investment-GDP ratio

Figure 3.2 indicates that China's investment has been growing rapidly in recent years. Since the slowdown of investment growth in the 1995 due to the government's tightening of the economy to combat the high inflation rate, and after the 1998 recession due to the Asian financial crisis, the investment growth rate decline to around 5% at the trough in 1999, the investment growth rate has picked up its pace and reached a peak of 27.7% in 2003. Although investment growth has been easing after 2003, investment has been continuously growing at a rate well above 20%.

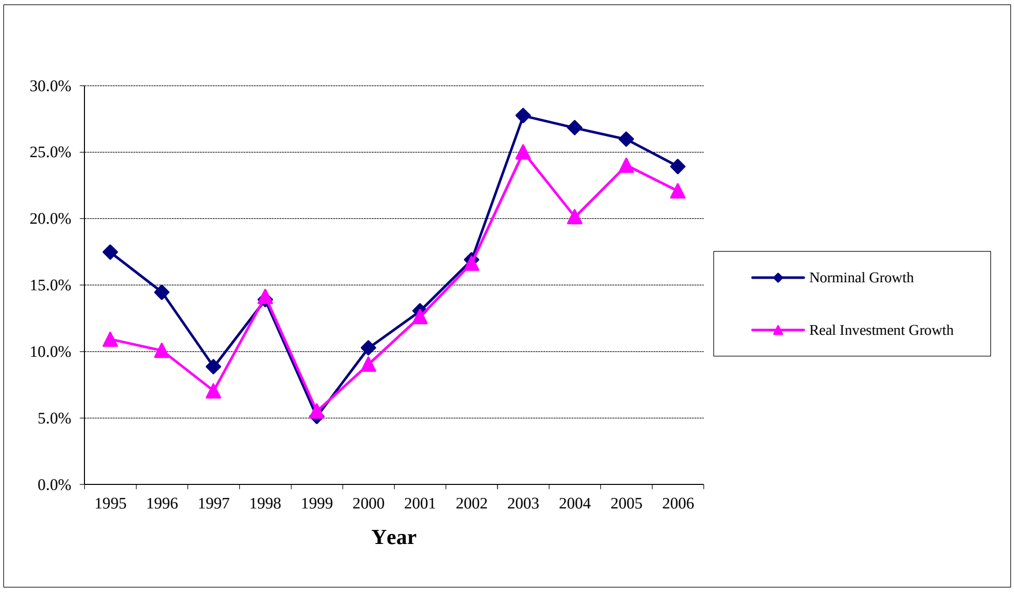

Figure 3.2: China's fixed investment growth rate.
Sources: NBS; and Authors' estimates

It is widely recognised that the phenomenal growth rate of the Chinese economy is largely driven by capital accumulation. Figure 3.3 plots the investment to GDP ratios over the period of 1995 and 2006. The investment to GDP ratio has been well above 30% since 1995, and continues to grow and reaching nearly 52% in 2006[5]. China's investment ratio in recent year is exceptionally high compare to other countries. Even when we compare China's

[5] See table 1 for detail investment to GDP ratios.

investment ratio to Korea and Japan during their boom years, China's investment ratio is much higher[6].

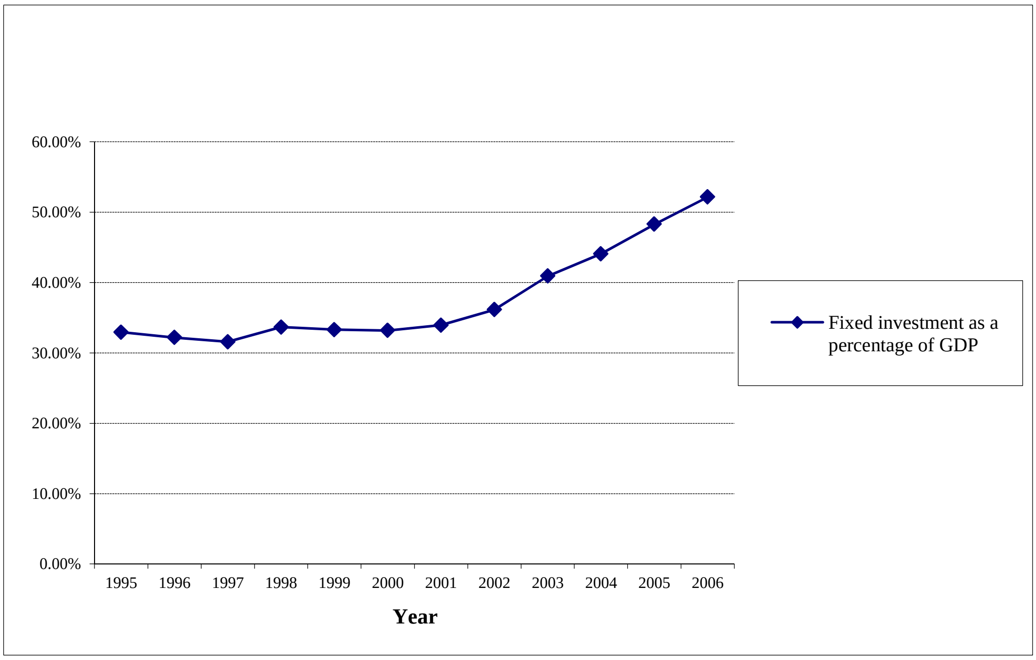

Figure 3.3: Fixed investment as a percentage of GDP in China 1995-2006
Sources: NBS; and Authors' calculation

Table 3.1 reports the level of foreign direct investment and foreign direct investment as a percentage of GDP. The absolute level of foreign direct investment has almost doubled over the past ten years reaching 69.47 billion USD in year 2006. However, its impact on GDP seems to be declining, due to the rapid increase in GDP: in 1995 FDI was around 5.15% of GDP, but it declines to around only 2.63% of GDP in 2006. The continuous inflow of FDI to China in recent year has been interpreted as a high demand for finance, where FDI is used as a substitute to domestic financing sources, given that some firms are biased against in the formal financial system in China. We will further look at this issue at the later sections. In particular, we would like to explore whether

[6] Japan's investment ratio peaked in 1973 at 37.1% and Korea's investment ratio peaked in1991 at 38.9%. Sources: OECD Fact book 2008.

foreign investment in the form of foreign ownership will help to alleviate firms' level of financial constraints.

Year	*GDP (RMB 100Million)*	*Total Fixed Investment (RMB 100Million)*	*Percentage of GDP*	*Foreig (US*
1995	60793.7	20019.3	32.93%	
1996	71176.6	22913.5	32.19%	
1997	78973.0	24941.1	31.58%	
1998	84402.3	28406.2	33.66%	
1999	89677.1	29854.7	33.29%	
2000	99214.6	32917.7	33.18%	
2001	109655.2	37213.5	33.94%	
2002	120332.7	43499.9	36.15%	
2003	135822.8	55566.6	40.91%	
2004	159878.3	70477.4	44.08%	
2005	183867.9	88773.6	48.28%	
2006	210871.0	109998.2	52.16%	

Table 3.1: Fixed Asset Investment and FDI as a percentage of GDP in China
Sources: NBS China Statistics Yearbooks; various issues

3.3.2 Investment by ownership

The National Bureau of Statistics of China (NBS) provides data on investment in fixed asset by different ownership types. Table 3.2 shows the share of investment in fixed asset by different ownership types for the period 1995 - 2005. The main ownership groups according to the official registered status include: state-owned units, collective-owned units, individual economy (private firms), joint ownership units, share-holding units, foreign funded units and units with funds from Hong Kong, Macao and Taiwan.

The state-owned firms' share of investment in fixed assets has declined over the ten year period from 54.44% to around 33.42%. This result is consistent with the on-going reform and privatisation of the state-owned sector. Despite the decline in the share of investment in fixed asset, it is clear that the state sector still accounts for about one third of the fixed asset investment, which makes them still the biggest player in the economy.

On the other hand, after years of reform and opening up of the Chinese economy, the private sector's share of fixed asset investment is stagnant. Private sector's share of investment in fixed asset remains at around 14% to 15%. Lack of access to external funding or financial constraints could be an important explanation for this stagnant growth of the private sector investment.

																Nominal	RMB millions	
Year	***Total***	***State-owned Units***	***%***	***Collective-owned Units***	***%***	***Individuals Economy***	***%***	***Joint Ownership***	***%***	***Share Holding***	***%***	***Foreign Funded***	***%***	***Units with Funds From Hong Kong, Macao and Taiwan***	***%***	***Others***	***%***	
1995	20,019.27	10,898.24	54.44%	3,289.45	16.43%	2,560.25	12.79%	118.48	0.59%	863.99	4.32%	1,555.26	7.77%	673.64	3.36%	60.00	0.55%	
1996	22,913.50	12,006.20	52.40%	3,651.50	15.94%	3,211.17	14.01%	126.78	0.55%	1,034.57	4.52%	1,876.11	8.19%	835.41	3.65%	171.80	1.43%	
1997	24,941.12	13,091.73	52.49%	3,850.87	15.44%	3,429.43	13.75%	123.12	0.49%	1,387.22	5.56%	1,955.95	7.84%	937.14	3.76%	165.68	1.27%	
1998	28,406.18	15,369.38	54.11%	4,192.24	14.76%	3,744.38	13.18%	60.50	0.21%	1,947.02	6.85%	1,639.61	5.77%	1,334.26	4.70%	118.96	0.77%	
1999	29,854.72	15,947.77	53.42%	4,338.55	14.53%	4,195.75	14.05%	97.90	0.33%	2,478.89	8.30%	1,433.41	4.80%	1,218.07	4.08%	144.45	0.91%	
2000	32,917.74	16,504.45	50.14%	4,801.45	14.59%	4,709.37	14.31%	94.73	0.29%	4,061.88	12.34%	1,313.21	3.99%	1,293.06	3.93%	139.62	0.85%	
2001	37,213.49	17,606.98	47.31%	5,278.58	14.18%	5,429.57	14.59%	94.52	0.25%	5,663.50	15.22%	1,415.47	3.80%	1,583.29	4.25%	141.68	0.80%	
2002	43,499.91	18,877.35	43.40%	5,987.43	13.76%	6,519.19	14.99%	138.19	0.32%	8,328.81	19.15%	1,685.43	3.87%	1,765.33	4.06%	198.19	1.05%	
2003	55,566.62	21,661.02	38.98%	8,009.49	14.41%	7,720.13	13.89%	187.97	0.34%	12,733.58	22.92%	2,533.71	4.56%	2,375.09	4.27%	345.70	1.60%	
2004	70,477.45	25,027.62	35.51%	9,965.73	14.14%	9,880.55	14.02%	217.55	0.31%	17,697.90	25.11%	3,854.02	5.47%	3,113.50	4.42%	720.59	2.88%	
2005	88,773.61	29,666.92	33.42%	11,969.65	13.48%	13,890.65	15.65%	229.59	0.26%	23,535.96	26.51%	4,657.06	5.25%	3,767.32	4.24%	1,056.47	3.56%	

Table 3.2: Total Investment in Fixed Assets in the China by Ownership 1995-2005
Sources: NBS China Statistics Yearbooks; various issues

The true ownership of collective-owned, joint-ownership, and share holding companies are harder to determine. Sometimes these ownership are combined and classified as non-state-owned sector, if we combined private-ownership with the non-state-owned sector, we would see that in the year 2002, their combined share of investment in fixed asset has surpass those of the state-owned sector. It is likely that the non-state sector will be the main driver of China's future growth. If we look at table 3.2 closely, we can see this is largely the result of significant increase in the share holding companies, which is mainly the result of restructuring state-owned enterprises during the reform. The central government restructured a number of state-owned enterprises as shareholding companies and list them on the stock exchange. The central government started to take a passive role in these new companies. During the early year of the reform, the candidates for listing in the stock exchange are recommended by the local governments and confirmed by the central government. Until 2004, private firms rarely have the opportunity to be listed in one of the two stock exchanges in China. These reform processes also deprive the private enterprises' opportunity for funding from the capital market.

Foreign funded units also show a decline in the share of investment in fixed asset in the early 2000 from 7.77% to 3.8%, but gradually climb back in recent years to around 5%. Firms with funds from Hong Kong, Macao, and Taiwan's share of investment in fixed asset are very stable at around 4% over the ten year period. In sum, foreign-invested firms only accounts for a small share of investment.

3.3.3 Sources of investment funding

Figure 3.4 and table 3.3 present the major sources of funding for fixed investment in China. NBS[7] China classified investment funding into four major categories: state budget, domestic loans, foreign investment, self-raised funds and others.

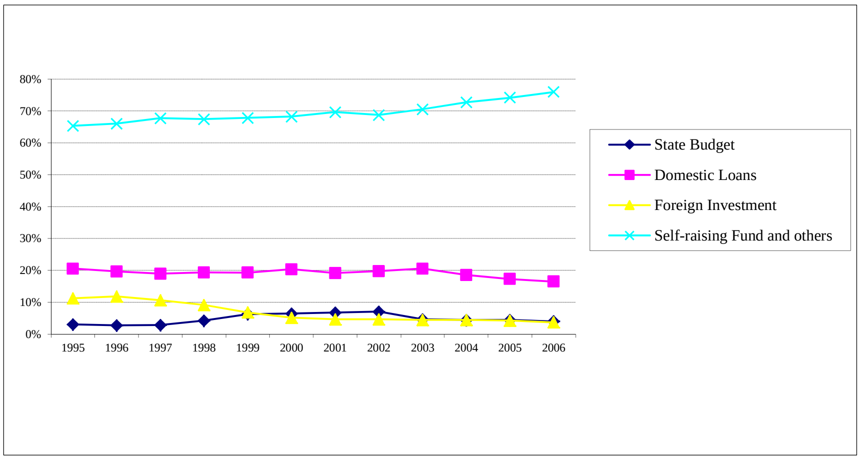

Figure 3.4 Financing of fixed investment in China
Sources: NBS; and Authors' estimation.

From figure 3.4, it is clearly that state budget no longer plays a major role in terms of financing fixed investment in China, it only accounts for around 4% of total funding of fixed investment (table 3.3). At first this might seem confusing in light of the results in section 3.3.2 where SOEs are the major investors in fixed asset investment, the low level of state budget as a source of funding is due to the fact that most SOEs do not have to contribute their profits to the state budget but instead are allowed to keep them as a source of funding for continuing expansion.

[7] National bureau of statistics of China

Year	*State*	*Domestic*	*Foreign*	*Self-raising*
	Budget	***Loans***	***Investment***	***Fund and others***
1995	3.00%	20.50%	11.20%	65.30%
1996	2.70%	19.60%	11.80%	66.00%
1997	2.80%	18.90%	10.60%	67.70%
1998	4.20%	19.30%	9.10%	67.40%
1999	6.22%	19.24%	6.74%	67.79%
2000	6.40%	20.30%	5.10%	68.20%
2001	6.70%	19.10%	4.60%	69.60%
2002	7.00%	19.70%	4.60%	68.70%
2003	4.60%	20.50%	4.40%	70.50%
2004	4.40%	18.50%	4.40%	72.70%
2005	4.39%	17.25%	4.21%	74.15%
2006	3.93%	16.47%	3.64%	75.96%

Table 3.3: Sources of Funds of Total Investment in Fixed Assets in China 1995-2006

Based on the share of funding from foreign investment, it is clear that the majority of the investment is financed domestically. The share of foreign investment funding has been declining from a peak of 11.2% in 1995 to only 3.64% in 2006 (table3.2). Furthermore, comparing the share of fixed asset investment by foreign investors and source of funding from foreign investors, we see that foreign investors[8] accounts for around 9.49% of fixed investment in China (table 3.2), where funding from foreign investors only accounts for 3.64%. This suggests that foreign firms may be starting to obtain finance for investment in China, which implies that foreign firms could be competing for funds with domestic firms.

Domestic bank loans are the second largest sources of financing in China, but they only accounts for around 20% of the total investment funding. Due to the tightening of monetary policy in 2004 and 2005, the availability of bank loans has declined to only 16.47% of the total investment funds. Given the underdeveloped stock market and negligible corporate bond market, it is clear that China's weak capital market is unable to support rapid expansion of the economy and investment. The largest component of funding for fixed asset investment is self-raised funds, where it accounts for around 65% in 1995 and gradually increases to around 75% of the total funding for investment. This is a major problem for Chinese firms, where self-raised and internal funding is the most important source of funding. Moreover it is likely that private firms will be discriminated in the capital markets. The lack of access to external finance may impose a significant obstacle to private firm's expansion and China's future

[8] Investors from Hong Kong, Macau and Taiwan are also classified as foreign investors.

growth. The heavy reliance of self-raising funds is consistent with the hypothesis of financial constraints where firms' investment is strongly related to the cash flow they are able to generate. We will test for the hypothesis of financial constraints in the later section of this paper.

3.3.4 Regional disparity in Investment

Another interesting fact about China' fixed investment is the strong regional disparity. Table 3.4 reports the share of fixed asset investment by different regions. In order for the trend to be more traceable, we classify the 32 provinces into three regions: East/Coastal, Central, and West; based on their geographical locations. This classification also has significant political and economic implications. The East/coastal region contains the experimental provinces that the central government used to test out its development policy at the early stage of the transition. The provinces in these regions tend to enjoy substantial favourable policies and special treatments from the central government. The local governments also enjoys a higher level of autonomy in their decision making process.

From table 3.4, we can see that fixed investment in the Eastern/Costal region accounts for more than 55 % of the national total fixed investment consistently over the ten year period, while the central region accounts for around 20% of total fixed investment and western region accounts for 15% of total fixed investment. This indicates there is a significant imbalance in the level of economic development across the three regions. The Chinese government has always concerned about the wide wealth gap between the urban and rural area, and in particular the difference between the eastern and western regions. Both the "go west" policy and the on-going 5 years plan put a huge emphasis on the developing of western regions. We can see the west region's share of fixed investment gradually increased over the years from a mere 12.46% in 1995 to around 17.68% in 2004 as a result of the policy to develop the west.

Table 3.5 provides us with more evidence on the substantial regional differences in fixed asset investment. Based on the provincial level data of fixed investment in China from year 2004, we provide data on three regions as well as individual provinces' fixed investment by different ownership groups. We can identify very interesting patterns from these data. State-owned enterprises tends to be the major investment forces in the central and western region, accounting for about more than 40% of the total provincial fixed asset investment. In particular SOEs presence is the highest in the western regions. The SOEs' share of fixed investment is lower in the Eastern region, which is now more market oriented and developed. On the other hand, foreign funded investment have taken an opposite patterns to the SOEs. Foreign funded investment is highest in the Eastern region and is lowest in the West region, where for some provinces the foreign funded investment accounts for less than 3% of the provincial level total fixed investment. Again, table 3.5 reinforces the idea that there are significant disparities in investment in different regions and for different ownership types.

Region	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
East	12369.46	13816.26	14743.93	16369.71	17330.27	18752.47	20874.16	24183.47	32140.13	40411.49
	59.10%	58.16%	57.47%	56.77%	57.13%	56.40%	55.88%	56.01%	57.86%	57.81%
Central	3958.4	4829.28	5315.46	6023.32	6217.05	7033.54	8058.98	9336.21	11620.72	15129
	18.91%	20.33%	20.72%	20.89%	20.49%	21.15%	21.57%	21.62%	20.92%	21.64%
West	2608.17	3114.14	3597.97	4443.22	4788.98	5463.33	6419.87	7658.45	9788.25	12355.55
	12.46%	13.11%	14.02%	15.41%	15.79%	16.43%	17.19%	17.74%	17.62%	17.68%
Total	20931.03	23755.68	25654.36	28834.25	30335.3	33249.34	37354.01	43180.13	55552.1	69900.04
	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 3.4: Fixed investment in China by regions, 1995-2004. (100 million RMB)
Sources: NBS China Statistics Yearbooks; various issues

Eastern region: Beijing, Tianjing, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan, Guangxi, Hebei.
Central region: Shanxi, Neimenggu, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan.
Western region: Sichuan, Chongqing, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang.

Region	State-owned Units	Collective	Individuals Economy	Joint Ownership	Share Holding	Foreign Funded	Others Ownership	Total
National Total	35.51%	14.14%	14.02%	0.31%	25.11%	9.89%	1.02%	100.00%
East	29.50%	18.46%	12.95%	0.37%	23.75%	13.95%	1.03%	100.00%
Beijing	29.05%	9.49%	6.58%	0.10%	38.79%	15.45%	0.55%	100.00%
Tianjin	38.85%	9.33%	6.66%	0.12%	26.19%	14.44%	4.41%	100.00%
Hebei	32.02%	21.02%	13.63%	0.80%	23.79%	6.81%	1.93%	100.00%
Liaoning	31.23%	10.96%	17.57%	0.20%	29.89%	9.28%	0.88%	100.00%
Shanghai	29.81%	10.12%	8.30%	0.87%	21.07%	26.84%	2.98%	100.00%
Jiangsu	30.55%	23.76%	13.70%	0.09%	16.86%	14.73%	0.32%	100.00%
Zhejiang	26.21%	28.53%	10.77%	0.08%	26.34%	7.46%	0.61%	100.00%
Fujian	30.21%	12.44%	15.40%	0.29%	17.84%	22.91%	0.90%	100.00%
Shandong	25.11%	23.22%	13.81%	0.69%	27.74%	8.47%	0.96%	100.00%
Guangdong	29.29%	15.30%	14.41%	0.42%	16.98%	23.10%	0.50%	100.00%
Hainan	31.67%	4.40%	8.74%	0.50%	34.68%	19.11%	0.89%	100.00%
Guangxi	43.33%	3.70%	22.47%	0.18%	22.71%	6.92%	0.69%	100.00%
Central	40.33%	8.67%	16.66%	0.28%	27.94%	4.88%	1.80%	100.00%
Shanxi	38.56%	8.27%	13.17%	0.84%	37.26%	1.52%	0.37%	100.00%
Inner Mongolia	48.72%	2.54%	12.04%	0.01%	34.21%	2.06%	0.42%	100.00%
Jilin	39.04%	4.58%	13.81%	0.09%	32.19%	9.36%	0.94%	100.00%
Heilongjiang	44.85%	3.34%	15.31%	0.02%	30.89%	2.45%	3.15%	100.00%
Anhui	37.03%	9.44%	20.79%	0.05%	26.67%	4.79%	1.23%	100.00%
Jiangxi	42.26%	9.38%	18.83%	0.21%	22.08%	6.81%	0.43%	100.00%
Henan	35.26%	13.17%	19.90%	0.18%	24.99%	5.46%	1.03%	100.00%
Hubei	40.97%	8.00%	14.50%	0.67%	26.44%	6.92%	2.50%	100.00%
Hunan	40.34%	12.95%	17.50%	0.37%	23.72%	4.21%	0.92%	100.00%
West	45.96%	7.56%	15.57%	0.15%	26.86%	3.10%	0.79%	100.00%
Chongqing	40.19%	7.29%	18.02%	0.20%	26.70%	6.83%	0.76%	100.00%
Sichuan	35.57%	13.27%	15.81%	0.09%	31.26%	3.28%	0.72%	100.00%
Guizhou	58.27%	4.43%	15.50%	0.24%	19.48%	1.88%	0.21%	100.00%
Yunnan	46.99%	4.87%	19.34%	0.06%	24.95%	2.32%	1.46%	100.00%
Tibet	84.41%	0.71%	5.92%	0.04%	5.43%	0.07%	3.41%	100.00%
Shaanxi	53.72%	4.72%	14.24%	0.34%	23.50%	2.29%	1.19%	100.00%
Gansu	60.86%	6.56%	12.64%	0.11%	16.66%	2.46%	0.71%	100.00%
Qinghai	51.51%	3.64%	9.86%	0.06%	31.39%	3.11%	0.44%	100.00%
Ningxia	36.65%	10.21%	20.65%	0.27%	29.88%	2.35%	0.00%	100.00%
Xinjiang	45.26%	4.75%	12.26%	0.02%	35.86%	1.63%	0.22%	100.00%

Table 3.5: Share of provincial fixed investment by ownership in year 2004. (Foreign funded include investment from HK, Macau and Taiwan) Sources: NBS China Statistics Yearbooks; 2005, and authors' calculations

3.3.4 The performance and profitability of private firms and SOEs

The last commonly noticed fact is that in China the private sector tends to perform better than the state sector. Figure 3.5 is adapted from the OECD country study on China (OECD 2004), based on the return of total physical assets (ROA) results over the period of 1999-2003, for private industrial firms and state controlled industrial firms. We can see that private firms' ROA consistently outperformed that of the state controlled firms by 3.5% in every year during the period. This has raised concerns that state owned enterprises are much less efficient than private firms.

Combined with the high investment rate conducted by state owned firms, we would suspect that a large amount of capitals invested by SOEs are inefficient. If we could shift these resources to the private sector, we would see a significant improvement of the overall efficiency of the whole economy, or China could sustain its current level of economic growth with less investment and its people could spend more on consumption. This result is also an indication of the existence of a lending bias among different ownership groups. The inefficient state owned enterprises are able to continuously obtain funding for their investment despite their low efficiency and profitability, while the more profitable private firms are unable to obtain enough financial resource for expansion. In the next section we will explore why such a lending bias exists among different ownership types.

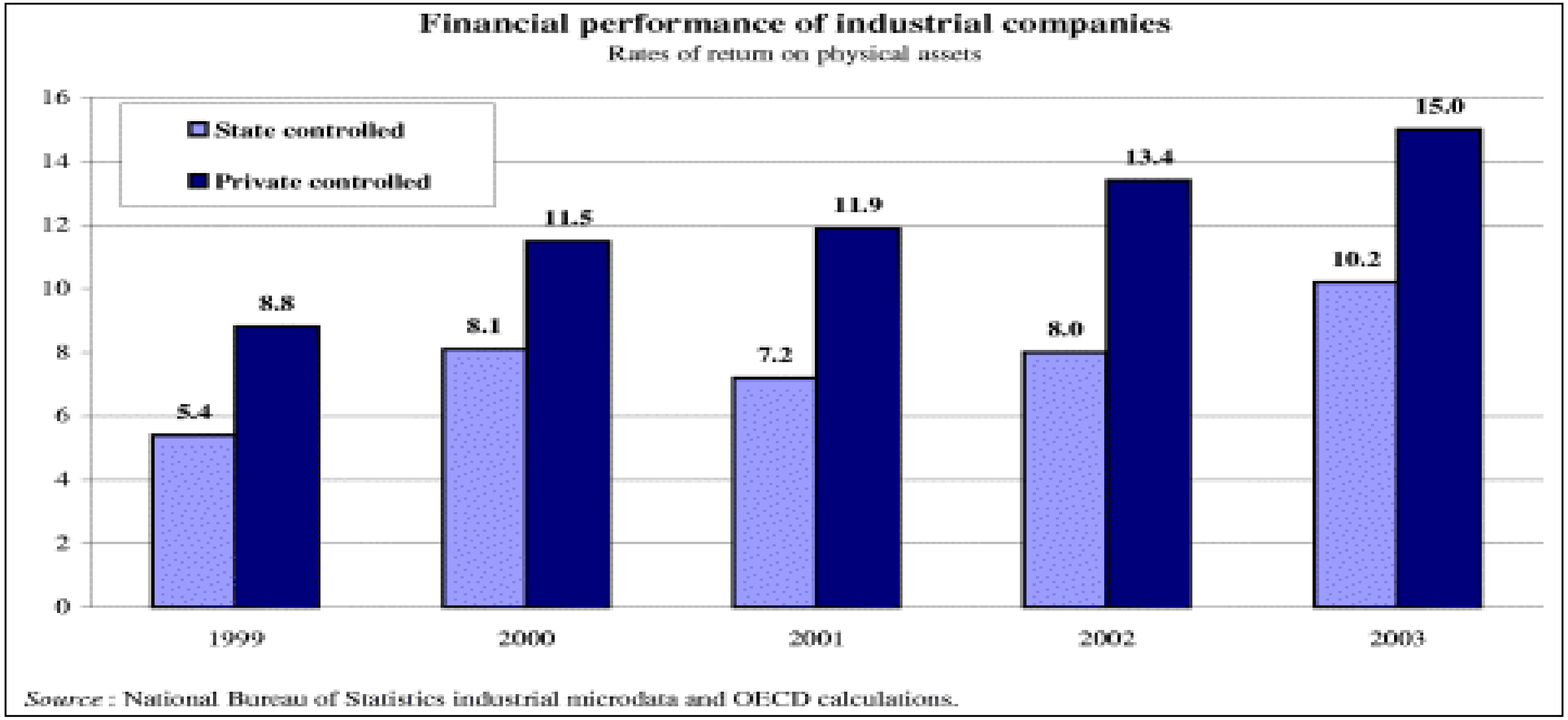

Figure 3.5: Financial performance of industrial companies:
private vs State controlled, 1999-2003.
Source: OECD Country study (2004)
Return of Asset (ROA) is defined as Net Income divided by total physical assets.

3.4 Financial constraints in China

In this section, we will explore the various causes of financial constraints for firms in China and we will form hypothesises to be tested with firms level data. In particular, we will focus on how firms with different ownership types may face different levels of financial constraints and whether there is regional heterogeneity for financial constraints. Last, we will explore whether the recent popular view of foreign direct investment alleviating financial constraints for firms in China.

3.4.1 Ownership, lending bias and financial constraints

In this study, we classify firms into five different ownership groups. They are state-owned enterprises, private firms, collective owned firms, foreign-owned firms and listed firms. State-owned firms are firms that are directly and indirectly controlled by the central government (state government). Collective owned firms were formally local government-owned, which were later partly privatised. Most of the collective firms remain under the control of the local government. They mainly operate in the form of township and village enterprises (TVEs)[9]. Private firms are firms controlled by private entity such as individuals, domestic legal persons. Foreign owned firms are firms controlled by foreign investors including those from Hong Kong, Taiwan and Macau. The last group of firms is listed firm, which in technical sense is not a type of

[9] TVEs are defined as all rural collectively owned enterprises. They are major components of the collective owned enterprises. TVEs are particularly successful in the Zhejiang and Jiangsu Provinces.

ownership. We group them together as a type of ownership for three main reasons. First, most of the firms listed on the stock exchange prior to 2004 are former state-owned enterprise and the right to be listed is based on a quota system allocated to different provinces. They tend to share a common status and behave in a similar ways. Second, once these firms are listed, they are subject to very tight scrutiny from the investors in terms of operations and financial decisions, in which they behave like firms in market economy. Third, including the listed firms as a group allows us to make direct comparison between listed firms and unlisted firms in China.

In recent studies of the Chinese economy, there is a common concern that capital and resources are possibly misallocated across firm ownership types. In particular there is a lending bias in China's financial system which gives preferential access to finance by state-owned firms, and creates political induced obstacles for private firms to obtain finance (Boyreau-Debray and Wei 2005; Dollar and Wei 2007). Huang (2004), in his book "Selling China", characterised this type of policy induced liquidity constraints for different ownership type as "political pecking order" for finance. There are a number of causes for the "political pecking order" for credit in China. We will explore some of the major causes here.

3.4.1.1 State-owned-enterprise

In China, the lending bias is a persistent phenomenon, which is rooted in the state-dominated financial system. The state-owned commercial banking system was set up in the late 1970s. Commercial banks were first set up to specialize in a particular sector. The Agricultural Bank of China specialized in rural credit, the Construction Bank of China in fixed asset investment, the Bank of China in the foreign exchange business and the Industrial and Commercial Bank of China was set up to serve a target client base consisting of industrial and commercial enterprises. In order to meet the high demand of diversified financing of enterprises, the sector barriers have been removed gradually. In 1994, three policy banks were set up to carry out policy financing, with each of them specialized in financing of fixed asset investment, agricultural procurement and international trade.

In order to allow the 'big four' state-owned banks to operate independently, the commercial banking law of the People's Republic of China was promulgated in 1995 to provide a legal framework for standardizing the operations of commercial banks in China. To further improve the strength of the state-owned commercial banks, four asset management companies were set to absorb the non-performing loans from the four state-owned commercial banks. At the same time, the government also undertook a number of reforms to increase the capital adequacy and the scope of business of state-owned commercial banks. Alongside with the reform of the state-owned commercial banking system, a number of other new financial institutions have been developed.

Banks with different ownership structures have been set-up, as well as various non-banking financial institutions such as securities, insurance, trust and finance companies. However, the Big four state-owned banks are still the dominated players in the financial system. Until 1998, state-owned commercial banks operated on a credit quota system, in which loans could only be allocated to state-owned entities. Therefore, before 1998 private firms are excluded from the formal financial system. Since 1998, the People's Bank of China (PBC) has abolished the credit quota system, and transform to an indirect control of the total supply of money and credit. From then, private firms have gained the legal recognition in the formal banking system. It is believed that this persistent lending bias would have been alleviated significantly by now, but it will still have a long term effects on the lending behaviour of state-owned banks towards private enterprises. As a result, we would expect that the SOEs will continuously enjoy preferential access to finance.

SOEs had multiple roles in the early stage of reform and transition. Some smaller SOEs that operate in the less important sector are being gradually privatised, while other larger or SOEs that operates in key industries are remaining under the control of the central government. Despite the long period of reform, SOEs still dominate the economy. During the earlier period of transition, SOEs were subject to restrictions on firing workers and there is no working social security system in China. The SOEs have significant responsibilities to maintain the employment level and provide welfare in the whole economy in order to maintain the stability of the economy(Bai et al. 2006). Moreover, privatising the inefficient SOEs may have a significant negative impact on the overall economies. Therefore it is in the state's best interest to have them under control instead of privatising them In order for

SOEs to fulfil their job in providing social stability, the state needs to continuously provide them with large amounts of external funding in the forms of grants and bank loans. Given this legacy of SOEs, the banks will continue to provide funds to SOEs.

Another major cause for lending bias is that banks perceive that SOEs are essentially less risky than their private counter parts. In the events of SOEs failing to pay for their loans, banks believe that the government will bail them out, and it is typically politically acceptable to lend to SOEs. Moreover, it is more cost effective for banks to lend to SOEs than to private enterprises. In general, due to the short period of establishment, private enterprises are relatively small and have shorter history which makes lending to them more risky and expansive to lend to.

Taking into account these major causes of lending bias, it is apparent that private enterprises are facing significant obstacles to obtain finance for their growth and investment despite their better performance. We would expect that private firms are more financially constrained than state-owned enterprises. Given the low efficiency and profitability of the SOEs, we would interpret the evidence of no financial constraints of SOEs as a sign of soft budget constraint.

3.4.1.2 Collective-Owned-Enterprise

Collective owned enterprises (COE) are also an interesting group to look at in terms of financial constraints. Collective owned enterprise is one of the most distinctive institutional features of China's economic transition. COEs were highly profitable during the early reform period. They took advantage of rising demand resulted from the rapid income growth, by filling in the niches that the state-owned sector had neglected. Collective owned firms or TVEs are industrial or commercial enterprises regulated by the government at the town-village level. They are owned by the community or administrated by town-village governments. COEs have some special characteristics. They do not have well-specified property right, where the firms are conceptually owned by the people of a community, but do not have specific identifiable owners. Typically COEs are set up by pooling the funds and assets from the community and partly with local government loans. While the people of the community own the COE, they do not have the right to directly share the profit from the COEs unless they are its employees, and subsequently compensated with wages. The COE capital cannot be transferred and sold freely. Individuals that leave the community will automatically lose their share of common ownership of the COEs (Tian 2000).

The managers of collective firms are typically appointed by local government leaders, who constantly monitor them and participate in the firms' decision making process. The performances of local COEs are closely linked with the local government leaders' future career development. Therefore COEs are subjected to close monitoring by the local government leaders, who will also tend to provide extra support to the local COEs such as giving them discretionary tax cuts. In practice, their resources are likely to be controlled by local government officials and profits of the COEs are accruing to the local government. Moreover, Park and Shen(2003) showed that bank lending to TVEs and the share of TVE lending in total rural lending grew substantially over the year and almost all rural enterprise lending went to TVEs. Based on the survey they conduct in the Jiangsu and Zhejiang provinces, they found that township leaders often played an active role in loan applications and in ensuring repayments of loans.

The urban COEs have similar characteristics, but instead of being owned by the people of the community, they were set up by the SOEs, during the reform era, as subsidiaries to reach out to retail and wholesale businesses. They were also considered as an alternative solution to the use of the surplus labour due to the firing restrictions imposed by the central government (Huang 2003). The COEs operates differently from SOEs, as the state does not directly appoint their managers. The managers of the COEs are appointed by the parent SOEs and its operation is under direct control of the SOEs instead of the state.

The unique status of COEs and the explicit or implicit guaranteed of loans provided by the local government helps them to gain a higher position in the “political pecking order” of credit. We expect that collective owned enterprises will be relatively less financially constrained than private firms or face no financial constraints at all.

3.4.1.3 Foreign Direct Investment

The benefits of foreign direct investment (FDI) including technology transfer, employee training and tax revenues in China are well recognised. China now is one of the top recipients of FDI in the world. Huang (2003) proposed that a major driving force of this substantial amount of FDI in China is due to the "political pecking order" in the credit market. Private firms, being ranked at the lowest level of the "political pecking order", are highly credit constrained and unable to secure finance to exploit the existing business opportunities. This institutional distortion forces private firms in China to seek finance from alternative sources, such as FDI. Foreign firms, especially multinationals, which locate in foreign countries, have relative easy access to capital markets and bank finance. By forming joint ventures with foreign firms, private firms can reduce the level of financial constraints. Guariglia and Poncet (2008), using provincial level data, provide evidence that FDI could be used to reduce the negative impact of the financial distortions on economic growth. By the same token, we would expect firms with a significant amount of foreign ownership to be less financially constrained than the private firms that do not have foreign ownership. Moreover, the presence of foreign ownership may help to alleviate the level of financial constraints.

In sum, due to the inherent institutional distortion there is a "political pecking order". Therefore, it is likely that China's formal financial system discriminates against firms according to their ownership structure, whereby SOEs received the most favourable treatment, and private firms face significant difficulties in obtaining finance. One of the main objectives of this paper is to test for the presence of "political pecking order". Furthermore we will also test whether the presence of foreign ownership helps to reduce financial constraints.

3.4.2 Regional disparities

Regional disparity is particularly relevant and interesting for China, due to the sheer size of the country. At national level, China's growth performance has been phenomenal, but actual economic conditions tend to vary substantially across regions. As we have discussed in section 3, China's fixed investment is subjected to significant regional disparities.

The significant regional disparity is mainly a result of China's development policy. In the early years of reform, the state government has concentrates its development policy on the coastal region at the expense of the central and western regions [10]. Given the relatively well-developed infrastructure, readily accessible geographical location and natural endowments, the coastal region offered a much higher rate of return on investment. By establishing special economic zones and giving regional governments a high degree of autonomy in terms of local policy setting, the central government has allow the coastal region to successfully attract large quantities of FDI and to achieve unprecedented level of economic growth. However, the rapid growth of the coastal region has continued to widen the gap with the central and western region in all areas of economic development.

[10] Demurger (2002) provides a detailed account of the preferential policies in China.

According to conventional views, the level of financial development has a significant impact on the level of financial constraints. High levels of financial development help to promote economic growth by reducing financial constraints that would otherwise distort the efficient allocation of investment. Using firm level data from 36 countries, Love(2003) provides evidence that financial development affects a firm's investment via their ability to obtain external finance. Based on the measure complied by Demurger et al. (2002) and Fan et al.(2000), we can get an approximate picture of the regional level of financial development in China. Demurger et al. (2002) use the preferential policies granted to each provinces by the central government to develop the PPI (preferential policies index) to captures the extent of marketization and internalization of a local economy. Fan et al.(2000) developed the NERI marketization index by examining the level of marketization based on the local and central government relationship, the development level of the product and factor markets and the legal environment, law enforcement. Table 3.6 adapts the two indexes of Fan et al (2000) and Demurger et al.(2002). We can see that provinces of the East/Coastal region score relatively high in both indexes compared to their counter parts in the central and western regions. Table 3.7 provides the mean level for both the NERI and PPI indexes for each of the three regions.. Based on both measures, coastal region is significantly more developed and receive more preferential policies from the central government. Western region is the least developed in terms of the level of institutions and financial development, while the central region falls between the coastal region and the western region.

If the hypothesis that the level of financial development helps to reduce the level of financial constraints and promote economic growth, we would expect that east region suffers least from the problem of financial constraints, and west region facing the highest level of financial constraints.

However, the case of China might be counter intuitive to the conventional thinking of financial development and financial constraints. Qian and Xu (1993) describe China as a case of *de facto* federalism, involving a decentralized economic system in which each region can be considered an autonomous economic entity. The decentralized system has significant impact on Chinese economy. If the economy is not fully integrated over time, it could build up a collection of highly protected and locally fragmented markets.

Those studies focus on the goods market show that the speed of convergence towards one price is comparable to that of the United States, which suggests that China has a highly integrated domestic goods market (Huang and Wei 2001). However, the capital market in China is much less integrated than the domestic goods market. There is enduring regional segmentation of the Chinese capital markets, which prevent capital to flow to the more productive regions (Boyreau-Debray and Wei 2005). There are a number of significant regional barriers that stop capital from flowing freely between regions. The incentive of the local government to preserve capital within their own regions to boost local government revenue and provide job opportunities stops local enterprises to conduct cross-regional investment. Moreover, the cross-regional lending by the banking sector is also limited. The inter-bank market was created in 1996. Before then the interest rate ceiling does not facilitate capital mobility. Boyreadu-Debray and Wei (2005) provides evidence that capital mobility is low across Chinese regions which indicates that Chinese capital market are fragmented.

Other empirical studies also provide indirect evidence that the Chinese capital markets are fragmented, Cull and Xu (2000) find that there was a deterioration in capital allocation over the 1990s, Dollar and Wei (2007) also documented that certain regions and sectors have consistently lower returns to capital than other regions and sectors which suggests that capital is unable to flow to the more productive regions. In fact there is evidence that the government systematically allocates capital away from more productive regions and towards the less productive ones. In 2000, the central government initiated a new policy focusing on the development of the western region with the aim to close the regional gap and inequality between the western region and the coastal region.

Region	*NERI*	*PPI*
National Total		
East		
Beijing	6.3	0.67
Tianjin	6.58	1.43
Hebei	6.7	1.24
Liaoning	5.6	1.24
Shanghai	6.59	1.76
Jiangsu	7.04	1.43
Zhejiang	8.24	1.43
Fujian	7.28	2.71
Shandong	6.22	1.43
Guangdong	8.33	2.86
Hainan	5.65	1.57
Guangxi	5.28	1.24
Central		
Shanxi	4.57	0.33
Inner Mongolia	3.45	0.67
Jilin	4.51	0.67
Heilongjiang	3.97	0.67
Anhui	5.4	0.62
Jiangxi	5.12	0.33
Henan	5.97	0.33
Hubei	5.53	0.62
Hunan	5.99	0.33
West		
Chongqing	5.57	
Sichuan	5.29	0.62
Guizhou	3.86	0.33
Yunnan	3.39	0.67
Tibet		0.33
Shaanxi	4.48	0.33
Gansu	4.02	0.33
Qinghai	2	0.33
Ningxia	2.69	0.33
Xinjiang	2.9	0.67

Table 3.6: NERI and PPI indexes as indicators of financial development.
Source: NERI index is adapted from Fan et al (2000). PPI index is adapted from Demurger et al.(2002)

	East	**Central**	**West**	**National**
NERI	6.65	4.95	3.8	5.284
PPI	1.58	0.51	0.44	0.917

Table 3.7: Mean level of NERI and PPI for three regions and for the whole country
Source: Fan et al(2000), Demurger el al (2002) and author's calculation.

If Chinese capital markets are indeed fragmented and the cross-provincial/ cross-regional mobility is low, and the government is systematically shifting resources from other regions towards the western regions, we might obtain an opposite prediction from the financial development theory. We conjecture that we are likely to find that the coastal region will be more financially constrained than western and central region. There are two main reasons for this prediction. First, since the capital market is fragmented and with low capital mobility, the availability of finance is limited by the amount of local resources, firms locate in the coastal region faces significantly higher level of competition for funding among themselves than firms located in the Western and Central regions. Secondly, the new central government policy of developing the western region tends to shift valuable funding away from the "rich regions" towards the western regions, which would decrease the availability of funds for coastal regions. This would increase the level of financial constraints facing by the coastal regions. However, FDI is unlikely to be subjected to barriers of capital mobility. It tends to flow to regions where it can obtain a higher return to capital. This is consistent with our argument that FDI may help to reduce financial constraints.

3.5 Estimation framework

3.5.1 Euler equation specification

One of the main reasons why we choose to use the Euler equation approach over the popular Q model is that the Q model discussed in chapter 2 suffers from a number of problems. Moreover the Chinese Stock market is highly distorted, and we are unlikely to be able to obtain accurate measures of Q. Furthermore, in our dataset, we have a large number of unquoted firms, for which we are unable to compute the Q variable. Using Euler equation approach allows us to bypass these obstacles to test the hypothesis develops in the last section.

The Euler equation specification is derived explicitly from a dynamic optimization problem with symmetric and quadratic costs of adjustment. The Euler equation model captures, under the maintained structure, the influence of expectations of future profitability on current investment decisions. Therefore, current and lagged financial variables are unlikely to enter the equation as proxies for future profitability.

The version of Euler equation investment model we used here is similar to models used in previous studies of financial constraints ((Bond and Meghir 1994; Bond et al. 2003; Harrison and McMillan 2003)). Our model describes below follows closely the specification in Harrison and McMillan (2003).

The firm is assumed to maximize its present discounted value of current and future net cash flows. Let L_{it} denotes for variable factor inputs, and w_{it} the price of variable factor inputs, p_{it}^{I} be the price of the investment good, p_{it} the price of output, and β^{t}_{t+j} the nominal discount factor between period t and period $t+j$, and δ the depreciation rate, and K_{it} denotes capital, I_{it} denotes investment. $F(K_{it}, L_{it})$ is the production function gross of adjustment costs, $G(I_{it}, K_{it})$ is the adjustment cost function and $E(\bullet)$ is the expectations operator. Conditional on information available in period t, the firm borrows the amount D_{it} at time t, and pays interest on the debt by i_{it}. Finally π_{it} denotes the inflation rate. The firm solves

$$\max E_t\left[\sum_{j}^{\infty}\beta^{t}_{t-j}R\left(K_{i,t+j}, L_{i,t+j}, I_{i,t+j}\right)\right] \tag{1}$$

$$\text{s.t.} \quad K_{it} = (1-\delta)K_{i,t-1} + I_{i,t} \tag{a}$$

$$D_{it} \leq D^{*}_{it} \tag{b}$$

$$D_{it} \geq 0 \tag{c}$$

$$R_{it} = p_{it}F(K_{it}, L_{it}) - p_{it}G(K_{it}, L_{it}) - w_{it}L_{it} - p^{I}_{it}I_{it} - i_{t-1}D_{it-1} + D_{it} - (1-\pi_{t-1})D_{i,t-1} \tag{d}$$

$$R_{it} \geq 0 \tag{e}$$

Constraint (a) is the accounting identity for the firm's capital stock, where capital stock at time t is equal to last periods of capital stock net of depreciation plus the current period's investment. Constraints (b) and (c) model the credit constraint with a borrowing ceiling and that debt must be greater than or equal to zero. Constraint (d) describes the firm's net revenue and constraint (e) implies that there is a premium on outside equity finance, which has the same effect as a restriction on new share issues.

Solving this problem, we can obtain the Euler equation that models the optimal investment path by relating the marginal adjustment costs in adjacent period. Firms that faced financial constraints face a higher discount rate for a given level of adjustment costs today. Therefore, financial constrained firms will delay today's investment and substitute it with tomorrow's investment. As Harrison and McMillan (2003), assuming the investment is immediately productive, the marginal cost of investment today net of the marginal increase in output (right-hand side of equation (2)), is equal to the present value of the marginal adjustment cost of investing tomorrow (left-hand side of equation (2)):

$$(1-\delta)\beta_{t+1}^{t} E\left[(1-\Omega_{i,t})\left(\frac{\partial R}{\partial I}\right)_{i,t+1}\right] = \left(\frac{\partial R}{\partial I}\right)_{i,t} + \left(\frac{\partial R}{\partial K}\right)_{i,t} \tag{2}$$

$\Omega_{i,t}$ represents the shadow value of the financial constraints. In the absence of financial constraints, $\Omega_{i,t}$ would equal to zero. Following Bond and Meghir (1994) we can use the quadratic adjustment cost $G\left(I_{it}, K_{it}\right) = \left(b/2\right) * \left[\left(I/K\right)_{it} - c\right]^{2} K_{it}$ which is linearly homogenous in investment and capital. Therefore, the derivatives of net revenue with respect to *I* (investment) and *K* (capital) can be written as:

$$\left(\frac{\partial R}{\partial I}\right)_{t} = -b\alpha p_{t}\left(\frac{1}{K}\right)_{t} + bc\alpha p_{t} - p_{t}^{I} \tag{3}$$

$$\left(\frac{\partial R}{\partial K}\right)_t = \alpha p_t \left(\frac{Y}{K}\right)_t - \alpha p_t \left(\frac{\partial F}{\partial L}\frac{L}{K}\right)_t + b\alpha p_t \left(\frac{I}{K}\right)_t^2 - bc\alpha p_t \left(\frac{I}{K}\right)_t \qquad (4)$$

In equation (3) and (4), $Y = F - G$ represents the net outputs and $\alpha = 1 - (1/\varepsilon) > 0$. The price elasticity of demand ($\varepsilon > 0$) is assumed to be constant. And Y is assumed to be linearly homogeneous in *K* and *L*. Assuming that there are no credit constraints $(\Omega_{it} = 0)$, by combining equation (3) and (4) we can derive our first estimating equation:

$$\left(\frac{I}{K}\right)_{i,t+1} = \beta_1 \left(\frac{I}{K}\right)_{i,t} - \beta_2 \left(\frac{I}{K}\right)_{i,t}^2 - \beta_3 \left(\frac{CF}{K}\right)_{i,t} + \beta_4 \left(\frac{Y}{K}\right)_{i,t} + \beta_5 U_{i,t} + v_{i,t} \qquad (5)$$

Equation (5) is derived under the assumption of no financial constraints $(\Omega_{it} = 0)$, it is expected that the expected future investment is positively related to current investment and negatively related to the square of current investment. Future investment is negatively related to current cash flow and positively related to the current output. The interpretation of the negative coefficient for the cash flow, as suggested by Harrison and McMillan (2003), is that a higher level of current cash flow implies lower net marginal adjustment costs today. Therefore it would lead to lower expected investment tomorrow. However, under the alternative assumption that the capital market is imperfect, future investment may be positively related to cash flow through the effect of financial constraints. This provides us with the first framework of testing for financial constraints. It is expected that equation (5) will describes the optimal investment path of firms that are not financially constrained, but the model will be rejected for firms that are financially constrained, in particular we expect to observe a positive relationship between future investment and current cash flow as the result of financial constraints. In order to test for financial constraints across ownership group and regions, we create and interact the dummy variables indicating the ownership types and regions with the measure of cash flow. It is expected that private firms will display higher sensitivity of cash flow to investment than foreign and state owned firms due to "political pecking order". And we also expect that the coastal region will display a lower level of cash flow sensitivity, but if the capital markets in China are indeed fragmented firms' in the coastal region may not be less financially constrained than firms located in the central and western regions.

3.5.2 Alternative test of financial constraints using the Euler equation

An alternative test of financial constraints using Euler equation is to find empirical proxies for $\Omega_{i,t}$, the shadow value of financial constraints. With imperfect capital markets, it is expected that $\Omega_{i,t}$ depends on some state variables, and could be identified with some observable firm characteristics. Previous literature relied on observable indicators of a firm's financial health, Whited (1992) use the coverage ratio and debt to asset ratios to proxy for the shadow value of financial constraints.

Following Harrison and McMillan (2003), we can linearize the product of $(1-\Omega)$ with the derivative of net revenue with respect to investment, using a Taylor expansion. We can then take $\Omega_{i,t}$ to the right-hand side of equation (5) and use two firm-level measures of financial constraints: the debt to fixed asset ratio, and the interest coverage ratio. In the absence of imperfect capital market and financial constraints, these financial constraint measures should have no impact on future investment at all. On the other hand, if financial constraints exist, then the measures of financial constraints and financial factors are expected to be positively related to future investment. For firms that have high debt to asset ratios and interest coverage ratios, are likely to have used up their debt capacities. Thus, they are more likely to delay their investment to the next period.

The debt to asset ratio (also known as leverage ratio, *LEV*) is the ratio of the book value of the firm's debt to the value of the firm's fixed assets. This ratio is typically used as a measure of a firm's lack of collateral for its borrowing and the amount of debt capacity that has been used up. The interest coverage ratio is defined as the ratio of the firm's interest expense to the sum of the firm's interest expense plus cash flow. The coverage ratio (*COV*) indicates the level of resources that are used to service the firm's debt, and increase in the interest coverage ratio indicate that current financing cost puts a larger pressure on firm's cash flow, and leads to a higher probability of financial distress. After augmenting equation (5) with the two measures of financial constraints, the new estimating equation will look as follows:

$$\left(\frac{I}{K}\right)_{i,t+1} = \beta_1\left(\frac{I}{K}\right)_{i,t} - \beta_2\left(\frac{I}{K}\right)^2_{i,t} - \beta_3\left(\frac{CF}{K}\right)_{i,t} + \beta_4\left(\frac{Y}{K}\right)_{i,t} + \beta_5 U_{i,t}$$

$$+\beta_6 COV_{i,t} + \beta_7 LEV_{i,t} + v_{i,t} \qquad (6)$$

We will also create ownership and regional interaction terms with the two new financial constraints measures to access the differential level of financial constraints among ownership and regions. This second framework provides us with an additional test for the financial constraints under the Euler equation framework.

3.5.3 Estimation methodology

The user cost of capital is typically unobservable. Therefore we will assume that it can be captured by firm fixed effects, which we will allow for and control for in the estimation. Using standard methods of regression, such as OLS or fixed-effects, to estimate equation (5) and (6) is problematic. Many of the independent variables in the Euler equation model are likely to be jointly endogenous, where they are simultaneously determined with the dependent variable or subject to two-way causality. Moreover, the dynamic investment model with the lagged endogenous variable for investment will bias the coefficient estimates.

To eliminate these problems, we use a first differenced GMM estimator developed by Arellano and Bond (1991), and Arellano and Bover (1995). This estimator takes first difference for each of the variables in order to eliminate the firm-specific effects, and then use lagged levels (2 time or more) of the variables as instruments. The first-difference GMM estimator takes into account both firm-specific heterogeneity and the potential endogeneity problems of the regressors. We rely on the m2 test and the Hansen/Sargan test to assess the validity of the model and instruments. The m2 test is a test of second-order serial correlation. It is asymptotically distributed as a standard normal distribution under the null of no second-order serial correlation of the residuals. The GMM estimator is consistent if there is no second-order serial correlation in the residuals. The Hansen/Sargan *J* statistic is a test of overidentifying restrictions. The *J* statistic is asymptotically distributed as chi-square distribution, under the null of instrument validity, with degrees of freedom equal to the number of instruments minus the number of parameters. As a general rule of thumb, if the *p-values* for the Sargan's test and the m2 test are greater than 0.05, the instruments are valid and there is no gross misspecification the model.

3.6 Data and Summary statistics

3.6.1 Data

The data we use to carry out the empirical study are drawn from the ORIANA database published by Bureau van Dijk, which contains financial information for public and private companies in the Asia-Pacific region. We focus only on data from China. By allowing firms to entry and exit the sample, we have a large unbalanced firm-level dataset covering the year between 1998 and 2005. The unbalanced panel structure has the benefit of partially mitigating potential selection and survival bias problems (Carpenter and Guariglia 2008). In this study, we focus on firms operate in the manufacturing sectors only.

Firms that have missing values of the key regression variables are dropped from the dataset. Sales, total assets, fixed assets can't be missing or negative. Following the standard panel regression method to control for the potential influence of outliers, we also drop one percentile from each tails for each of the regression variables. Table 3A1-3A3 presents the structure of our panel data. Our final dataset covers 22,274 firms which are mainly unlisted firms, corresponding to 114,098 observations. The panel is unbalanced, with number of observations ranging from a minimum of 9,910 in year 1998 to a maximum of 17,460 in 2005[11].

The dataset provides a continuous measure of ownership composition[12]. The measure of ownership is not time variant[13]. In contemporary theories of the firm, Hart(1995) argues that ownership should be defined in terms of what shareholder controls the "residual rights" of the firm, in the sense of who dictates unforeseen contingencies. Typically this role is the responsibility of the major shareholders. Following Cull et al. (2007), we classified firms, based on the average majority ownership, into five different groups: state, foreign,

[11] See the Appendix for details about the structure of our panel, and complete definitions of all variables used.
[12] See section 4 for discussion for definition and characteristics of different ownership.
[13] Since we are not studying the effects of ownership change on financial constraints, the time invariant ownership does not affect our study.

private, collective and listed The ownership type of the firms follows the dominant owner's ownership status based on paid-in-capital. Foreign firms include those firms with investors from Hong-Kong, Macao, Taiwan. Private firms include both individuals and legal entities. Our measure of ownership is better than identifying ownership based on registration status, which is unreliable. As actual ownership does not always correspond to the ownership type on the firm's business registration due to change of ownership after registration (Dollar and Wei 2007).

Table 3A4 reveals some interesting trends in ownership type change over the study period. The SOEs share of total observation in each year shows a steadily decline from 23.45% in 1998 to 13.68% in 2005, while private firm displays a steadily increase in terms of the share of total observation from 37.85% in 1998 to 44.86% in 2005. Collective-owned enterprises also show a steady decline. Foreign and Listed firms' annual share of total observation number are roughly unchanged. These changes of ownership composition are in line with changes of fixed investment by different ownership type based on aggregate data presents in Table3.2. These significant changes in the ownership composition of our dataset reflect the significant on-going restructuring of firms in China in the past 10 years, where private firms are gradually emerging as major players in the economy.

There are 31 provinces or province-equivalent municipal cities in China. In order to examine the regional disparity in the level of financial constraints, we group firms into three main regions: the East/Costal, Central, and West.

Table 3A5 provides the detailed allocation of provinces or province-equivalent municipal cities into the three regions. Table 3A6 presents the distribution of observations by ownerships in the three regions. It is interesting to see that SOEs' observation represents a much larger proportion of total regional observations in the central and western region, than in the Coastal region. The majority of foreign firms are located in the coastal regions account for more than 30% of the total observations in the coastal region, while foreign firms has a relatively small role in the central and western region[14].

3.6.2 Descriptive Statistics

Table3.8 reports the summary statistics of the firms for the key regression variables used in the regression for the whole sample and different ownership groups. Investment (*Iit*) in our study is defined as the change in real tangible fixed assets plus depreciation. Focusing on tangible fixed assets allows us to reduce the distortion in the valuation and measurement error of intangible assets such as goodwill, patents, trademarks, etc. In order to compare and control the size scale effects, we scale the key variables with lagged fixed assets (*Kit*). All variables are deflated using provincial level GDP deflators taken from the China Statistical Yearbook. Using provincial level deflators allow us to control the differential pricing across different regions.

[14] This reflects the early "open-up" policy focus on the coastal region. The governments invest heavily in infrastructure and provide favourable policies to attract foreign investors.

The first row of table3.8 reports the investment to tangible fixed assets ratio which measures how much investment each group invested relative to their asset base. This ratio can be thought of as the intensity of investment for the firms. If this ratio is high the firm is investing heavily. Based on this measure, private firms, foreign firms and listed firms are all investing heavily. The private, foreign and the listed firms invest 14.1%, 12.4% and 16.3% of their total tangible fixed assets each year respectively. In contrast, SOEs and collective firms are only investing moderately with investment ratio of 7.7% and 9.7% respectively.

Ownership	State	Private	Foreign	Collective	Listed	All
$(I_{it}/K)_{it-1}$	0.077	0.141	0.124	0.097	0.163	0.124
	(0.335)	(0.372)	(0.325)	(0.372)	(0.269)	(0.347)
$(I_{it}/K_{it})^2$	0.118	0.158	0.121	0.148	0.099	0.136
	(0.490)	(0.472)	(0.422)	(0.516)	(0.296)	(0.455)
S_{it}/K_{it}	2.680	7.352	8.635	9.044	3.227	6.751
	(3.893)	(10.112)	(11.715)	(12.493)	(5.485)	(10.062)
CF_{it}/K_{it}	0.154	0.362	0.470	0.451	0.252	0.356
	(0.281)	(0.499)	(0.654)	(0.653)	(0.342)	(0.535)
Coverage ratio	0.260	0.189	0.080	0.083	0.120	0.158
	(11.392)	(2.698)	(2.813)	(5.511)	(1.208)	(5.394)
Leverage ratio	0.366	0.239	0.114	0.253	0.284	0.229
	(0.510)	(0.750)	(0.502)	(0.638)	(0.399)	(0.626)
Number of observations	13866	33279	23351	5799	6171	82466

Table 3.8: Descriptive statistics for key regression variables by ownership.

The table reports sample mean, corresponding standard deviations are presented in parentheses. I represents real investment, S represents real sales and CF represents cash flow, all these variables are scaled by real fixed assets K. Coverage ratio is defined as the ratio of the firm's interest expense to the sum of the firm's interest expense plus cash flow. Leverage ratio is calculated as book value of total long term liabilities divided by firm's fixed assets.

ownership	SOE	Private	Foreign	Collective	Listed
Net Profit Margin	-0.0042	0.030269	0.030124	0.029376	0.035238
	(0.164709)	(0.103383)	(0.118742)	(0.081865)	(0.208629)
ROA	0.009516	0.04704	0.049566	0.078413	0.023577
	(0.062637)	(0.093409)	(0.141299)	(0.171627)	(0.075596)
Real sales	3329.373	1912.772	2231.529	1417.875	16240.07
	(13723.06)	(8793.897)	(8451.208)	(3792.614)	(110179.6)
Real Total Assets	5747.948	2221.667	1834.87	1165.375	20330.13
	(21057.92)	(10165.13)	(5085.146)	(3300.742)	(119776.7)
Number of Employee	3025.23	1085.377	925.2114	1028.562	4588.927
	(8642.347)	(2405.971)	(1538.812)	(1736.519)	(20137.63)
Number of observations	*13866*	*33279*	*23351*	*5799*	*6171*

Table 3.9: Summary statistics for profitability and size measures by ownership.

The table reports sample mean, corresponding standard deviations are presented in parentheses. Net profit Margin is calculated as net income divided by net sales. ROA (return on total asset) is calculated by dividing net income by total assets. Real sales and Real total assets are deflated by provincial GDP deflator, it is measured at (Thousands of Yuan RMB). Number of employee is the reported number of employee employed by the firm.

The sales to capital ratio can be seen as fixed asset turnover ratio, which measures the operational efficiency of the firm. The SOEs and Listed firms perform poorly compare to, with *S/K* equals to 2.68 and 3.22, private, foreign and collective-owned firms with sales turnover ratios equal to 7.35, 8.63 and 9.04 respectively. This reflects private, foreign and collective-owned firms operate more efficiently than SOEs and listed firms. The cash-flow ratio is particularly high for private, foreign and collective firms, (which equals to 36.2%, 47% and 45.1%), while it is relatively low for SOEs (15.4%). The cash-flow ratio is relative high compare to firms in the US and Europe, Carpenter and Petersen(2002) reports a comparable cash flow to capital ratio of 0.06 for the US firms; Bond et al.(2003) using sample from Belgium, France, Germany, and the UK found that this ratio is ranging from 0.11 to 0.13.

The interest coverage ratio is defined as the ratio of the firm's interest expense to the sum of the firm's interest expense plus cash-flow. The SOEs have the highest interest coverage ratios of 0.26, which partly reflects their inability to generate cash-flow. The private firms has the second highest ratio of coverage ratio (0.189), given the large amount of cash flow being generated by those firms. The mean coverage ratio for foreign firms, collective owned firms and listed firms are 0.08, 0.083 and 0.12, which are lower than those of the SOEs and private firms.

Leverage ratio in our study is calculated as the book value of total long term liabilities divided by firm's fixed assets[15]. Similar definition of leverage can be found in Lang *et al* (1996). It provides an indication on the firm's debt capacity. A higher leverage ratio implies that firm is near its debt capacity. Again, SOEs have the highest leverage ratio of 0.366, which indicates they that SOEs have taken out a large amount of debts. Moreover, it may also reflect that SOEs are able to take up more debts than other ownership type. The leverage ratios for private firms, foreign firms, and collective owned firms are 0.239, 0.114, 0.253 and 0.284 respectively. The foreign owned firms have the lowest level of leverage ratio.

In order to better understand the differences among different ownership group, we will look at some profitability measures and size measures. Table 3.9 reports summary statistics of the profitability and size of firms by ownership. Net profit margin is calculated as net income divided by net sales, and ROA (return on assets) is calculated as net income divided by total assets. According to these two profitability measures, SOEs are the worst performers among the different ownership group. SOEs have a negative mean net profit margin of -0.0042 and a very small ROA of 0.009. Private, Foreign, Collective-owned are having a similar level of average net profit margin of around 0.03, while listed firms have a slightly better net profit margin of 0.035. The collective-owned firms outperform all other ownership type in terms of return on asset (0.078). Again private and foreign firms have a similar level of

[15] As the market value of the long term debt is not available, we use the book value of total long term liabilities to proxy the market value of the long term debt.

return on assets of 0.047 and 0.049, respectively. The return on assets for listed firms is 0.0235.

Table 3.9 also reports real sales, real total assets and number of employees as indicators of firm size. All three measures indicate that listed firms are the largest firms in our sample, with mean real sales of 16 million yuan, mean real total assets of 20 million yuan. Listed firms on average employ 4588 employees. Other than listed firms, SOEs are the largest firms with average real sales of 3.3 million yuan and average real total assets of 5.7 million yuan. SOEs on average employ 3025 employees. Private, foreign and collectively-owned firms are much smaller than SOEs and listed firms. The average real total sales for private owned firms, foreign owned firms and collectively-owned are 1.9 million, 2.2 million and 1.4 million, respectively. The private owned firms, foreign owned firms and collectively owned firms on average employ 1085, 925 and 1028 employees, respectively.

3.7 Results and Discussion

3.7.1 Regression results for baseline specification

Table 3.10 presents estimates of the baseline specification (equation (5)) for the whole sample without controlling for ownership and regions. Equation (5) is estimated with OLS, within fixed-effect and first-differenced GMM estimator. Due to the specification and the independent variables of our empirical equation, we would expect that some regressors of our specification may be endogeneously determined which lead to potential sources of bias. The endogeneity problems of the regressors are likely upward bias the OLS estimate of the lagged dependent variable, while the fixed effects estimators would lead to a downward bias of the lagged dependent variable. The first-differenced GMM estimators are useful in simultaneously controlling for unobserved heterogeneity and endogeneity problems by using first-differenced transformation to control for heterogeneity in the sample, and used lagged values of the regressors as instruments to control for endogeneity problems.

Blundell and Bond(1998) indicates that the first-difference GMM suffers from finite-sample bias when instruments are weak. Bond et al.(2003) suggests a simple way to test whether the finite-sample bias by comparing the coefficients of the lagged dependent variable from GMM estimators with the results from OLS and Fixed-effects estimators. If we can find evidence that the lagged dependent variable's coefficient lies above the Fixed-effects estimates and lies below the OLS estimates, we can then tentatively conclude that the finite-sample bias due to weak instruments is unlikely to be a major problem.

The results from table 3.10 indicates that the regression coefficients of the lagged dependent variables from OLS, Fixed-effects and GMM are -0.002, -0.249 and -0.054, respectively. The coefficient of the lagged dependent variables indeed lies above the fixed-effects estimates and below the OLS estimates. This indicates the finite-sample bias would not be a major problem for our study. Therefore, from this point onwards we will estimate all our specifications with our preferred first-difference GMM estimator. The focus of the baseline estimation is the coefficient for the lagged cash flow terms. Under the assumption of no credit constraints, investment should be negatively related to lagged cash flow. The main structure of the Euler equation model is maintained[16]. Sales are positive and highly significant. The estimates of the three different estimators show that the lagged cash flow terms are consistently positive and significant at 1% level. This is the first evidence that firms are financially constrained in China.

16 However, the lagged investment term is negative and significant, which is different from the prediction of the theoretical model. This may be caused by the large number of firm-years that are making negative investment during the restructuring period. If we control for all the negative investment observations, we obtain the theoretical prediction of the Euler equation model. Yet, deleting these observations significantly reduces our sample size and coverage of firms. We choose preserve the observations with negative investment, because there represents about 20% of our observations.

Dependent variables I_{it}/K_{it}	*OLS Estimator*	*Within Estimator*	*First-differenced GMM*
$(I_{it}/K_{it})_{t-1}$	-0.002	-0.249***	-0.054***
	(0.006)	(0.007)	(0.010)
$(I_{it}/K_{it})^2{}_{t-1}$	0.041***	0.058***	0.017
	(0.005)	(0.009)	(0.010)
$(CF_{it}/K_{it})_{t-1}$	0.063***	0.075***	0.086***
	(0.003)	(0.006)	(0.015)
$(S_{it}/K_{it})_{t-1}$	0.004***	0.013***	0.014***
	(0.000)	(0.001)	(0.002)
N	64709	64709	44771
R square	0.041		
rho		0.468	
M2			0.138
J (p-value)			0.567

Table 3.10: Baseline specification of Euler equation estimation.

Time dummies were included in all specifications. M2 tests for second-order serial correlation in the first-differenced residuals, under the null of no serial correlation. The Hansen J statistics tests the overidentifying restrictions, under the null of instrument validity. *, **, * denotes significance at the 10% level, 5% level, and 1% level respectively. The first differenced GMM estimator use lagged values of all right side variables dated t-2 as instruments. For all specifications time dummies and industry dummies are included.**

3.7.2 Regression results for different ownership status

Table 3.11 presents the estimation of equation (5) by controlling for ownership status. We first run split sample regressions based on ownership status. All the results from table 3.11 are estimated by GMM first differenced estimator with all the right hand variables dated t-2 as instruments[17]. An interesting pattern emerges from the results. The cash flow terms for the SOEs and COEs are not statistically significant, while they are highly positive and significant at 1% level for private firms, foreign firms and listed firms. These indicate that private firms, foreign firms and listed firms in China are subject to financial constraints.

By closely examining the magnitude of the cash flow coefficient for private firms (0.118), foreign firms (0.05) and listed firms (0.224), we find that foreign firms' investment displays lowest sensitivities to cash flows (about only half of that of the private firms). These results are consistent with the hypothesis of the existence of "lending bias" and "political pecking order". It appears that SOEs firms' investments are not constrained to their level of internal cash flow. Along with the evidence that SOEs are inefficient, we would believe that SOEs in China are still subject to "soft budget constraints", where the state dominated banking system continuous to prefer to lend to State owned enterprises and its close resemblance, the COEs. The evidence that private firms are relatively more financially constrained than the less efficient SOEs, given that private firms are more efficient and able to achieve higher

[17] The m2 tests (the test for second order serial correlation of the residuals) indicate no second order serial correlation of the residuals and the p value of the Hansen/Sargan's tests of overidentification restriction indicate the instruments are valid and the model are correctly specified for all the first differenced GMM regressions in table 3.11.

returns from their investment, suggests that private firms are being discriminated by the formal financial system. The evidence suggests that foreign firms may not be financially constraints or are less financially constrained, possibly because they can obtain funds from their parent company.

As a robustness test, we create interaction terms of ownership status and interact the ownership status dummies with cash flow terms to see the relative level of financial constraints across different ownership. The use of interaction terms approach allows us to utilise the whole sample of data. The results from the interaction regression are consistent with the finding from the split sample regression. The cash flow coefficients are positive and highly significant for listed firms and private firms, except now foreign firms are no longer showing signs of financial constraints. This further confirms our hypothesis of "political pecking order", where private firms rank behind SOEs and foreign firms in terms of access to finance. This suggests private firms are the most financially constrained in China.

Dependent variables I_{it}/K_{it}	SOEs	Private	Foreign	Collective	Listed	Whole Sample	Interaction with ownership
$(I_{it}/K_{it})_{t-1}$	-0.068***	-0.042***	-0.096***	-0.100***	0.103***	-0.054***	-0.054***
	(0.025)	(0.015)	(0.020)	(0.038)	(0.031)	(0.010)	(0.010)
$(I_{it}/K_{it})^2_{t-1}$	0.050**	0.018	-0.026	-0.006	0.082**	0.017	0.016
	(0.025)	(0.015)	(0.020)	(0.056)	(0.037)	(0.010)	(0.011)
$(CF_{it}/K_{it})_{t-1}$	0.008	0.118***	0.050**	0.190	0.224***	0.086***	
	(0.093)	(0.025)	(0.020)	(0.124)	(0.044)	(0.015)	
$(S_{it}/K_{it})_{t-1}$	0.033***	0.015***	0.008**	0.018**	-0.008	0.014***	0.014***
	(0.011)	(0.002)	(0.003)	(0.009)	(0.010)	(0.002)	(0.002)
$(CF_{it}/K_{it})_{t-1}$* SOEs							0.080
							(0.113)
$(CF_{it}/K_{it})_{t-1}$* Private							0.133***
							(0.033)
$(CF_{it}/K_{it})_{t-1}$* Foreign							0.037
							(0.024)
$(CF_{it}/K_{it})_{t-1}$* Collective							0.224
							(0.196)
$(CF_{it}/K_{it})_{t-1}$* Listed							0.107***
							(0.044)
N	7642	17506	13019	3146	3458	44771	42995
M2	0.938	0.228	0.253	0.452	0.298	0.138	0.203
J (p-value)	0.144	0.768	0.364	0.924	0.987	0.567	0.134

Table 3.11: Euler equation estimation controlling for ownership.

Time dummies were included in all specifications. M2 tests for second-order serial correlation in the first-differenced residuals, under the null of no serial correlation The Hansen J statistics tests the overidentifying restrictions, under the null of instrument validity. *, **, * denotes significance at the 10% level, 5% level, and 1% level respectively. For all specifications time dummies and industry dummies are included, all specification are estimated with first differenced GMM estimator which used lagged values of all right side variables dated t-2 as instruments. The figure reported in parenthesis is asymptotic standard error.**

Dependent variables I_{it}/K_{it}	Whole sample (1)	SOE (2)	Private (3)	Foreign (4)	Collective (5)	Listed (6)	Ownership interactions (7)
$(I_{it}/K_{it})_{t-1}$	-0.054***	-0.064***	-0.044***	-0.097***	-0.100***	0.096***	-0.054***
	(0.010)	(0.025)	(0.015)	(0.020)	(0.038)	(0.031)	(0.010)
$(I_{it}/K_{it})^2_{t-1}$	0.017	0.053**	0.017	-0.027	-0.005	0.088**	0.017
	(0.010)	(0.025)	(0.015)	(0.020)	(0.056)	(0.037)	(0.011)
$(CF_{it}/K_{it})_{t-1}$	0.087***	0.028	0.112***	0.048***	0.189	0.250***	
	(0.015	(0.093)	(0.026)	(0.020)	(0.124)	(0.043)	
$(S_{it}/K_{it})_{t-1}$	0.014***	0.033***	0.015***	0.008***	0.018**	-0.003	0.014***
	(0.002)	(0.011)	(0.002)	(0.003)	(0.009)	(0.009)	(0.002)
COV_{t-1}	0.001	0.088***	-0.043	-0.040	0.082	-0.060	
	(0.015)	(0.025)	(0.028)	(0.025)	(0.061)	(0.057)	
$(CF_{it}/K_{it})_{t-1}$* SOEs							0.069
							(0.112)
$(CF_{it}/K_{it})_{t-1}$* Private							0.134***
							(0.034)
$(CF_{it}/K_{it})_{t-1}$* Foreign							0.037
							(0.024)
$(CF_{it}/K_{it})_{t-1}$* Collective							0.209
							(0.187)
$(CF_{it}/K_{it})_{t-1}$* Listed							0.129***
							(0.043)
COV_{t-1}* SOEs							0.070**
							(0.028)
COV_{t-1}* Private							-0.022
							(0.031)
COV_{t-1}* Foreign							-0.048
							(0.026)
COV_{t-1}* Collective							0.105
							(0.098)
COV_{t-1}* Listed							-0.043
							(0.059)
M2 (p-value)	0.142	0.871	0.225	0.267	0.495	0.195	0.24
J (p-value)	0.521	0.059	0.791	0.459	0.959	0.835	0.061
Number of observations	44750	7638	17500	13017	3144	3451	42980

Table 3.12: Euler equation estimation controlling for ownership augmented with coverage ratios.

Time dummies were included in all specifications. M2 tests for second-order serial correlation in the first-differenced residuals, under the null of no serial correlation The Hansen J statistics tests the overidentifying restrictions, under the null of instrument validity. *, **, * denotes significance at the 10% level, 5% level, and 1% level respectively. For all specifications time dummies and industry dummies are included, all specification are estimated with first differenced GMM estimator which used lagged values of all right side variables dated t-2 as instruments. The figure reported in parenthesis is asymptotic standard error. COV is the coverage ratio defined as interest payment divided by interest payment plus cash flow.**

Dependent variables I_{it}/K_{it}	Whole Sample	SOE	Private	Foreign	Collective	Listed	Ownership Interaction
$(I_{it}/K_{it})_{t-1}$	-0.052***	-0.066***	-0.040***	-0.095***	-0.100***	0.106***	-0.052***
	(0.010)	(0.025)	(0.015)	(0.020)	(0.038)	(0.031)	(0.010)
$(I_{it}/K_{it})^2_{t-1}$	0.017*	0.050**	0.018	-0.026	-0.006	0.083**	0.017*
	(0.010)	(0.025)	(0.015)	(0.020)	(0.057)	(0.035)	(0.010)
$(CF_{it}/K_{it})_{t-1}$	0.086***	0.009	0.122***	0.050**	0.186	0.225***	
	(0.015)	(0.094)	(0.025)	(0.020)	(0.125)	(0.044)	
$(S_{it}/K_{it})_{t-1}$	0.014***	0.033***	0.014***	0.008***	0.020**	-0.007	0.014***
	(0.002)	(0.011)	(0.002)	(0.003)	(0.009)	(0.009)	(0.002)
$Leverage_{t-1}$	0.027**	0.022	0.052***	0.005	-0.037	0.105	
	(0.012)	(0.033)	(0.016)	(0.019)	(0.067)	(0.070)	
$(CF_{it}/K_{it})_{t-1}$* SOEs							0.091
							(0.111)
$(CF_{it}/K_{it})_{t-1}$* Private							0.136***
							(0.033)
$(CF_{it}/K_{it})_{t-1}$* Foreign							0.043*
							(0.023)
$(CF_{it}/K_{it})_{t-1}$* Collective							0.142
							(0.169)
$(CF_{it}/K_{it})_{t-1}$* Listed							0.112***
							(0.043)
$Leverage_{t-1}$* SOEs							0.018
							(0.033)
$Leverage_{t-1}$* Private							0.052***
							(0.016)
$Leverage_{t-1}$* Foreign							0.005
							(0.020)
$Leverage_{t-1}$* Collective							-0.042
							(0.079)
$Leverage_{t-1}$* Listed							0.080
							(0.082)
M2 (p-value)	0.13	0.933	0.224	0.249	0.507	0.285	0.216
J (p-value)	0.646	0.227	0.763	0.253	0.886	0.993	0.176
Number of observations	44771	7642	17506	13019	3146	3458	42995

Table 3.13: Euler equation estimation controlling for ownership augmented with leverage ratios.

Time dummies were included in all specifications. M2 tests for second-order serial correlation in the first-differenced residuals, under the null of no serial correlation The Hansen J statistics tests the overidentifying restrictions, under the null of instrument validity. *, **, * denotes significance at the 10% level, 5% level, and 1% level respectively. For all specifications time dummies and industry dummies are included, all specification are estimated with first differenced GMM estimator which used lagged values of all right side variables dated t-2 as instruments. The figure reported in parenthesis is asymptotic standard error. Leverage ratio is calculated as total long term liabilities divided by firm's fixed assets.**

Table 3.12 and table 3.13 present the estimates of equation (6) which augment equation (5) with two new measures of financial constraints: the coverage ratio and the leverage ratio. Table 3.14 presents the estimates of equation (6), by augmenting the baseline equation with the two new financial measures. Coverage ratio can be understood as a solvency based ratio, which measures the firm's ability to serve its debt. The coverage ratio in our studies is defined as interest costs divided by interest costs plus cash flow. The inability to generate cash to service the interest cost will lead firms into insolvency. On the other the hand the leverage ratio, which is defined as the total long-term liabilities divided by total fixed assets. The leverage ratio can be seen as a collateral based measure of financial constraints. Given the underdevelopment of the legal system in China, bankruptcy is extremely difficult to carry out. Hence, banks tend to lend on the basis of collateral which are mainly land and building. Other types of collateral are less acceptable, since property rights tend not to be well-defined and costly to enforce. This puts increasing pressures on private firms, which have relatively low level of total fixed assets in the form of land and building as collateral to secure a debt from the banks.

Table 3.12 reports the results of the augmented Euler equation with the coverage ratio. Including the coverage ratio in the regressions only has a small impact on the coefficients of cash flow, for example private firms' coefficient for cash flow is now 0.112, compare to 0.118 in table 3.11. The cash flow terms continue to be positive and statistically significant for private firms, foreign firms and listed firms. Column (2) of table 3.12 presents us with an interesting result: although SOEs are not financially constrained by the measure of cash flow, SOEs are the only ownership group that is sensitive to the measures of coverage ratio. The regression result in column (7) of table 3.12 also indicates the same results by interacting the cash flow ratio and coverage ratio with ownership dummies. The coverage ratio is only positive and significant for SOEs. This suggest that although SOEs do not suffered from financial constraints, they still follow some rules to maintain themselves solvent, given that their inability to generate cash flows, the coverage ratio is an important determinant to their investment decisions. This result hints that the budget constraints are gradually hardening for SOEs as the Chinese financial system continues to reform.

Table 3.13 presents the results of augmented Euler equation with the leverage ratio. The results indicate that, for the whole sample, leverage is an important determinant of the investment decisions. After we control for ownership group by running split sample regression with the augmented Euler equation. Private firms appear to be the only group that is affected by the leverage ratio. By adding the leverage ratio into the regression leads to an increase the in the cash flow terms to 0.122. This again confirms the finding that private firms are financially constrained. The positive relationship between private firms' investment and leverage ratio is consistent with the idea that private firms are unable to obtain loans without enough collateral. Banks in China typically require the debt to be "over collateralized" to protect them from the drop in value of the collateral. Due to the limited tangible fixed assets that private firms can use as collateral, they will find it difficult to secure loans and are very sensitive to the leverage measure.

I_{it}/K_{it}	*Full sample*	*SOE*	*Private*	*Foreign*	*Collective*	*Listed*		*Ownership Interaction*
$(I_{it}/K_{it})_{t-1}$	-0.053***	-0.063***	-0.042***	-0.096***	-0.099***	0.100***	$(I_{it}/K_{it})_{t-1}$	-0.052***
	(0.010)	(0.025)	(0.015)	(0.020)	(0.038)	(0.031)		(0.010)
$(I_{it}/K_{it})^2_{t-1}$	0.017	0.054**	0.017	-0.027	-0.006	0.089**	$(I_{it}/K_{it})^2_{t-1}$	0.018*
	(0.010)	(0.025)	(0.015)	(0.020)	(0.057)	(0.036)		(0.010)
$(CF_{it}/K_{it})_{t-1}$	0.087***	0.028	0.117***	0.048**	0.189	0.252***	$(S_{it}/K_{it})_{t-1}$	0.014***
	(0.015)	(0.095)	(0.025)	(0.020)	(0.126)	(0.044)		(0.002)
$(S_{it}/K_{it})_{t-1}$	0.014***	0.033***	0.014***	0.008**	0.020***	-0.004	$(CF_{it}/K_{it})_{t-1}$* SOEs	0.085
	(0.002)	(0.011)	(0.002)	(0.003)	(0.009)	(0.009)		(0.110)
COV_{t-1}	0.0002	0.089***	-0.044	-0.040	0.083	-0.061	$(CF_{it}/K_{it})_{t-1}$* Private	0.136***
	(0.015)	(0.025)	(0.028)	(0.025)	(0.061)	(0.057)		(0.033)
$Leverage_{t-1}$	0.026**	0.018	0.052***	0.005	-0.038	0.113*	$(CF_{it}/K_{it})_{t-1}$* Foreign	0.041*
	(0.012)	(0.033)	(0.016)	(0.019)	(0.067)	(0.069)		(0.023)
							$(CF_{it}/K_{it})_{t-1}$* Collective	0.144
								(0.166)
							$(CF_{it}/K_{it})_{t-1}$* Listed	0.135***
								(0.042)
							COV_{t-1}* SOEs	0.073***
								(0.028)
							COV_{t-1}* Private	-0.023
								(0.030)
							COV_{t-1}* Foreign	-0.046
								(0.026)
							COV_{t-1}* Collective	0.070
								(0.089)
							COV_{t-1}* Listed	-0.040
								(0.058)
							$Leverage_{t-1}$* SOEs	0.007
								(0.032)
							$Leverage_{t-1}$* Private	0.053***
								(0.016)
							$Leverage_{t-1}$* Foreign	0.005
								(0.020)
							$Leverage_{t-1}$* Collective	-0.044
								(0.077)
							$Leverage_{t-1}$* Listed	0.092
								(0.084)
M2 (p-value)	0.133	0.865	0.22	0.263	0.556	0.182		0.248
J (p-value)	0.585	0.114	0.803	0.331	0.937	0.942		0.071
N	44750	7638	17500	13017	3144	3451		42980

Table 3.14: Euler equation estimation controlling for ownership and augmented with leverage ratios and coverage ratio.

M2 tests for second-order serial correlation in the first-differenced residuals, under the null of no serial correlation The Hansen J statistics tests the overidentifying restrictions, under the null of instrument validity. *, **, * denotes significance at the 10% level, 5% level, and 1% level respectively. For all specifications time dummies and industry dummies are included, all specification are estimated with first differenced GMM estimator which used lagged values of all right side variables dated t-2 as instruments. The figure reported in parenthesis is asymptotic standard error.**

By bringing together both the coverage ratio and leverage ratio, table 3.14 presents the result of equation (6). Similar results emerged: SOEs and COEs are not financially constrained in terms of cash flow measure, while private firms and listed firms are financially constrained. SOEs and Private firms' investment reacts to different financial measures. SOEs' investments are affected by the coverage ratios, while Private firms' investments are mainly affected by the leverage ratios.

However, from the results of table 3.11 to 3.14, one peculiar result emerges persistently: listed firms are always displaying the highest level of investment cash-flow sensitivities. Generally, listed firms are much larger and more transparent which reduce the level of asymmetric information. They should be less financially constrained than the private firms, which are smaller and suffers from high level of asymmetric information and agency costs. Some possible explanations for this finding are as follows: 1) the strict requirements[18] set by the government make refinancing very costly and difficult to conduct for the listed firms in China; 2) the transparency of the operation for listed firms and strict regulation stop them from obtaining financial resources from alternative routes such as informal finance, which falls on the grey area in law.

3.7.3 Regression results for Regional disparity

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[18] In order to refinance by issuing new shares, Chinese listed firms need to be profitable continuously for three years. If the firm has already issued new shares in the past 24 months, the operating profit can't decrease more than 50% in the year of new shares issue.

Table 3.15 presents our empirical tests of regional disparities in financial constraints. By creasing three regional dummies[19]: East, Central and West, and interact these regional dummies with the cash flow terms to assess the differential level of financial constraints across the three regions. Table 3.15 column (1) presents the results based on the whole sample. The cash flow terms are positive and significant at 1% level of the eastern region, while the cash flow terms are not statistically significant for the central and western regions. This indicates that the eastern region suffers most from financial constraints. This result supports our conjecture in section 4.2 that we are likely to find that eastern/coastal region will be more financially constrained than western and central region. In our opinion, this is due to the combine effects of fragmented capital market and central government's continuous allocation of resources from the eastern region towards the western and central regions to narrow the development gap.

Furthermore, in table 3.15 we also run a split sample regression for each individual ownership group with regional dummies interaction. We find that SOEs and COEs are continue to be unaffected by cash flows in all regions, while only private firms and foreign firms located in the eastern/coastal regions appear to be financially constrained. This is likely caused by the fact than the demand for funds are very high in the eastern/coastal regions, where many firms are competing for limited amount of funds.

[19] See Table 3A5 for classification details.

Another interesting fact from table 3.15 is the regression based on listed firms, the coastal region appears to suffer the least from financial constraints and western region suffers the most from financial constraints, and the central region falls in between. This result is consistent with the theory that the level of local financial development helps to reduce the level of financial constraints. This is likely due to the fact that listed firms mainly rely on formal source of finance, and listed firms located in region with better financial development may benefit from easier access to finance.

Table 3.16 presents the Euler equation estimation augmented with both coverage ratio and leverage ratio. We interact cash flow, coverage ratio and leverage ratio with three regional dummies to test for the regional disparities of financial constraints across different ownership type. The result indicates that cash flow terms are positive and significant only for private firms, foreign firms located in the eastern/coastal region. Cash flow terms are positive and significant for all three regions for the listed firms. Listed firms located in the western region display the highest level of cash flow sensitivities, which suggests that western region is more financially constrained for the listed firms.

Moreover, the results continue to suggest that SOEs and collectively owned firms are not subject to financial constraints. However, the coverage ratios are positive and significant for SOEs located in the eastern/coastal region and the central region. This suggests that SOEs located in the eastern/coastal and the central regions are subject to some form of hardening budget constraints. The coverage ratio is positive and significant for private firms located in the eastern/coastal region only. Last, the leverage ratio is positive and significant only for private firms located in the eastern/coastal regions. Overall, the result suggests that private firms located in the eastern/coastal region are most financially constrained.

I_{it}/K_{it}	*Whole Sample*	*SOE*	*Private*	*Foreign*	*Collective*	*Listed*
$(I_{it}/K_{it})_{t-1}$	-0.047***	-0.064***	-0.041***	-0.094***	-0.108***	0.105***
	(0.009)	(0.025)	(0.015)	(0.020)	(0.038)	(0.031)
$(I_{it}/K_{it})^2_{t-1}$	0.016*	0.048*	0.019	-0.026	0.000	0.085**
	(0.009)	(0.025)	(0.015)	(0.020)	(0.060)	(0.036)
$(CF_{it}/K_{it})_{t-1}$* East	0.092***	0.177	0.127***	0.054***	0.163	0.196***
	(0.017)	(0.228)	(0.031)	(0.020)	(0.196)	(0.061)
$(CF_{it}/K_{it})_{t-1}$* Central	0.052	0.137	0.084	0.003	-0.046	0.235***
	(0.067)	(0.162)	(0.113)	(0.199)	(0.109)	(0.045)
$(CF_{it}/K_{it})_{t-1}$* Western	0.069	-0.220	0.079	0.095	0.378	0.334***
	(0.054)	(0.165)	(0.077)	(0.150)	(0.251)	(0.082)
$(S_{it}/K_{it})_{t-1}$	0.014***	0.035***	0.015***	0.008***	0.012*	-0.003
	(0.002)	(0.011)	(0.002)	(0.003)	(0.007)	(0.009)
M2 (p-value)	0.16	0.878	0.297	0.406	0.358	0.278
J (p-value)	0.25	0.059	0.698	0.249	0.65	0.971
Number of observations	42995	7315	16901	12472	3059	3248

Table 3.15: Euler equation estimation controlling for regional disparities across different ownership

M2 tests for second-order serial correlation in the first-differenced residuals, under the null of no serial correlation The Hansen J statistics tests the overidentifying restrictions, under the null of instrument validity. *, **, * denotes significance at the 10% level, 5% level, and 1% level respectively. For all specifications time dummies and industry dummies are included, all specification are estimated with first differenced GMM estimator which used lagged values of all right side variables dated t-2 as instruments.**

East region: Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan, Guangxi. Central region: Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan. Western region: Neimenggu, Sichuan, Chongqing, Guizhou, Yunnan, Shannxi, Gansu, Qinghai, Ningxia, Xinjiang, Tibet

I_{it}/K_{it}	*Whole Sample*	*SOE*	*Private*	*Foreign*	*Collective*	*Listed*
$(I_{it}/K_{it})_{t-1}$	-0.0541***	-0.0626*	-0.0424**	-0.0954***	-0.111**	0.0993**
	(0.00994)	(0.0252)	(0.0151)	(0.0193)	(0.0380)	(0.0312)
$(I_{it}/K_{it})^2_{t-1}$	0.0175	0.0405	0.0192	-0.0127	-0.00576	0.0862*
	(0.00994)	(0.0260)	(0.0152)	(0.0181)	(0.0571)	(0.0358)
$(CF_{it}/K_{it})_{t-1}$* *East*	0.0878***	0.328	0.117***	0.0552**	0.156	0.227***
	(0.0177)	(0.270)	(0.0314)	(0.0198)	(0.186)	(0.0651)
$(CF_{it}/K_{it})_{t-1}$* *Central*	0.105	0.109	0.0825	-0.0865	0.0600	0.233***
	(0.0739)	(0.156)	(0.121)	(0.227)	(0.0825)	(0.0478)
$(CF_{it}/K_{it})_{t-1}$* *Western*	0.0779	-0.288	0.0834	0.0840	0.372	0.312***
	(0.0578)	(0.175)	(0.0771)	(0.146)	(0.247)	(0.0829)
COV_{t-1}* *East*	-0.0232	0.126*	0.0858*	-0.0238	0.111	-0.0520
	(0.0191)	(0.0497)	(0.0366)	(0.0257)	(0.0959)	(0.0658)
COV_{t-1}* *Central*	0.0320	0.110*	0.0185	-0.187	-0.00792	-0.145
	(0.0398)	(0.0495)	(0.0797)	(0.137)	(0.0972)	(0.140)
COV_{t-1}* *Western*	0.0278	0.0519	0.00432	-0.0970	-0.105	0.0880
	(0.0297)	(0.0444)	(0.0524)	(0.0860)	(0.120)	(0.109)
$Leverage_{t-1}$* *East*	0.0386	0.0472	0.145**	0.0463	-0.0126	0.0651
	(0.0199)	(0.0644)	(0.0557)	(0.0340)	(0.0817)	(0.0879)
$Leverage_{t-1}$* *Central*	-0.0159	-0.00348	0.0158	-0.208	-0.148	0.266
	(0.0477)	(0.0709)	(0.0684)	(0.209)	(0.121)	(0.178)
$Leverage_{t-1}$* *Western*	0.0681	-0.0497	0.0441	0.0864	0.0289	0.0469
	(0.0406)	(0.0797)	(0.0276)	(0.183)	(0.127)	(0.156)
$(S_{it}/K_{it})_{t-1}$	0.0138***	0.0372**	0.0146***	0.00909**	0.0166**	0.000935
	(0.00189)	(0.0122)	(0.00235)	(0.00285)	(0.00628)	(0.00798)
M2 (p-value)	0.163	0.938	0.298	0.236	0.590	0.154
J (p-value)	0.233	0.0961	0.110	0.380	0.491	0.868
Number of observations	42455	7168	16692	12373	3016	3206

Table 3.16: Euler equation estimation controlling for regional disparities across different ownership.

See notes from table 3.14 and 3.15

3.7.4 Regression results for foreign ownership and financial constraints

A popular view in the literature of financial constraints argues that the presence of foreign capital helps to reduce the level of financial constraints. This is because the foreign investors are typically large multinationals which can help firms to obtain funds from their parent companies. Moreover, in the firms with foreign ownership typically receive preferential policy treatments from the local and central government, such as reduction in tax level. Last, as Huang (2003) proposed that firms located in the High FDI provinces have better access to extra source of finance, while firms located in region of FDI provinces only have access to limited sources of finance. He further argues that private firms rely more on FDI than other ownership types, as they rank at the end of the political pecking order which makes them very difficult to obtain external finance.

In this section we conduct a test to see whether the presence of foreign capital indeed helps firms to alleviate the level of financial constraints. We use the average ownership data to divide firms into two groups: 1) firms with foreign ownership[20] (WF) and 2) firms without foreign ownership[21] (NF). Table 3.16 presents our test results on whether the presence of foreign capital using the baseline Euler equation specification. Column (1)-(3) utilise the full

[20] Firms are defined as WF if the actual share of foreign capital in the firm's equity is greater than zero.
[21] Firms are defined as NF if the actual share of foreign capital in the firm's equity is equal to zero.

sample of data[22]. Column (1) is for firms without the presence of the foreign ownership, the cash flow term is 0.126 and statistically significant at 1%. The cash flow term for firms with the presence of foreign ownership is 0.0681 (only half the size of the cash flow terms for firm without foreign ownership) and statistically significant at 1% level. This suggests that the presence of foreign ownership helps to reduce the level of financial constraints in China. In column (3) of table 3.17, we interact the cash flow with two dummy variables indicating the presence of foreign ownership in a firms share capital: 1) NF=1 if the actual share of foreign capital in the firm's equity is equal to zero, NF=0 otherwise; 2) WF=1 if the actual share of foreign capital in the firm's equity is greater than zero, WF=0 otherwise. From column (3) of table 3.17, we find that for the full sample of data, the cash flow term for NF firms is 0.133, while the cash flow term for WF firms is 0.0621 (only half the size of the NF firms' cash flow term). This evidence indicates that firms with foreign ownership are less financially constrained than firms without foreign ownership.

Given the findings that private firms are the most financially constrained ownership type in China. Therefore, column (4)-(6) of table 3.17 focus on private firms exclusively. We can see that cash flow terms for NF private firms and WF private firms are 0.131 and 0.114 respectively. The cash flow terms are statistically significant at 1% level. The result in column (6) confirms the finding that private firms without foreign ownership displaying a higher level of investment cash flow sensitivities.

[22] As we do not have ownership details for the listed firms, listed firms are excluded in this regression.

Table 3.18 reports the result of the Euler equation augmented with coverage ratio and leverage ratio as a robustness check. Again, column (1)-(3) utilise the full sample of data. We can see that the cash flow term for NF firms continues to be about twice as large as the cash flow term for the WF firms. However, neither coverage ratio nor leverage ratio appear to be significant for both types of firms. Column (4)-(6) of table 3.18 focus only private firms, the result suggests that the cash flow terms are positive and significant for both NF firms and WF firms, and the magnitude of the cash flow terms are also similar (0.121 for NF firms vs. 0.11 for WF firms in column(6) of table 3.18). A more interesting result is that leverage continues to be positive and significant for NF private firms. This suggests the presence of the foreign ownership does help to alleviate private firms' financial constraints problem.

I_{it}/K_{it}	*Full sample* *WF=0* (1)	*WF=1* (2)	*Full sample* (3)	*Private* *WF=0* (4)	*WF=1* (5)	*Private* (6)
$(I_{it}/K_{it})_{t-1}$	-0.0471***	-0.0864***	-0.0632***	-0.0352*	-0.0772*	-0.0420**
	(0.0141)	(0.0158)	(0.0104)	(0.0177)	(0.0302)	(0.0152)
$(I_{it}/K_{it})^2_{t-1}$	0.0231	-0.00323	0.0122	0.0285	-0.0174	0.0188
	(0.0145)	(0.0147)	(0.0104)	(0.0182)	(0.0287)	(0.0154)
$(S_{it}/K_{it})_{t-1}$	0.0177***	0.00977***	0.0137***	0.0150***	0.00625	0.0143***
	(0.00300)	(0.00265)	(0.00191)	(0.00289)	(0.00466)	(0.00236)
$(CF_{it}/K_{it})_{t-1}$	0.126***	0.0681***		0.131***	0.114**	
	(0.0365)	(0.0177)		(0.0390)	(0.0356)	
$(CF_{it}/K_{it})_{t-1}$* NF			0.133**			0.123**
			(0.0434)			(0.0465)
$(CF_{it}/K_{it})_{t-1}$* WF			0.0621**			0.116**
			(0.0205)			(0.0385)
M2 (p-value)	0.107	0.291	0.113	0.145	0.919	0.297
J (p-value)	0.167	0.829	0.714	0.542	0.282	0.916
Number of observations	21937	18845	39205	13028	4254	16668

Table 3.17: Euler equation estimation for firms with and without foreign ownership

M2 tests for second-order serial correlation in the first-differenced residuals, under the null of no serial correlation The Hansen J statistics tests the overidentifying restrictions, under the null of instrument validity. *, **, * denotes significance at the 10% level, 5% level, and 1% level respectively. For all specifications time dummies and industry dummies are included, all specification are estimated with first differenced GMM estimator which used lagged values of all right side variables dated t-2 as instruments.**

WF=1: if the actual share of foreign capital in the firm's equity is greater than zero.
WF=0: if the actual share of foreign capital in the firm's equity is equal to zero.

I_{it}/K_{it}	Full sample WF=0 (1)	Full sample WF=1 (2)	Full sample (3)	Private WF=0 (4)	Private WF=1 (5)	Private (6)
$(I_{it}/K_{it})_{t-1}$	-0.0447**	-0.0860***	-0.0626***	-0.0311	-0.0798**	-0.0425**
	(0.0139)	(0.0155)	(0.0103)	(0.0174)	(0.0299)	(0.0151)
$(I_{it}/K_{it})^2_{t-1}$	0.0243	-0.00292	0.0127	0.0302	-0.0122	0.0207
	(0.0144)	(0.0145)	(0.0103)	(0.0178)	(0.0280)	(0.0151)
$(S_{it}/K_{it})_{t-1}$	0.0183***	0.00987***	0.0138***	0.0161***	0.00698	0.0144***
	(0.00291)	(0.00254)	(0.00191)	(0.00278)	(0.00441)	(0.00235)
$(CF_{it}/K_{it})_{t-1}$	0.134***	0.0668***		0.122***	0.120**	
	(0.0361)	(0.0175)		(0.0355)	(0.0376)	
$(CF_{it}/K_{it})_{t-1}$*			0.133**			0.121*
NF			(0.0433)			(0.0469)
$(CF_{it}/K_{it})_{t-1}$*			0.0615**			0.110**
WF			(0.0204)			(0.0388)
COV_{t-1}*	0.0266	-0.0461		-0.0334	-0.0965	
	(0.0183)	(0.0245)		(0.0288)	(0.0655)	
$Leverage_{t-1}$*	0.0283	0.0468		0.112*	0.0419	
	(0.0209)	(0.0273)		(0.0491)	(0.0252)	
COV_{t-1}*			0.0213			-0.0480
NF			(0.0201)			(0.0302)
COV_{t-1}*			-0.0429			-0.0438
WF			(0.0254)			(0.0728)
$Leverage_{t-1}$*			0.0488			0.120*
NF			(0.0274)			(0.0514)
$Leverage_{t-1}$*			0.0236			0.0377
WF			(0.0215)			(0.0254)
M2 (p-value)	0.127	0.489	0.115	0.177	0.779	0.284
J (p-value)	0.147	0.610	0.386	0.583	0.253	0.520
Number of observations	21081	18115	39196	12539	4125	16664

Table 3.18: Euler equation estimation augmented with coverage ratio and leverage ratio for firms with and without foreign ownership

M2 tests for second-order serial correlation in the first-differenced residuals, under the null of no serial correlation The Hansen J statistics tests the overidentifying restrictions, under the null of instrument validity. *, **, * denotes significance at the 10% level, 5% level, and 1% level respectively. For all specifications time dummies and industry dummies are included, all specification are estimated with first differenced GMM estimator which used lagged values of all right side variables dated t-2 as instruments.**

WF=1: if the actual share of foreign capital in the firm's equity is greater than zero.
WF=0: if the actual share of foreign capital in the firm's equity is equal to zero.

3.8 Conclusions

Based on a large firm-level dataset, which mainly consists of unlisted firms over the period of 1998-2005, using the Euler equation investment model we investigate whether Chinese firms are financially constrained. In particular we focus on assessing the impact of ownership, regional disparities and the presence of foreign ownership on the level of financial constraints.

By dividing firms into five ownership groups, we find strong evidence indicating there is a “lending bias” at work. The SOEs and COEs are least financially constrained, while the private firms are the most financially constrained. This is largely the result of significant distortion in the financial system cause by the state-dominated banking system that favours SOEs over private ownership. There is evidence that SOEs are still enjoying the benefits of “soft budget constraints” even after 30 years of transition.

A surprising result from the study is that listed firms in China are subject to severe financial constraints, which contradicts the traditional view that listed firms, are subject to less asymmetric information problems, and should be less financially constrained. The causes of this result deserve further research.

By augmenting the Euler equation investment model with two financial measures: the coverage ratio and the leverage ratio; we find evidence that SOEs are sensitive to the solvency based coverage ratio, and the private firms are sensitive to the collateral based financial measure, the leverage ratio. This may suggest that banks and other lenders place different lending criteria on different ownership groups. The foreign firms, COEs and listed firms do not appear to be affected by these two ratios.

Moreover, we also find that there are significant regional disparities in terms of the level of financial constraints. We find evidence that the eastern/coastal regions are more financially constrained than the central and western regions, which support the conjecture that capitals are highly immobilize in China. Government's allocation of resources from eastern regions towards the less developed western and central regions creates more distortion in the financial markets. It is likely that the level of financial constraints in the less developed region is reduced at the cost of the economic growth potential in the eastern/coastal regions.

Last, we also find evidence the presence of foreign ownership helps to reduce the level of financial constraints. Because foreign firms are less dependent on the local capital markets, they have the ability to avoid the lending bias in China and obtain valuable financial resources from abroad.

The more efficient and profitable private firms have been the engine of growth in the Chinese economy. However, due to lending bias in the financial system, private firms are severely discriminated against by the banking sector and facing high level of financial constraints, which eventually turn into a slowdown in the economic growth. The continuous distortion in the financial markets and misallocation of capital by the government will prevents the financial market to develop and help the economy to achieve full efficiency.

Data Appendix 3A:

Structure of the unbalanced panel full sample

Year	*Number of observations*	*Percent*	*Cumulative*
1998	9,910	8.69	8.69
1999	10,716	9.39	18.08
2000	12,753	11.18	29.25
2001	14,556	12.76	42.01
2002	15,422	13.52	55.53
2003	16,306	14.29	69.82
2004	16,975	14.88	84.7
2005	17,460	15.3	100
Total	114,098	100	

Table 3A1: Number of observations by year. (1998-2005)

Number of observations per firm	*Number of firms*	*Percent*	*Cumulative*
1	249	1.12	1.12
2	2,245	10.08	11.2
3	1,895	8.51	19.7
4	1,975	8.87	28.57
5	3,060	13.74	42.31
6	3,074	13.8	56.11
7	1,356	6.09	62.2
8	8,420	37.8	100
Total	22,274	100	

Table 3A2: Number of firms by year. (1998-2005)

Year	Number of observations	Percent	Cumulative
1999	638	10.07	10.07
2000	662	10.45	20.51
2001	782	12.34	32.85
2002	936	14.77	47.63
2003	1,000	15.78	63.41
2004	1,142	18.02	81.43
2005	1,177	18.57	100
Total	6,337	100	

Table 3A3: Number of observations for listed firms by year. (1999-2005)

year	SOE	Private	Foreign	Collective	Listed	Total
1998	2,324	3,751	2,907	928	0	9,910
	23.45	**37.85**	**29.33**	**9.36**	**0**	**100**
1999	2,329	3,819	2,998	932	638	10,716
	21.73	**35.64**	**27.98**	**8.7**	**5.95**	**100**
2000	2,626	4,813	3,612	1,040	662	12,753
	20.59	**37.74**	**28.32**	**8.15**	**5.19**	**100**
2001	2,586	6,102	3,956	1,130	782	14,556
	17.77	**41.92**	**27.18**	**7.76**	**5.37**	**100**
2002	2,795	6,469	4,055	1,167	936	15,422
	18.12	**41.95**	**26.29**	**7.57**	**6.07**	**100**
2003	2,683	6,997	4,463	1,163	1,000	16,306
	16.45	**42.91**	**27.37**	**7.13**	**6.13**	**100**
2004	2,504	7,404	4,905	1,020	1,142	16,975
	14.75	**43.62**	**28.9**	**6.01**	**6.73**	**100**
2005	2,389	7,833	5,101	960	1,177	17,460
	13.68	**44.86**	**29.22**	**5.5**	**6.74**	**100**
Total	20,236	47,188	31,997	8,340	6,337	114,098
	17.74	**41.36**	**28.04**	**7.31**	**5.55**	**100**

Table 3A4: Distribution of observations by ownership type. (1999-2005)
Note: the numbers in Bold are percentages; other numbers are number of observations

Region 1: Costal/East Region	Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan, Guangxi
Region 2: Central Region	Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan
Region 3: Western Region	Neimenggu, Sichuan, Chongqing, Guizhou, Yunnan, Shannxi, Gansu, Qinghai, Ningxia, Xinjiang, Tibet

Table 3A5: Detailed regions classification

Region	*SOE*	*Private*	*Foreign*	*Collective*	*Listed*	*Total*
Costal	*10.72%*	*40.76%*	*36.56%*	*6.95%*	*5.01%*	*100.00%*
Central	*30.39%*	*44.49%*	*6.82%*	*8.66%*	*9.63%*	*100.00%*
West	*33.46%*	*48.46%*	*4.64%*	*5.23%*	*8.22%*	*100.00%*
Whole Sample	*16.67%*	*42.38%*	*27.91%*	*6.93%*	*6.10%*	*100.00%*

Table 3A6: Distribution of observations by ownership type and regions

Data Appendix 3B:

Definitions of variables

I_{it}: investment is calculated as the change in real tangible fixed assets plus depreciation

CF_{it}: is calculated as the sum of net income plus depreciation plus the amortization of other long-term assets, intangible assets and long-term prepaid expense.

K_{it}: Capital is proxy by real tangible fixed assets.

S_{it}: Sales is the total real sales turnover of the firm.

Deflators: the provincial level deflators are extracted from the China Statistical Yearbook published by the National Bureau of Statistics of China. The capital stock (*i.e. firm's tangible fixed assets*) is deflated with the provincial ex-factory price indexes. All other variables are deflated with the provincial *GDP* deflator.

COV ratio: is defined as the ratio of the firm's interest expense to the sum of the firm's interest expense plus cash flow

Leverage ratio: is calculated as the book value of total long term liabilities divided by firm's fixed assets.

Chapter 4: *Financial constraints and Inventory investment: Evidence from China*

4.1 Introduction

The importance of the role of inventory investment has often been neglected by economists. The interest in inventory behaviour is ignited by Metzler's (1941) paper, which demonstrates that inventory behaviour can helps to explain the business cycle. Nowadays, it is commonly understood that inventory investment plays a prominent role in the business cycle. Despite of its small magnitude relative to total production, the reduction of inventory during economic recession accounts for a significant portion of the reduction in the gross domestic product (GDP).

Blinder and Maccini (1991) show that, in a purely arithmetical sense, inventory investment reduction has accounted for around 87% of the drop in GNP during the average post-war recession in the United States. Cunningham (2004) finds even more significant results for Canada. She shows that inventory investment declines by almost 200% more than decline in output over an average business cycle. Based on these startling results, it is believed that a better understanding of the inventory investment behaviour at both the micro level and macro level will help us to gain better understanding of the business cycle and the micro behaviour of the firms. In recent recessions, inventory investment reduction has been widely cited as an important component of leading business cycle indicators. Furthermore, due to the significant magnitude of the volatility of inventory investment, economists believe that policies that reduce the inventory fluctuations could dampen the business cycle.

At the micro level, when companies face shocks, they have a number of adjustments to the shocks, such as change in employment level, fixed investment etc. However, inventory investment is typically considered to be the first choice, since the adjustment costs for inventories are relatively low compare to other forms of investment adjustment[23]. The understanding of firms' inventory adjustment will also offer insights to the monetary policy transmission mechanism. Inventory investment behaviour has been widely studied in the context of developed economies such as US and UK, yet there isn't any study on inventory investment in the context of China. This study aims to fill this gap by empirically study whether financial variables play an important role in inventory investment decisions of Chinese firms. Specifically we would like to see whether financial factors have different impacts on inventory investment decisions of firms with different ownership and different firm characteristics.

4.2 Inventory investment and financial constraints: a literature review

The studies of financial constraints and inventory investment are motivated by the theoretical research of capital market imperfection, which argues that the internal finance and net worth will have a significant impact on firm behaviour if external

[23] For example, fixed investment and R&D investment face very high adjustment costs.

finance is not perfect substitute for internal finance. The details of the theoretical arguments of the capital market imperfection are documented in the second chapter of this thesis. In this chapter we focus on testing the linkage between inventory investment and internal finance and how these linkages different across firms with different characteristics. In this section we provide a review of the existing studies on the financial constraints and inventory investment based on aggregate data and firm-level panel studies.

In the presence of capital market imperfection, firms' might have limited access to external finance. This will affect firms' ability to achieve their optimal level of inventories and lead to excess fluctuations in inventory investment. Earlier paper on the link between financial factors and inventory investment is motivated by the fact that monetary policy can affect firm's ability to obtain finance for their investment behaviours (including inventory investment). Using aggregate data from US in between 1964 and 1989, Kashyap, Stein and Wilcox(1993) show that financial factors, proxy by the prime commercial paper spread and the mix of bank loans and commercial paper, have a significant predictive power of inventory investment. Moreover, they find that monetary tightening does reduce the loan supply and has a significant impact on the real activities in the economy.

Based on a less aggregated time-series data taken from the Quarterly Financial Report for Manufacturing Corporations (QFR) between 1960 and 1991, Gertler and Gilchrist (1994) analyse the response of manufacturing firms in different size groups to the change in monetary policy. They find that small firms account for a significant large proportion or reduction in inventory investment relative to large firms after monetary tightening. Using firm size as a proxy for capital market access and coverage ratio as a proxy for financial factors, Gertler and Gilchrist (1994) find that coverage is a highly significant predictor for small firm inventory investment but not for large firms. They interpret their result as supportive evidence of liquidity constraints on small firms due to capital market imperfection faced by small firms.

In a related paper Kashyap, Lamont and Stein(1994), motivated by the "lending view" of monetary policy transmission, use cash stock (cash plus marketable securities) as a measure of liquidity to proxy financial factor, and find that cash stock is a significant determinants of the inventory growth for firms without bond ratings. They also show that financial constraints appear to be much more important during recessionary episodes. The main difference between Kashyap, Lamont and Stein's (1994) paper and the previous two papers is that KLS utilizes a cross-section of firms instead of aggregate time-series data. Due to the importance of firm heterogeneity in the test of financial constraints and capital market imperfection, less aggregated data can provide more insights to the problem of interest.

With the wider availability of firm level panel dataset, researchers start to resort to micro dataset to study the link between financial factors and inventory investment. The use of firm-level panel data presents a number of advantages to study inventory investment. For example, firm level panel data allows us to include firm fixed effects and disaggregated industry time dummies. The fixed effects can control the time-invariant determinants of inventory investment that differ across firms. The industry specific time dummies allow the researchers to control for the cost or technological shocks at industry level. Carpenter, Fazzari and Petersen (1994) is the first paper that exploit panel data of firms to study the links between inventory investment and internal finance. Using quarterly data for US manufacturing firms from Compustat, their results strongly support the idea that financial factors have a significant impact on firms' inventory investment for both small and large firms and the effect is significantly stronger for small firms than for large firms. They have also obtained similar result when they separate the sample according to whether firms have bond rating or not, where they find firms without bond rating display higher cash flow sensitivities.

The literatures on financial constraints and inventory investment have employed a number of different financial variables to test which channels financial constraints operate through. Gertler and Gilchrist (1994) employs coverage ratio to test for the presence of "balance sheet channel" of monetary policy transmission mechanism for monetary policy, while Kashyap, Lamont and Stein(1994) use cash stock to test the presence of “bank lending channel” of monetary policy transmission, and Carpenter, Fazzari and Petersen (1994) use cash flow to emphasize the importance of internal finance on inventory investment decisions. Despite the different proxies used in these studies, the results generally support the existence of financial constraints and indicate that financial factor is a significant determinant of inventory investment.

In order to compare the performance of these three financial variables, Carpenter, Fazzari and Petersen (1998a) test these three financial variables in a common econometric framework with an identical sample of quarterly firm panel data from US manufacturing sectors. They find that cash stocks and coverage ratio have a weaker impact on inventory investment compare to cash flow. Cash flow helps to explain different inventory behaviour not only across firms with different firm size, but also across three different inventory cycles.

Guariglia (2000) analyse the relation between financial constraints and inventory investment in a structural generalized linear quadratic model, instead of reduced form regression in previous studies. She finds that financial constraints are important determinant of inventory decisions for UK manufacturing firms who have high short-term debt to inventories ratios or low coverage ratios, but financial constraints are not binding for firms with strong balance sheets.

Blinder and Maccini (1991) note that raw materials and work-in-progress inventory held by firms are the most volatile components of inventory investment. This point is also raised by Carpenter, Fazzari and Petersen (1994), who find firms use the stock of raw materials and delay reordering to increase their liquidity. Despite these facts, most of earlier theoretical and empirical works focus on manufacturers' inventories of finished goods.

Guariglia (1999) addresses this problem in her study using a panel of UK manufacturing firms from 1968 to 1991. She classified firms' inventory investment into three different groups: work-in-process inventories, raw materials and total inventories. She shows that the effect of financial constraints is particularly strong for work-in-process and raw material inventories which have lower adjustment costs relative to finished goods.

Further evidence on inventory investment and cash flow from the UK is provided by Small (2000), who finds that the effect of cash flow on inventory investment is concentrated among firms that are identified as financially constrained on the basis of either their financial policy or their current ratio, only cash flow still has an effect on inventory investment of unconstrained firms. His study shows that there is no unique criterion for identifying financially constrained firms. Contrary to other studies, he finds that firm size and coverage ratio are not good indicators of whether a firm is financially constrained or not.

Benito (2005) conducts a comparative study of the inventory investment by firms in UK and Spain. He finds evidence that cash flow effects and liquidity effects are presence for both countries in the study. These effects are stronger in the UK than in Spain. Benito (2005) suggest this is due to: firs, Spanish banks have good liquidity buffers that allow them to cope with the interest rate change without significant impact on the credit supply; second, the direct involvement of the Spanish banks in the governance of Spanish companies helps to reduce the information problems.

Using a modified version of Lovell's (1961b) stock adjustment model, Bo *et al* (2002), show that inventory investment of Dutch firms are motivated by stock-out avoidance and capital market imperfection. Failing to consider the effects of capital market imperfection would underestimate the accelerator effect and the adjustment speed for financially unconstrained firms and overestimate these effects for financially constrained firms. Contrary to most of the studies, Cunningham (2004) finds no evidence of link between cash flow and inventory investment for Canadian manufacturing firms over the period of 1992-1999. The author believes this is likely due to the fact that the Canadian economy did not suffer from any recession during the study period, which makes it hard to detect the effects of financial constraints.

Guariglia and Mateut (2006) extends the study of financial constraints and inventory investment to test for the existence of trade credit channel of monetary transmission in UK over the period 1980-2000. By estimating error-correction inventory investment equations augmented with coverage ratio and trade credit to assets ratio for financially constrained and financially unconstrained firms, they find that both credit and trade credit channels of transmission of monetary policy operate side by side in the UK and the use of trade credit could offset the liquidity constraints. Guariglia and Mateut (2009) further show that global engagement substantially reduces financial constrained firms' sensitivities of inventory investment to financial composition variable. They conclude that participation of global engagement helps to shield firms from financial constraints.

4.3 Baseline specification and Estimation methodology

4.3.1 Baseline specification

In order to test the link between financial factors and inventory investment, we use a modified version of Lovell's target-adjustment model (1961a). The target adjustment model suggests that, in general, firms' have a desired or optimal level of inventories level (equilibrium level) relative to sales they would like to maintain. Firms typically find it difficult to maintain their inventories at the desired target level due to sales shocks and forecasting errors. In a simple sales accelerator model, firms would attempt to immediately adjust their inventories to the new equilibrium level. However, this is unrealistic in the real world situation due to a number of reasons. First, orders in small bunch and fast delivery will typical impose a premium on the cost of the purchases. Moreover, as suggested in Lovell (1961), due to the heterogeneous nature of stocks, stocks are replaced at a less frequent interval. Therefore, firms only make partial adjustment towards the equilibrium level. Based on these ideas, a partial target adjustment is a more suitable choice than the standard sales accelerator model. In this section, we derive a reduced form error-correction inventory investment model for our empirical studies[24].

Abstracting from the influence of sales shocks, cost factors and liquidity constraints, we assume that the desired(target) level of inventories $I^*_{i,t}$ of firm *i* at time *t* is positively related to sales $S_{i,t}$ at time *t* in equation (1), where $I^*_{i,t}$ and $S_{i,t}$ are real inventory stock and real sales in logarithm forms respectively.

$$I^*_{i,t} = \alpha_0 + \alpha_1 S_{i,t} \tag{1}$$

α_1 in equation (1) has a number of interpretations: 1) it can be seen as the marginal desired stock coefficient; 2) it is also a sales accelerator effect; when sales are expected to increase so will the inventory stock target. Equation (1) is a basic representation of how firms set the target inventory investment. If the inventory to sales ratio is stable, the target inventory model implies that α_1 =1.

[24] Our model follows closely to that of Guariglia and Mateut (2009), who use a similar model to study the impacts of global engagement on inventory investment.

Let I_{it} be the logarithm of the actual stock of inventories for firm *i* at time *t* and ΔI_{it} represents the actual inventory investment at time *t*. Based on the assumption of partial adjustment, we further assume that current inventory investment $\Delta I_{i,t}$ is a fraction δ of the gap between target level of inventory investment $I^{*}_{i,t}$ and actual level of investment in last period ($I_{i,t-1}$) :

$$\Delta I_{i,t} = I_{i,t} - I_{i,t-1} = \delta(I^{*}_{i,t} - I_{i,t-1}) \qquad \textbf{(2)}$$

Substituting (1) into (2) and rearranging yields:

$$I_{i,t} = \delta\alpha + \delta\beta S_{i,t} + (1-\delta)I_{i,t-1} \qquad \textbf{(3)}$$

In order to take into accounts the dynamic nature of investment behaviour and capture the slow effects of adjustment towards target level of inventories, we nested the simple partial target adjustment model in an autoregressive distributed lag specification with second-order dynamics[25]. This yields:

$$I_{i,t} = \alpha_1 I_{i,t-1} + \alpha_2 I_{i,t-2} + \alpha_3 S_{i,t} + \alpha_4 S_{i,t-1} + \alpha_4 S_{i,t-2} + v_i + v_{j,t} + v_t + e_{i,t} \qquad \textbf{(4)}$$

In equation (4), we include v_i to control for firm-specific effects, $v_{j,t}$ to control for industry-time specific effects, v_t to control time-specific effects and $e_{i,t}$, which is the idiosyncratic component. Rearranging equation (4) into differenced forms to study the growth of inventory investment:

[25] An ADL(2, 2) model.

$$\Delta I_{i,t} = (\alpha_1 - 1)\Delta I_{i,t-1} - (1-\alpha_1-\alpha_2)\Delta I_{i,t-2} + \alpha_3 \Delta S_{i,t} + (\alpha_3+\alpha_4)\Delta S_{i,t-1} + (\alpha_3+\alpha_4+\alpha_5)\Delta S_{i,t-2} + v_i + v_{j,t} + v_t + e_{i,t} \qquad \textbf{(5)}$$

We further impose the restriction of $(\alpha_3+\alpha_4+\alpha_5)/(1-\alpha_1-\alpha_2)=1$ under the assumption that there is a unit elasticity of inventory stocks with respect to sales26. This ensures a long-run equilibrium behaviour of the inventories investment to sales. We can reparameterize equation (5) by replacing $\beta_1 = \alpha_{i,t-1} - 1$, $\beta_2 = \alpha_3$, $\beta_3 = (\alpha_3+\alpha_4)$ and $\beta_4 = (1-\alpha_1-\alpha_2)$ into an error-correction format:

$$\Delta I_{i,t} = \beta_1 \Delta I_{i,t-1} + \beta_2 \Delta S_{i,t} + \beta_3 \Delta S_{i,t-1} + \beta_4 (I_{i,t-2} - S_{i,t-2}) + v_i + v_{j,t} + v_t + e_{i,t} \qquad \textbf{(6)}$$

Equation (6) forms the basic conventional error-correction model of inventory investment without taking into account the effects of financial factors, where $(I_{i,t-2} - S_{i,t-2})$ is the error correction term. The coefficient β_4 associates with the error-correction term should be negative, in the sense that if current inventory level is higher (lower) than sales the firm should decrease (increase) their future inventory stock. β_1 captures the short-term dynamics of the inventory investment from last period. Current and lagged differenced log sales are included as

[26] See Bond et alBond S, Elston JA, Mairesse J, Mulkay B. (2003). "Financial Factors and Investment in Belgium, France, Germany, and the United Kingdom: A Comparison Using Company Panel Data." Review of Economics and Statistics 85, 153-165. and Guariglia and MateutGuariglia A, Mateut S. (2009). "Inventory investment, global engagement, and financial constraints in the UK: Evidence from micro data." Journal of Macroeconomics In Press, Corrected Proof. for similar assumption in fixed investment and inventory investment studies.

important control for accelerator effects and stock adjustment effects, as well as to capture the short term dynamic effects of sales on inventory investment. If β_2 or β_3 is negative, it indicates that inventories are used to buffer production from sales shocks. However, empirical evidence typically finds that production varies more than sales, inventories and sales are positively related and there is little evidence for production smoothing behaviour. As emphasize in Ramey and West (1997), the two empirical regularities for inventories are that inventories are pro-cyclical and the movements are quite persistent, these implies that β_2 or β_3 should be positive or at least that $(\beta_2 + \beta_3) > 0$.

4.3.2 Measures of financial factors

In order to assess the effects of financial constraints and financial factors on firms' inventory investment behaviours, we augment equation (6) with measure of financial factors ($FF_{i,t}$), which reflect the financial pressure experienced by a company, in equation (7) below, which is our baseline specification of the empirical studies.

$$\Delta I_{i,t} = \beta_1 \Delta I_{i,t-1} + \beta_2 \Delta S_{i,t} + \beta_3 \Delta S_{i,t-1} + \beta_4 (I_{i,t-2} - S_{i,t-2}) + \beta_5 FF_{i,t} + v_i + v_{j,t} + v_t + e_{i,t} \quad (7)$$

The literature of financial constraints and inventory investment typically augmenting equation (7) with three main financial variables: coverage ratio/borrowing ratio, leverage, and cash flow to identify the main financial influences on inventories. These different financial variables tend to be correlated with each other, but each emphasizes a different channel through which financial constraints operate through.

Borrowing ratio is defined as the ratio of interest payments to cash flow, a financial measure used by Nickell and Nicolitsas (1999b) to analyse the impact of financial pressure on employment, wage growth and productivity for UK firms. It is essentially a measure of interest burden to firm's cash flow. A tightening of monetary policy and increase in borrowing cost would reflect in this measure. The borrowing ratio is, in fact, the inverse of the coverage ratio used by Carpenter et al (1998a) and Guariglia (1999; 2000).

Leverage ratio is a stock measure instead of a flow measure like the other financial indicators. Leverage is defined as the total liabilities over total assets. In general, if the leverage is too high, the bankruptcy risk will increase and leads to a reduction of spending to reduce debt level. This would lead to a negative relationship between the inventory investment and the leverage measures.

Cash flow has long been the most popular measures of internal finance and is widely used in the study of financial constraints and firm behaviours. It represents the internal finance available to a firm to spend on investment in fixed capital (Fazzari et al. 1988), inventory investment and employment. If firms are indeed financially constrained, cash flow should have a positive and significant impact on their inventory investment decision. In a comparative study by Carpenter et al (1998a), they find cash flow is more successful than cash stocks or coverage in explaining inventory investment. We consider internal finance to be a major source of finance for firms in China, Therefore, for the purpose of this study we choose to use cash flow as our measures of financial factors to test for the effects of financial constraints on inventory investment.

4.3.3 Estimation methodologies

All equations are estimated using differenced Generalized Methods of Moments (GMM) approach (Arellano and Bond 1991). The differenced GMM is an effective method to control for firm-specific and time invariant fixed effects. Given that our regression equations includes lagged dependent variables and the possible endogeneity of regressors, GMM method use all the regressors lagged two periods as instruments.

To test for the validity of the instruments and the model is correctly specified, we use the test for serial correlation in the differenced residuals. We assess the presence of n^{th}-*order* serial correlation in the differenced residuals using the *M(n)* test, which is asymptotically distributed as a standard normal under null of no serial correlation of the differenced residuals. Since all our specification use variables lagged twice as instruments, we rely on the M2 test to test for the second-order serial correlation in the first differenced residuals. The absence of the second-order serial correlation in the first differenced residuals indicates that our results are valid and the model is adequate.

Another widely used test in the literature of the validity of the instruments is the Hansen/Sargan statistics (*J test*), a *P-value* greater than 0.05 indicates that our instruments are valid. However, the test power of the Hansen/Sargan statistics is weak when a very large cross-sectional sample of data is used. The Hansen/Sargan statistics (*J test*) tends to over-reject the validity of the instruments in large panel data estimation (Blundell et al. 2001; Benito 2005; Guariglia et al. 2010). The results of Nickell and Nicolitsas's (1999a) UK study all indicate a significant Hansen/Sargan test statistics. Benito (2005) also report several results with significant Hansen/Sargan test statistics in their comparative study of UK and Spain. Given our very large panel data size, the Hansen/Sargan test would tend to over-reject the validity of our instruments. Therefore in this study we tend to rely on the M2 test for the validity of the instruments and model specification.

As an additional check of whether the GMM estimator in our analysis suffers finite sample bias, we compare the GMM estimates of the coefficient on the lagged dependent variable with the OLS levels and the Within Groups estimates of the coefficient on the lagged dependent variable in the baseline regression equation (7). Nickell (1981) shows the Within Groups estimator tends to downward biased the coefficient on the lagged dependent variable. And the OLS estimates are likely to bias upwards. Therefore we would expect the coefficient estimates on the lagged dependent variable from GMM to lie above the within estimates and below the OLS estimates. The results are presented in section 7 along with the empirical results. Bond et al (2003) use similar approach to assess whether there is finite-samples bias in their studies of financial factors and investment.

4.4 Sample partition criteria and the development of hypothesis

One of the important factors in the study of financial constraints is firm heterogeneity. It is likely that all firms will face certain level of financial constraints or at least at some point in their operation, but the level of the constraints might differ significantly across firms with different characteristics. Fazzari, Hubbard and

Petersen(1988) points out that firm heterogeneity is an important factor to consider in the use of firm panel data to study the effects of capital market imperfections. This is based on the idea that firms with different characteristics tend to face different level of information problems and therefore different level of financial constraints. Subsequent studies of financial constraints typically focus more on the differential impact of imperfect capital market. This is typically done by partition the sample of firms into groups that are more or less likely to be financially constraints using a *priori* criteria that are derived from sound economic reasoning.

In order to gain better understanding of the differential impacts of financial constraints on inventory investment, in this study, we classify our firms into different groups according to a number of different criteria and firm characteristics that may lead to differential response to financial constraints. These criteria are closely related to the different level of information problems and allow us to exploit the importance of firm heterogeneity.

4.4.1 Ownership and financial constraints

Despite more than two decades of reform and development, Chinese economy's transition to market economy is still largely incomplete. The central government continues to play a significant role in the allocation of resources, in particular in the credit allocation in the banking sectors. Based on data in city level between 1989 and 1991, Wei and Wang (1997) find evidence that state owned commercial banks[27] favour state-owned enterprises (SOEs) over other ownership type. They also find cities with a higher SOEs' share in output tend to have a faster growth in loans. Cull and Xu (2003) find that, between 1980 and 1994, there is a positive relationship between bank finance and SOE profitability. This link grew stronger in the 1980s, but became weaker in the 1990s due to the shift of bailout responsibilities from the government to banks. This suggests that SOEs might continue to face soft budget constraints. Bai et al(2006) argues that this soft budget constraint is closely related to SOEs' multi responsibilities to handle the social responsibility and political responsibility in order to reduce the social-economic costs incurred in the early period of reforms. We expect SOEs' inventory investments not to be affected by financial factors, as these firms are not financially constrained.

Allen et al(2005) show that the recognition of being an integral part of the economy by the communist party, private firms are typically being discriminated against for access to external finance compare to their less profitable counter-parts with significant state ownership. We consequently hypothesise that private enterprises will be significantly affected by the financial factors and are financially

[27] The 'Big Four' state-owned commercial banks: namely, the Bank of China (BOC); the Construction Bank of China (CBC); the Agricultural Bank of China (ABC); and the Industrial and Commercial Bank of China (ICBC).

constrained. This is largely due to the lending bias that persists in China's banking sector and financial market.

Collective-owned enterprises (COEs) are a special ownership type, which are the special products of the early reforms. COEs were very successful in the 1980s with a number of special treatments, such as tax advantages and access to external bank finance. In the early years, they shared the characteristics of SOEs and possibly enjoyed certain level of soft budget constraints. However, COEs became less competitive in the 1990s as the special treatments granted to them by the government were stripped away. Furthermore, the banking reforms have led the COEs to face hardened budget constraints. COEs are expected to be financially unconstrained in the early period, but progressively facing hardening budget constraints. We also expect that COEs will be less financially constrained than private firms.

Foreign firms are the last ownership group that we will consider. During the reform era, foreign owned firms enjoyed a superior treatment than the private firms in China. Central and local governments have granted a number of special policies to foreign firms to attract them to invest in China to help to develop the local economy (Naughton 2007). Moreover, foreign firms are less dependent on the local financial system for funding in China. Foreign firms mainly rely on other sources of funds to finance their growth, and they have the advantage of having access to funds from their overseas parent company and foreign capital markets. Therefore, foreign firms are less likely to suffer from financial constraints. Using a China firm-level dataset between 1998-2005, Poncet et al (2010) show that foreign-owned firms are not credit constrained in China, and the geographical and sectorial presence of foreign capital help to alleviates credit constraints faced by private firms. Similar empirical evidence is also found in the literature studying other transition economies: using a financial and constraints and investment framework, Perotti and Luka (2004) and Harrison and McMillan (2003) also find that foreign firms are not financially constrained for Hungary and Ivory Coast respectively. In this paper, we also hypothesise that foreign owned firms are not financially constrained.

We group firms into four different ownership groups according to the majority average ownership shares. If the average share of the paid-in-capital of a firm is from private investors over the study period is greater than 50%, then this firm is classified as private owned. The same rule is applied to the other three ownership types: SOEs, foreign and collectively-owned firms[28].

4.4.2 Geographical regions and financial constraints

[28] The ownership distribution over the period 2000 and 2007 is reported in table 4A4 in the data appendix 4A.

The second key sample partition criterion is geographical region. There are 31 provinces in China. We divide them into three broad regions according to their geographical locations (costal, central and west). We expect firms from the three regions[29] to display different level of financial constraints to inventory investment. First of all, the internal capital market of china is possibly segmented due to informal interference of the local government. Boyreau-Debray and Wei (2005) provide evidence that the degree of internal financial integration appears to have decreased rather than increased in the 1990s compare to previous periods. Secondly, the central government tends to reallocate capital from more productive regions toward less productive one to induce development. For example, the "China Western Development" project, initiated in 2000, has spent a total of 1 trillion Yuan on building infrastructure in western China by 2006. As a result of these policies, we expect firms located in western region to be less financially constrained. While the firms in the Coastal region will face very high competition for access to external finance, which lead them to face higher level of financial constraints.

4.4.3 Firm size and financial constraints

Size of the firms is the most widely used proxy for the level of capital market imperfection firm faced by the firm and used as an *a priori* criterion to classify

[29] See data appendix for details of composition for each regions.

firms into groups of financially constrained and unconstrained firms (Carpenter et al. 1994; Chow and Fung 1998; Cleary 1999; Bond et al. 2003). Small firms tend to face a higher level of asymmetric information and more risky than large firms. They also face higher transaction costs for external finance, thus they generally face higher premium in accessing external finance than large firms. In this study, we use two methods to classify firm size. First, we classify firms in the top 25th percentile of real sales in their industry in a given year as large firms and the rest as small firms. Therefore, essentially we are working with firm-years which allow firms to switch between "constrained" and "unconstrained" regimes. Secondly, we also use real total assets to divide the sample as a robustness test. Firms with employment falling in the top 25th percentile of employment in a given year are classified as large firms, and the rest of them as small firms. We expect small firms are more financially constrained than large firms.

4.4.4 Sectoral difference and financial constraints

An important sectoral difference in the cyclical pattern of inventory investment is that there is a much larger cyclical movement in durable inventory investment compared with nondurables (Zarnowitz 1985). Carpenter et al (1998a) is the first paper to explore the ability of financing constraints to explain inventory behaviour. However, they find inconclusive evidence using high-frequency panel data with different financial variables over different inventory cycles. Carpenter et al (1998) find no significant differences between the durable and nondurable sector when the regression is augmented with cash stocks and coverage ratio as measures of financial factor, but they do find that, when augmented with cash flows, the cash flow sensitivities are at least as large for durable as nondurables. This is possibly due to the fact that firms operating in the durable sector tight up a higher amount of capital in their production than nondurable sector, and the adjustment costs for the durable sector are much higher than nondurable sector. This suggests durable sector firm is possibly more sensitive to cash flow than nondurable firms.

We define durable and nondurable firms according to the two-digit SIC categories. Nondurable manufacturing consists of SIC codes 20-23 and 26-31. Durable firms consists of SIC codes 24-25 and 32-38. We deleted miscellaneous manufacturing firms with SIC code 39[30]. In this paper we will test whether durable and nondurable firms face different levels of financial constraints.

4.4.5 Political affiliation and financial constraints

Political affiliation (*lishu*) is a measure indicating whether the firm is affiliated with the central or provincial government. It plays an important role in business operation in China. A higher level of political affiliation could benefit businesses'

[30] We follow Carpenter et al (1998)'s approach to define durable and nondurable firms, see data appendix for details.

access to the key departments and resources that are controlled by the party and government. This is consistent with the idea of political pecking order of finance, where bank preferred to lend to state owned enterprises. Moreover, governments can also grant firms affiliated with them with additional benefits such as waivers of import tariffs, tax reductions. Therefore, firms may reduce their level of financial constraints by obtaining political affiliation. We expect firms with high political affiliation will be less financially constrained, as political affiliation will give them wider access to bank loans and other forms of supports, while firms without any political affiliation will be more financially constrained.

In our sample, we divide firms into three groups: high political affiliation, low political affiliation and no political affiliation. High political affiliation group includes firms politically affiliated at the central and provincial level, low political affiliation group includes firms politically affiliated at the city or district level to village level, and no political affiliation group includes firms report no political affiliation at any government level.

4.4.6 Time periods and financial constraints

Last, we also will divide our sample into two periods with year 2003 as a cut-off point. Since our data span between 2000 and 2007, we have four years in each of the sub-period. We choose 2003 as the cut off point for a number of reasons. First, since 1998 the authorities have continues to issue strict guidelines on bank lending (Fung et al. 2000), which often are pure quantitative restrictions on bank lending. Until 2004, the last step in interest rate liberalisation was taken in October 2004, when commercial banks' lending rates start moving freely with the lower limit for deposit rates removed. Second, China's monetary policy committee conducted a tightening of monetary policy between late 2003 and June 2007. Prior to this monetary tightening, PBOC has followed an expansionary monetary policy between 1998 and 2002. This monetary cycle offers us a unique opportunity to test the hypothesis that a tightening of monetary policy will leads to stronger effects of financial constraints in China's context. By dividing firms into two subsamples using year 2003 as cut-off point, we are able to test whether level of financial constraints change over time.

4.5 Data

The data for this study is based on the financial data filed by the industrial firms with the NBS for the period over the period of 2000-2007. This unique dataset consists of firms with different ownership (including state-owned enterprises, private ownership, collectively-owned firms and foreign owned firms) and with annual total revenue above of five million Chinese RMB[31]. These industrial firms

[31] An equivalent of $735,000 US dollar at the exchange rate of 6.8RMB/USD. (Exchange rate in Jan 2010)

are from the manufacturing and mining sectors across 31 provinces in China. For the purpose of this study, we limit our attention to the manufacturing firms only.

Before we report the descriptive statistics and analysis, we perform a number of consistency checks to control for the errors and anomalies within the dataset. First, we eliminate the number that is not sensible accounting practice and our analysis, such as negative figures for total assets, negative sales. Secondly, we delete firm years with negative shareholder's fund. The shareholder's fund can be negative due to two main reasons: these firms are continuing loss making firms or there are mistakes during the process of data collection. Thirdly, we eliminate firm-years for which displaying real asset or sales growth in excess of 100%, which allow us to control the influence of major merger and acquisition among firms during the period. Furthermore, we also delete 1% of observations from each tail of the key regression variables, this allows us to control for the influence of outliers. Last, due to the dynamic nature and lag structure of our empirical regression, we only keep firms with more than 4 years of continuous data for all the relevant regression variables.

The final dataset is an unbalanced panel of firms with between 5 to 8 years of observations between 2000 and 2007. Appendix 4A provides information on the data structure and ownership structure distribution over the study period. From table 4A1 and 4A2, we can see there are 401,247 firm-year observations between

2000 and 2007, each firm with at least 5 years of observations and at most 8 years of observations. There are 62,195 firms in our sample.

Table 4A3 shows the ownership distribution of firms over the study period. We classify ownership groups based on the shareholding information of China's National Bureau of Statistics. Instead of using the ownership group indicates by their business registration, we classify ownership based on the average shareholding by different categories of shareholder over the period. We group them into four different ownership groups as we discussed in section 5 namely: SOEs, private, COEs and Foreign firms. Table A3 provides some insights of the ownership dynamics in China; State owned enterprises representation is gradually decline overtime, a reduction from 14.39% to only 7.06%. Collective firms also display a reduction in the share of sample from 11.96% to 9.87% . Private firms share of sample have increased dramatically from 50.44% of the sample towards 62.08% at the end of 2007, while foreign owned firms share remain relatively stable at around 10%. This pattern of ownership transition is consistent with the trend from the aggregate data presented in chapter 3, where the number of private firms is growing steadily overtime in China.

4.6 A descriptive analysis of firms' inventory behaviour in China and descriptive statistics

4.6.1 Inventory to sales ratio

In recent studies of inventory investment, empirical evidences show that modern inventory control methods (such as just-in-time practice) have improved overtime. This leads to a significant decrease in inventory to sales ratio. Benito(2005) finds that the inventory to sales ratio for UK firms has fallen steadily over time from 21.7% in1979 to 12.6% in 2000. While for Spanish firms, the inventory to sales ratio has fallen from 15.1% to 13.4% between 1985 and 2000. Our sample of Chinese manufacturing firms also display significant drop in inventory to sales ratio. Figure 4.1 reports the median inventory to sales ratio for the full sample and across four different ownership groups between year 2000 and 2007 (Table 4A4 provides detail numbers for each sample year across the ownership groups). The median inventory to sales ratio drops from 17.9% to 12.1% for the full sample over the study period. Moreover, we find significant heterogeneity in terms of the inventory to sales ratio across ownership groups.

SOEs have the highest inventory to sales ratio at the beginning of the sample period with 30.5% of inventory to sales ratio. This ratio has decrease by around 11% to 19.4% in 2007 for SOEs. Private firms and Collective firms also display significant decrease in inventory to sales ratio, the ratio decrease from

16.3% to 10.4% and15.6% to 9.8%, respectively for private firms and collective firms. Contrary to the trend, foreign firms' inventory to sales ratio is relative stable. The ratio decreases from 16.8% to 15%.

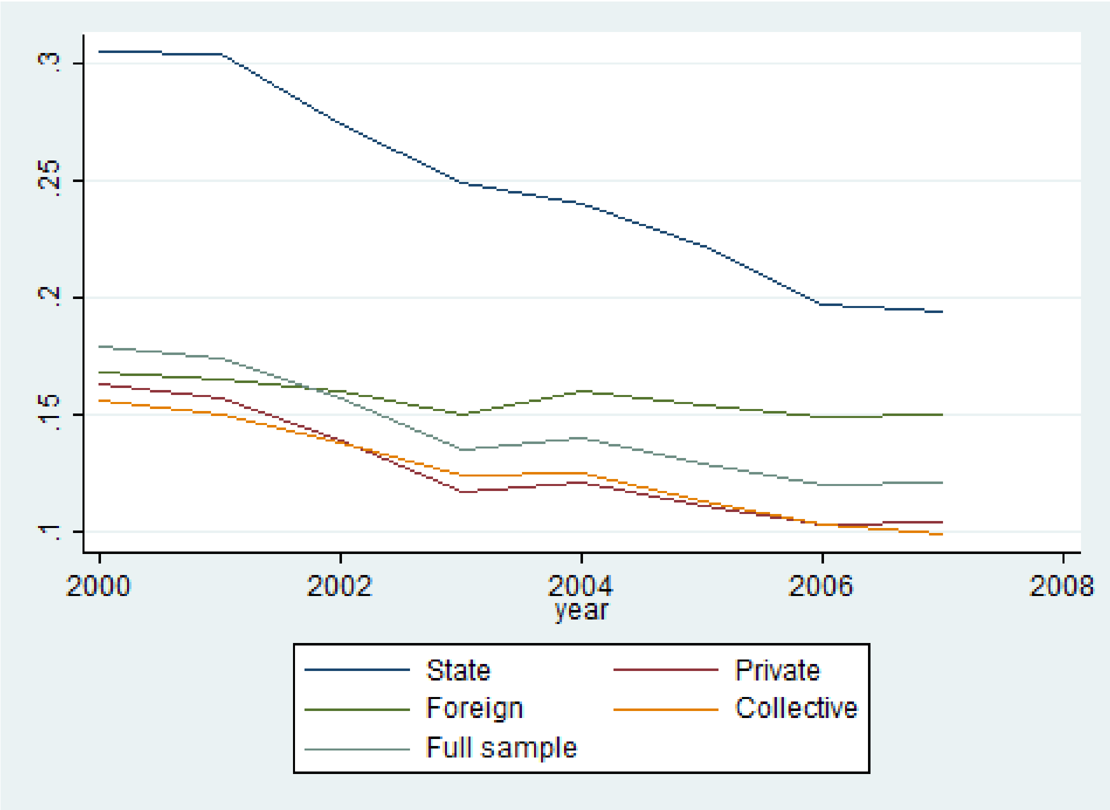

Figure 4.1: Median inventory to sales ratio across ownership between 2000-2007

This dramatic different behaviour in inventory sales ratio could have a number of implications for our studies. Given that the modern inventory control method is widely available, we would expect all firms display similar reduction in inventory to sales ratio. The differential behaviours indicate there are other factors at work. One the main factor related to this study is the financial pressure. As we discussed in section 4.4.1, SOEs are favoured by the banking sector and may still facing soft budget constraints. Therefore, they can afford to hold more inventories and operate at a less efficient mode. The dramatic decrease in inventory to sales ratio for collective firms may reflect the hardened budget constraints to the COEs due to the banking reforms. The changing financial pressure forces COEs to work more efficiently and free up the funding for other firm activities.

The same logic applies to the private firms. Despite the continuous reform of the banking sector, private firms still lack of effective external financing channels for their growth and expansion. Private firms can only overcome this obstacle by working more efficiently, and utilising internal funds to finance their growth. Foreign firms enjoy a relatively stable financing channel, mainly from their parent companies from aboard. There is no apparent external financial pressure forcing them to work more effectively and they are often perceived to be the most efficient group. This could explain their relative stable inventory to sales ratio for foreign firms.

The decline in inventory to sales ratio could have an important impact on our empirical results. Since, firms now are able to control their inventory more effectively. Inventory investment would demands less funding and possibly displays a lower level of inventory investment cash-flow sensitivities.

4.6.2 Descriptive statistics

Table 4.0 presents the descriptive statistics for some key variable for the full sample and reports the subsample descriptive statistics according to ownership group and regions. The average real sales and average real total assets of the sample average are 1,434,200RMBs and 1,377,600RMBs. The SOEs appear to be the largest amount the four ownership groups. The average real sales and real total assets of SOEs are 2,577,000RMBs and 3,590,000RMBs, compare to only 1,078,000RMBs and 1,018,400RMBs for those of private firms. The average real sales and real total assets for foreign firms fall between those of the SOEs and private firms. Collective owned firms are much smaller in terms of real sales and real total assets compare to the other three groups. There is no significant difference in the average real sales and average real total assets across the three regions.

SOEs are still the largest employers among the four ownership groups. The average number of employees for the SOEs is 878, which is at least two times larger than those for private, foreign and collective ownership firms (350, 488 and 292 employees, respectively). The average number of employees (398) is the lowest for the eastern region. This partly reflects the fact that a larger number of private firms located in the eastern region.

	Full Sample (1)	*SOEs* (2)	*Private* (3)	*Foreign* (4)	*Collective* (5)	*East* (6)	*Central* (7)	*West* (8)
Real Sales	1434.2	2577.7	1078.7	1976.3	643.9	1480.9	1396.9	1143.7
	(11402.0)	(19914.9)	(7330.6)	(14574.6)	(4146.3)	(12045.6)	(10637.2)	(6451.2)
Real Assets	1377.6	3590.2	1018.4	1510.6	498.7	1315.3	1601.5	1561.0
	(10322.2)	(26497.1)	(5995.6)	(6549.7)	(3061.7)	(10247.7)	(11990.9)	(8580.8)
No of employees	430.0	878.0	350.4	488.7	292.6	398.0	562.9	502.8
	(1503.0)	(3585.5)	(972.7)	(1295.9)	(746.0)	(1403.7)	(1975.2)	(1537.5)
$I_{i,t} / S_{i,t}$	0.231	0.404	0.200	0.228	0.226	0.212	0.271	0.318
	(0.322)	(0.554)	(0.270)	(0.267)	(0.340)	(0.292)	(0.409)	(0.391)
$\Delta I_{i,t}$	0.0459	-0.0217	0.0570	0.0697	0.00594	0.0550	0.0151	0.0165
	(0.668)	(0.585)	(0.690)	(0.637)	(0.688)	(0.670)	(0.685)	(0.630)
$\Delta S_{i,t}$	0.0907	0.0276	0.108	0.0889	0.0687	0.0942	0.0888	0.0682
	(0.364)	(0.382)	(0.364)	(0.354)	(0.361)	(0.359)	(0.385)	(0.370)
$I_{i,t-1} - S_{i,t-1}$	-2.046	-1.441	-2.190	-1.916	-2.146	-2.116	-1.964	-1.642
	(1.178)	(1.142)	(1.184)	(1.022)	(1.280)	(1.161)	(1.288)	(1.072)
$CF_{i,t}/K_{i,t-1}$	0.400	0.133	0.416	0.451	0.461	0.435	0.335	0.231
	(0.741)	(0.445)	(0.714)	(0.780)	(0.944)	(0.768)	(0.702)	(0.527)
N	401247	39375	218943	84726	37575	307771	50517	42959

Table 4.0: Descriptive statistics.

This table reports the sample mean and standard deviations (in bracket) for the full sample and divides firms into subsample according to ownership and region. Real sales, real assets are total sales and total assets deflated by provincial level GDP deflator. They are in 1,000s of yuan RMB. $I_{i,t} / S_{i,t}$ is the inventory to sales ratio. $\Delta I_{i,t}$: is the change in log inventories, which is the inventory growth. $\Delta S_{i,t}$:is the change log real sales. $I_{i,t-1} - S_{i,t-1}$:is the change in log real sales. $CF_{i,t}/K_{i,t-1}$: is the cash flow divide by capital stock.

The SOEs have the highest level of inventory to sales ratio. They maintain an average inventory level equal to about 40% of their sales. The inventory to sales ratios for private, foreign and collective are 0.2, 0.228 and 0.226, respectively. There is not any significant difference in the inventory to sales ratio across the three different regions. The sample average inventory growth rate ($\Delta I_{i,t}$)is 4.59%. The SOEs have a negative growth rate of -2.17%. This is possibly due to the fact that the SOEs are trying to be more efficient in their inventory control. The inventory growth rate for collective-owned firms is also very low (0.59%). The average inventory growth rate is the highest for foreign firms (6.97%), followed by private firms (5.7%). An interesting fact is that the mean inventory growth rate is much higher in the eastern region (5.5%) than in the central (1.51%) and the western region (1.65%).

The sample average sales growth ($\Delta S_{i,t}$)is very high at 9.07%. As the future engine of growth, private firms have a mean sales growth rate of 10.8%, in contrast to only 2.76% for SOEs. The mean sales growth rates for foreign and collective firms are 8.89% and 6.87%, respectively. Both the eastern region and central region has a high average sales growth rate (9.42% and 8.88%, respectively). The average sales growth rate for the western region is only 6.82%. This partly reflects the regional development disparity across the three regions.

The sample average cash flow to capital ratio is 40%. The SOEs has the lowest cash flow to capital ratio (13.3%), while the collective-owned firms have the highest cash flow to capital ratio (46.1%). The cash flow to capital ratios for private firms and foreign firms are 41.6% and 45.1%, respectively. The firms in eastern and central regions have a significantly higher cash flow to capital ratio (43.5% and 33.5%) than firms located in the western region (23.1%).

4.7 Empirical results and discussion

4.7.1 Baseline specification

Table 4.1 reports the results of the baseline regression equation (7) augmented with cash flow. As discussed in section 4.3.3, we can test whether the GMM estimator suffers from finite sample bias by comparing the coefficients of lagged dependent variables from GMM to those of OLS and within fixed effect estimator. The coefficient of the lagged dependent variables from GMM is -0.565 and significant, which is greater than the within estimation of -0.684 and less than the OLS estimation of -0.318. All the control variables are significant and with correct signs. Based on this result, we can tentatively conclude that GMM estimator in our study does not suffer from serious finite sample bias. The M2 suggests the instruments are valid and no gross misspecification in our model. Given GMM estimator's superior ability to control for the problem of endogeneity and more efficient than the IV estimator, we will use the differenced GMM estimator for all our subsequent analysis.

	OLS	GMM	Fixed effects
$\Delta I_{i,t-1}$	-0.318***	-0.565***	-0.684***
	(0.00)	(0.01)	(0.00)
$\Delta S_{i,t}$	0.221***	0.363***	0.349***
	(0.00)	(0.10)	(0.00)
$\Delta S_{i,t-1}$	0.181***	0.490***	0.451***
	(0.00)	(0.02)	(0.00)
$I_{i,t-2}- S_{i,t-2}$	-0.132***	-0.495***	-0.656***
	(0.00)	(0.02)	(0.00)
$CF_{i,t}/K_{i,t-1}$	-0.023***	0.036	-0.037***
	(0.00)	(0.02)	(0.00)
R^2	0.117		0.326
M2(p-value)		0.137	
rho			0.605
N	316650	251671	316650

Table 4.1 Baseline specification with OLS, GMM and Fixed effects estimators

Notes: The dependent variable for all specification is $\Delta I_{i,t}$. The figures reported in parentheses are asymptotic standard errors. Time dummies and industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments for all GMM estimation are all the regressors lagged 2 periods. *M2* is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1). * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level

Table 4.2a reports the results of the baseline regression with the full sample. Column 1 and 2 include only the current period cash flow terms, while column 3 and 4 includes cash flow lagged one period. This allows us to test whether firms based their inventory investment on current or previous period of cash flow. All the control variables are significant and with the correct signs. In particular, both the current sales growth coefficients (0.363, 0.380 for column 1 and 2, respectively) and lagged sales growth coefficients (0.49 and 0.492 for column 1 and 2, respectively) are positive and significant at 1% level. This indicates, Chinese firms base their inventory investment decision on the current and previous sales, and that inventory investments in China are pro-cyclical. However, none of the cash flow terms are significant.

Adding the lagged cash flow term into the regression makes little change, the coefficient for cash flow in column 1 increases from 0.036 to 0.059 in column3, and the cash flow coefficient in column 2 increases from 0.041 to 0.065 in column4. Yet, the cash flow coefficients remain insignificant. Column 2 and 4 also test whether including time interact with industry dummy will make and significant improvement over the results. We do not find this is the case. The *M2* test indicates there is no second order serial correlation in the differenced residuals. Based on this preliminary result, there is no evidence of any relationship between inventory investment and cash flow in China. However the true relationship could be mask by the aggregation of the sample, at firm level data, heterogeneity plays an important role. Next we will look at whether ownership will provide us with more insights.

	1	2	3	4
$\Delta I_{i,t-1}$	-0.565***	-0.566***	-0.565***	-0.566***
	(0.01)	(0.01)	(0.01)	(0.01)
$\Delta S_{i,t}$	0.363***	0.380***	0.356***	0.372***
	(0.10)	(0.11)	(0.10)	(0.11)
$\Delta S_{i,t-1}$	0.490***	0.492***	0.491***	0.492***
	(0.02)	(0.02)	(0.02)	(0.02)
$I_{i,t-2}$- $S_{i,t-2}$	-0.495***	-0.497***	-0.496***	-0.497***
	(0.02)	(0.02)	(0.02)	(0.02)
$CF_{i,t}/K_{i,t-1}$	0.036	0.041	0.059	0.065
	(0.02)	(0.02)	(0.05)	(0.05)
$CF_{i,t-1}/K_{i,t-2}$			-0.006	-0.007
			(0.01)	(0.01)
Time dummies	Yes	Yes	Yes	Yes
Industry interact with time	No	Yes	No	Yes
M2(p-value)	0.137	0.143	0.136	0.143
N	251671	251671	251671	251671

Table 4.2a: Baseline regression for full sample

Notes: The dependent variable for all specification is $\Delta I_{i,t}$. The figures reported in parentheses are asymptotic standard errors. Time dummies and industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments for all GMM estimation are all the regressors lagged 2 periods. *M2* is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1). * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level. N: is the number of observations.

4.7.2 Regression results based on ownership groups

Table 4.2b reports the inventory investment and cash flow regression differentiated by ownership groups. All the control variables are highly significant with correct signs and similar magnitude across ownership groups, with the exception of the current sales growth is not significant for the collective firms. The cash flow term is -0.157 and marginally significant at 10% level for state owned firms. This finding is consistent with the idea of SOEs in China are facing soft budget constraints. The non-financially constrained SOEs obtain funds that are not necessary for their investment and channel their funds for other benefits. Perotti and Gelfer (2001) has found similar negative relationship between cash flow and fixed investment for firms in the bank-led groups in Russian during the transition period. Perotti and Gelfer (2001) suggests this possibly due to the close relationship between bank-led group firms enables them to raise investment funding, while constraining the use of free cash flow.

The cash flow coefficient is positive and significant at 5% level for private firms, while insignificant for foreign and collective firms. This results is consistent with Poncet *et al* (2010), who show that private firms in China are the most financially constrained, while foreign firms and SOEs are not financially constrained. The result suggests that private firm's inventory investments are financially constrained. This effects is not only statistical significant, but also economically significant. A one standard deviation increase of the cash flow to capital ratio for private firms will increase their inventory investment by 7.7%. This effect, is consistent with the findings in Guariglia and Mateut (2010), who find a one standard deviation increase in the "Mix[32]" ratio, the inventory investment would rise by 5.2% for firms in UK.

In column 5 of table 4.2b, we interact the cash flow terms with four ownership dummies and include them in the regression as a robustness test. This exercise allows us to provide a direct comparison between the cash flow coefficients across ownership groups. This approach also gives us more degree of freedom in our regression. We find that the inventory to cash flow sensitivities for SOEs drops from -0.157 to -0.126 and no longer significant, but the private firms continue to show a positive and significant inventory to cash-flow sensitivity of 0.115, which confirms that private firms are financially constrained. The results from table generally support our hypothesis in section 4.4.1 that SOEs, Collective firms and foreign firms are not financially constrained, while private firms tend to be the most financially constrained[33]. These results suggest a possible "lending bias" is operating in China.

[32] Mix: ratio of short-term debt to short-term debt plus trade credit (Guariglia and Mateut 2010).
[33] The F-test of equality of cash flow coefficients indicate that the cash flow coefficients for private firms is significantly different from the other three ownership groups at 1% level.

	State	Private	Foreign	Collective	Interaction
	(1)	(2)	(3)	(4)	(5)
$\Delta I_{i,t-1}$	-0.638***	-0.556***	-0.557***	-0.554***	-0.569***
	(0.05)	(0.01)	(0.03)	(0.04)	(0.01)
$\Delta S_{i,t}$	0.562**	0.214*	0.409*	0.176	0.391***
	(0.19)	(0.10)	(0.19)	(0.21)	(0.09)
$\Delta S_{i,t-1}$	0.568***	0.469***	0.501***	0.475***	0.496***
	(0.06)	(0.02)	(0.04)	(0.06)	(0.02)
$I_{i,t-2}$- $S_{i,t-2}$	-0.579***	-0.487***	-0.494***	-0.492***	-0.500***
	(0.06)	(0.02)	(0.03)	(0.05)	(0.02)
$CF_{i,t}/K_{i,t-1}$	-0.157*	0.110**	0.055	-0.076	
	(0.08)	(0.03)	(0.04)	(0.06)	
$CF_{i,t}/K_{i,t1}$* *SOEs*					-0.126
					(0.08)
$CF_{i,t}/K_{i,t1}$* *Private*					0.115*
					(0.04)
$CF_{i,t}/K_{i,t1}$* *Foreign*					-0.009
					(0.05)
$CF_{i,t}/K_{i,t1}$* *Collective*					-0.02
					(0.10)
M2	0.363	0.219	0.248	0.544	0.107
N	21788	142480	52905	22058	251656

Table 4.2b: Inventory investment regression across ownership group

Notes: The dependent variable for all specification is $\Delta I_{i,t}$. The figures reported in parentheses are asymptotic standard errors. Time dummies and industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments for all GMM estimation are all the regressors lagged 2 periods. *M2* is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1). * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

4.7.3 Regression results based on Regions

As discussed in section 4.4.5, due to the immobility of capital in China and the intervention of government policy will lead to different level of financial constraints across different regions (East/Coastal, Central and West). Column 1-3 of table 4.3 reports the regression results based on regional differentiation. The structure of the error correction model is well maintained. Lagged inventory growth, sales growth and lagged sales growth are all positive and precisely determined for all three regions. The error correction terms are negative and precisely determined. The cash flow coefficient is positive and significant at 5% level for the coastal region only, while the cash flow coefficients for central and western regions are insignificant. The *M2 test* does not suggest any problem with our model specifications and the instrument sets used. This confirms our early hypothesis that firms in the Coastal region are more likely to be financially constrained than the other two regions.

As a robustness test we create interaction dummies for each of the three regions and interact with the cash flow terms. Column (4) of table 4.3 reports the result for the interaction regression. The sensitivity of inventory to cash flow is only significant for the coastal region. A one standard deviation increase in the cash flow to capital ratio for firms in the coastal region the inventory growth would rise by 2.5%. Given that the average inventory growth rate for the coastal region is 5.5%, an additional 2.5% inventory growth translate into a 50% increase for inventory growth rate. We can see this effect is economically significant for the coastal region.

	Region			
	(1)	(2)	(3)	(4)
	Coastal	**Central**	**West**	**Interaction**
$\Delta I_{i,t-1}$	-0.553***	-0.753***	-0.608***	-0.550***
	(0.01)	(0.05)	(0.05)	(0.01)
$\Delta S_{i,t}$	0.391***	0.567***	0.580*	0.271**
	(0.10)	(0.15)	(0.27)	(0.08)
$\Delta S_{i,t-1}$	0.481***	0.697***	0.544***	0.471***
	(0.02)	(0.06)	(0.05)	(0.02)
$I_{i,t-2}$- $S_{i,t-2}$	-0.486***	-0.708***	-0.533***	-0.479***
	(0.02)	(0.06)	(0.05)	(0.01)
$CF_{i,t}/K_{i,t-1}$	0.055*	0.038	-0.017	
	(0.02)	(0.07)	(0.06)	
$CF_{i,t}/K_{i,t-1}$*				0.033*
Coastal				(0.02)
$CF_{i,t}/K_{i,t-1}$*				-0.117
Central				(0.08)
$CF_{i,t}/K_{i,t-1}$*				0.079
West				*(0.09)*
M2	0.255	0.62	0.212	0.139
N	194304	30188	27179	251671

Table 4.3: Inventory investment regression across regions

Notes: The dependent variable for all specification is $\Delta I_{i,t}$. The figures reported in parentheses are asymptotic standard errors. Time dummies and industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments for all GMM estimation are all the regressors lagged 2 periods. *m2* is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1). * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level. East, Central and West are interaction dummy equal to one if the firm located in the respective region, and equal to zero otherwise.

4.7.4 Regression results based on sectorial differences: durable vs. nondurable

There are important sectoral differences in the cyclical pattern of inventory investment. In particular, there tend to be much larger cyclical movements in durable inventory investment compared to nondurable inventory investment. Carpenter et al (1998a) finds that the sum of the cash flow coefficients are at least as large for durables as for nondurables, which indicates that firms operating in durable industries tend to be at least as financial constrained as the firms operating in the nondurable sector, if not more financial constrained. In our study we follow Carpenter et al (1998)'s approach to classify firms into durable and nondurable industries[34].

Column 1-2 of table 4.4 reports the result of the regression based on durable and nondurable sample splits. The cash flow coefficients appear to be insignificant for both the durable and nondurable sector, while the lagged

[34] We define durable and nondurable firms with the two-digit SIC categories. Nondurable manufacturing consists of SIC codes 20-23 and 26-31. Durable firms consists of SIC codes 24-25 and 32-38. We deleted miscellaneous manufacturing firms with SIC code 39.

inventory growth, sales growth, lagged sales growth and error corrections terms are precisely determined with correct signs. Column 3 of table 4.4 presents the results with the interaction of durable and nondurable industry dummy with the cash flow. The inventory investment cash flow sensitivity is now positive and significant for the durable sector, but it remains insignificant for the nondurable sector. The cash flow coefficient is much larger for the durable sector (0.88) than the nondurable sector (-0.013). This result is consistent with the idea that firms operate in durable sector are more financially constrained than firms operate in nondurable sector

In table 4.5 we further split the sample based on the four ownership group. State and collective firms continue to show no signs of cash-flow sensitivities to inventory investment across the durable and nondurable sectors. Yet, private firms and foreign firms operating in the durable sector display significant cash-flow sensitivities of 0.14 and 0.102 respectively, while the cash flow coefficients for the nondurable sector firms are insignificant and much smaller than those of the durable sector. As all previous regression, all the control variables are highly significant and have the correct signs. The *M2 test* shows no sign of second order serial correlation for all ownership. The overall results from table 4.4-4.5 that firms operating in the durable sector tend to face higher level of financial constraints. After controlling for ownership, we find that this case applies only to private firms and foreign firms operate in the durable sector.

	Durable	Nondurable	Interaction
	(1)	(2)	(3)
$\Delta I_{i,t-1}$	-0.574***	-0.572***	-0.569***
	(0.02)	(0.02)	(0.01)
$\Delta S_{i,t}$	0.306*	0.534***	0.415***
	(0.13)	(0.16)	(0.09)
$\Delta S_{i,t-1}$	0.496***	0.503***	0.494***
	(0.03)	(0.03)	(0.02)
$I_{i,t-2}$- $S_{i,t-2}$	-0.506***	-0.501***	-0.498***
	(0.02)	(0.02)	(0.02)
$CF_{i,t}/K_{i,t-1}$	0.05	0.033	
	(0.04)	(0.03)	
$CF_{i,t}/K_{i,t-1}$*			0.088*
Durable			(0.04)
$CF_{i,t}/K_{i,t-1}$*			-0.013
Nondurable			(0.05)
M2	0.078	0.891	0.09
N	123475	123303	245501

Table 4.4: Inventory investment regression across durable and nondurable industry

Notes: The dependent variable for all specification is change in log stocks. The figures reported in parentheses are asymptotic standard errors. Time dummies and industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments for all GMM estimation are all the regressors lagged 2 periods. *M2* is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1). * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.
Durable: dummy variable equal to one if the firm is operating in the durable sector, equal to zero otherwise. Nondurable: dummy variable equal to one if the firm is operating in the durable sector, equal to zero otherwise.

	State	Private	Foreign	Collective
	(1)	(2)	(3)	(4)
$\Delta I_{i,t-1}$	-0.638***	-0.555***	-0.573***	-0.575***
	(0.05)	(0.01)	(0.03)	(0.04)
$\Delta S_{i,t}$	0.604***	0.223*	0.477**	0.295
	(0.18)	(0.10)	(0.16)	(0.20)
$\Delta S_{i,t-1}$	0.568***	0.467***	0.508***	0.507***
	(0.06)	(0.02)	(0.03)	(0.05)
$I_{i,t-2}$- $S_{i,t-2}$	-0.577***	-0.485***	-0.507***	-0.517***
	(0.06)	(0.02)	(0.03)	(0.05)
$CF_{i,t}/K_{i,t-1}$*	-0.157	0.140*	0.102*	-0.071
Durable	(0.13)	(0.06)	(0.05)	(0.08)
$CF_{i,t}/K_{i,t-1}$*	-0.125	0.045	0.031	-0.021
Nondurable	(0.10)	(0.08)	(0.06)	(0.10)
M2	0.287	0.201	0.173	0.475
N	21520	139370	50724	21692

Table 4.5: Inventory investment regression for durable and nondurable industry across different ownership groups*.*

Notes: The dependent variable for all specification is change in log stocks. The figures reported in parentheses are asymptotic standard errors. Time dummies and industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments for all GMM estimation are all the regressors lagged 2 period. *M2* is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1). * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.
Durable: dummy variable equal to one if the firm is operating in the durable sector, equal to zero otherwise. Nondurable: dummy variable equal to one if the firm is operating in the durable sector, equal to zero otherwise.

4.7.4 Regression results based on political affiliation

Column 1-3 of table 4.6 reports the regression results for firms with high political affiliation, low political affiliation and no political affiliation respectively. The structure of the error correction model is well maintained. The result indicates that cash flow is an important determinant of inventory investment for firms with no political affiliation only. The cash flow coefficient for firms with no political affiliation is 0.065, compare to those of firms with high political affiliation (0.007) and low political affiliation (-0.003). This suggests firms with no political affiliation are financially constrained.

We create three interaction terms to indicate firm's political affiliation status: *high affiliation, low affiliation and no affiliation.* For example, high *affiliation* equals to one if a firm is politically affiliated to the central and provincial level, and equals to zero otherwise. The same rule applies to the other two interaction terms as well. We interact the cash flow with each of these three political affiliation indicators to further test the impact of political affiliation on inventory cash flow sensitivities. Column 4 of table 4.6 shows no evidence of financial constraints for firms with different level of political affiliation.

In table 4.7, we further take into account the ownership dimension to study the impact of political affiliation on the inventory to cash flow sensitivities. We find that SOEs, Foreign firms and Collective firms show no signs of significant cash flow coefficient, with the exception of the collective firms with high political affiliation display a negative and significant cash flow coefficient. This suggests that collective firms with high political affiliation may enjoy soft budget constraints.

A more interesting result is reported in column 2 of table 4.7, where cash flow coefficient for the private firms with high level political affiliation is insignificant. Given the finding from table 4.2 that private firms are always financially constrained, the result may suggest that high level of political affiliation helps to alleviate private firm's financial constraints. Yet, private firms with medium level of political affiliation attract a positive cash flow coefficient. Moreover, the cash flow coefficient for private firms with low political affiliation (0.121) is higher than those of private firms without political affiliation (0.099). A test of equality of cash flow coefficients among the three different political affiliation level for private firms, with *F-test,* indicates the cash flow coefficients for private firms with high political affiliation are significantly different from those of private firms with low or no political affiliation[35]. But, no evidence suggests any significant difference in the cash flow sensitivities to inventory between private firms with low political affiliation and private firms with no political affiliation.

[35] The F statistics for CFK*High affiliation=CFK*Low affiliation is F(1, 34138)=5.09 with p-value of 0.024.The F statistics for CFK*High affiliation=CFK*No affiliation is F(1, 34138)=3.13 with p-value of 0.07. The F statistics for CFK*Low affiliation=CFK*No affiliation is F(1, 34138)=0.46 with p-value of 0.49.

	High affiliation	*Low affiliation*	*No affiliation*	*Interaction*
	(1)	(2)	(3)	(4)
$\Delta I_{i,t-1}$	-0.534***	-0.596***	-0.564***	-0.567***
	(0.05)	(0.03)	(0.02)	(0.01)
$\Delta S_{i,t}$	0.689***	0.468**	0.359**	0.374***
	(0.19)	(0.15)	(0.12)	(0.09)
$\Delta S_{i,t-1}$	0.465***	0.525***	0.489***	0.493***
	(0.05)	(0.03)	(0.02)	(0.02)
$I_{i,t-2}$- $S_{i,t-2}$	-0.440***	-0.527***	-0.498***	-0.497***
	(0.06)	(0.03)	(0.02)	(0.02)
$CF_{i,t}/K_{i,t-1}$	0.007	-0.003	0.065*	
	(0.07)	(0.04)	(0.03)	
$CF_{i,t}/K_{i,t-1}$*				-0.079
High affiliation				(0.04)
$CF_{i,t}/K_{i,t-1}$*				0.037
Low affiliation				(0.03)
$CF_{i,t}/K_{i,t-1}$*				0.056
No affiliation				(0.03)
M2	0.087	0.31	0.778	0.124
N	19266	88040	144365	251671

Table 4.6: Inventory investment regression with different level of political affiliation

Notes: The dependent variable for all specification is change in log stocks. The figures reported in parentheses are asymptotic standard errors. Time dummies and industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments for all GMM estimation are all the regressors lagged 2 periods. *M2* is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1). * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

	Political affiliation interact with ownership			
	State	**Private**	**Foreign**	**Collective**
$\Delta I_{i,t-1}$	-0.642***	-0.556***	-0.559***	-0.577***
	(0.05)	(0.01)	(0.03)	(0.04)
$\Delta S_{i,t}$	0.526**	0.229*	0.404*	0.302
	(0.16)	(0.10)	(0.16)	(0.18)
$\Delta S_{i,t-1}$	0.572***	0.469***	0.504***	0.508***
	(0.06)	(0.02)	(0.03)	(0.05)
$I_{i,t-2}- S_{i,t-2}$	-0.585***	-0.486***	-0.497***	-0.518***
	(0.06)	(0.02)	(0.03)	(0.05)
$CF_{i,t}/K_{i,t-1}$*	-0.153	-0.029	0.079	-0.166*
High affiliation	(0.10)	(0.06)	(0.07)	(0.08)
$CF_{i,t}/K_{i,t-1}$*	-0.154	0.121***	0.009	-0.064
Low affiliation	(0.08)	(0.04)	(0.04)	(0.05)
$CF_{i,t}/K_{i,t-1}$*	-0.086	0.099*	0.058	0.065
No affiliation	(0.08)	(0.04)	(0.03)	(0.09)
M2	0.394	0.215	0.269	0.597
N	21788	142480	52905	22058

Table 4.7: Inventory investment regression with different level of political affiliation across ownership groups

Notes: The dependent variable for all specification is change in log stocks. The figures reported in parentheses are asymptotic standard errors. Time dummies and industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments for all GMM estimation are all the regressors lagged 2 periods. *M2* is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1). * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

4.7.4 Regression results based on firm size

Table 4.8 presents the results based on firm size. We use two measures of firm size as a robustness test of our results. Firms are classified as large firms if the firm's real total sales/real total assets fall in the two 25th percentile in their industry in a given year, and a firm is classified as small if the firm's real total sales/real total assets fall in the bottom 75th percentile in their industry in a given year[36]. For our regression with interaction terms, we create interaction dummy *large* equal to 1 if a firm-year is classified as a large firm and equal to zero otherwise. Interaction term *small* equals to 1 if a firm-year is classified as small firms, and equal to zero otherwise. This same rule applies to both the classification based on real total sales and real total assets.

For all six specifications in table 4.8, the structure for the error-correction models is well maintained. Lagged inventory growth, sales growth, lagged sales growth and the error-correction terms are all highly significant with the correct signs. However, cash flow terms for all six specifications in table 4.8 are insignificant. These results suggest there is no evidence of financially constraints. This is possibly due to we failed to take into account the ownership status of firms. In table 4.9, we explore whether this is the case.

[36] We have also experimented with different cut-off point such as 30% and 50% as robustness test. The different cut-off points do not alternate the results significantly. We do not report them here for brevity.

	Based on Real total assets			Based on Real sales		
	Large	**Small**	**Interaction**	**Large**	**Small**	**Interaction**
$\Delta I_{i,t-1}$	-0.569***	-0.559***	-0.570***	-0.642***	-0.536***	-0.566***
	(0.02)	(0.02)	(0.01)	(0.03)	(0.02)	(0.01)
$\Delta S_{i,t}$	0.537***	0.268*	0.439***	0.543***	0.287*	0.378***
	(0.13)	(0.12)	(0.10)	(0.13)	(0.12)	(0.10)
$\Delta S_{i,t-1}$	0.527***	0.474***	0.499***	0.584***	0.437***	0.493***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)
$I_{i,t-2}$- $S_{i,t-2}$	-0.497***	-0.491***	-0.500***	-0.582***	-0.459***	-0.497***
	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)
$CF_{i,t}/K_{i,t-1}$	0.037	0.034		0.022	0.003	
	(0.04)	(0.03)		(0.04)	(0.03)	
$CF_{i,t}/K_{i,t-1}$*			0.049			0.044
Large			(0.05)			(0.03)
$CF_{i,t}/K_{i,t-1}$*			0.036			0.035
Small			(0.03)			(0.03)
M2	0.184	0.492	0.129	0.499	0.449	0.14
N	65692	185979	251671	65101	186570	251671

Table 4.8: Inventory investment regression with different firm size level

Notes: The dependent variable for all specification is change in log stocks. The figures reported in parentheses are asymptotic standard errors. Time dummies and industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments for all GMM estimation are all the regressors lagged 2 periods. *M2* is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1). * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Firms are classified as large firms if the firm's real total sales/real total assets fall in the two 25th percentile in their industry in a given year, and a firm is classified as small if the firm's real total sales/real total assets fall in the bottom 75th percentile in their industry in a given year. For our regression with interaction terms, we create interaction dummy large equal to 1 if a firm-year is classified as a large firm and equal to zero otherwise. Interaction term small equals to 1 if a firm-year is classified as small firms, and equal to zero otherwise.

	SOEs		Private		Foreign		Collective	
	Assets	***Sales***	***Assets***	***Sales***	***Assets***	***Sales***	***Assets***	***Sales***
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta I_{i,t-1}$	-0.645***	-0.634***	-0.558***	-0.557***	-0.544***	-0.540***	-0.575***	-0.580***
	(0.0463)	(0.0461)	(0.0149)	(0.0143)	(0.0297)	(0.0307)	(0.0410)	(0.0413)
$\Delta S_{i,t}$	0.531**	0.528**	0.277**	0.259**	0.314	0.286	0.295	0.310
	(0.168)	(0.166)	(0.100)	(0.0984)	(0.168)	(0.176)	(0.195)	(0.189)
$\Delta S_{i,t-1}$	0.579***	0.566***	0.470***	0.470***	0.491***	0.485***	0.504***	0.512***
	(0.0581)	(0.0580)	(0.0200)	(0.0196)	(0.0333)	(0.0342)	(0.0532)	(0.0543)
$I_{i,t-2}$- $S_{i,t-2}$	-0.590***	-0.575***	-0.487***	-0.486***	-0.483***	-0.478***	-0.516***	-0.523***
	(0.0581)	(0.0578)	(0.0181)	(0.0176)	(0.0331)	(0.0338)	(0.0521)	(0.0533)
$CF_{i,t}/K_{i,t-1}$*	-0.0524		0.0121		0.145**		0.0435	
Large	(0.210)		(0.0712)		(0.0550)		(0.170)	
$CF_{i,t}/K_{i,t-1}$*	-0.111		0.110**		-0.00966		-0.0568	
Small	(0.0775)		(0.0392)		(0.0415)		(0.0569)	
$CF_{i,t}/K_{i,t-1}$*		-0.00209		0.0767		0.103*		0.0172
Large		(0.162)		(0.0487)		(0.0478)		(0.0975)
$CF_{i,t}/K_{i,t-1}$*		-0.112		0.108**		-0.0208		-0.0710
Small		(0.0747)		(0.0393)		(0.0438)		(0.0566)
N	21788	21788	142480	142480	52905	52905	22058	22058
M2	0.453	0.425	0.174	0.180	0.299	0.259	0.496	0.497

Table 4.9: Inventory investment regression with different firm size level across ownership

Notes: The dependent variable for all specification is change in log stocks. The figures reported in parentheses are asymptotic standard errors. Time dummies and industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments for all GMM estimation are all the regressors lagged 2 periods. *M2* is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1). * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.
Firms are classified as large firms if the firm's real total sales/real total assets fall in the two 25th percentile in their industry in a given year, and a firm is classified as small if the firm's real total sales/real total assets fall in the bottom 75th percentile in their industry in a given year. For our regression with interaction terms, we create interaction dummy large equal to 1 if a firm-year is classified as a large firm and equal to zero otherwise. Interaction term small equals to 1 if a firm-year is classified as small firms, and equal to zero otherwise.

Table 4.9 reports the regression results for firms classified as small and large firms based on real total assets and real total sales across ownership. Column 1 and 2 of table 4.9 report the results for SOEs. The error correction model's structure is well maintained. Neither do the *M2 test* statistics suggest any problems of the instruments and model specification. The results suggest no evidence of significant cash flow coefficients for both small and large SOEs. Column 7 and 8 of table 4.9 report the results for collective-owned firms, again the cash flow coefficients are insignificant for both small and large firms. These evidences are consistent with the lending bias hypothesis that SOEs and collective owned firms are not financially constrained due to the preferential treatments from the state dominated financial sectors.

Column 3 and 4 of table 4.9 report the results for private firms. Small private firms display positive and significant cash flow coefficients in the specification based on real total assets (0.11) and the specification based on real total sales (0.108), while the cash flow coefficients for the large private firms are small and not statistically significant in both specification. This suggests small private firms may be more financially constrained than large private firms, and cash flow is an important determinant of small private firms' inventory investment[37].

[37] However, the F test of the equality of cash flow coefficients suggests that for column 3 of table 4.8, the cash flow coefficients are only marginally statistically significant different from each other. The F test of

The results for foreign owned firms differentiated between small and large firms are reported in column 5 and 6 of table 4.9. We find that the cash flow coefficients are positive and significant for large foreign firms, while they are negative, very small in magnitude and insignificant for small foreign firms[38]. The results from column 5 and 6 of table 4.9 suggest that large foreign firms are more financially constrained. Large foreign firms have significant cash flow sensitivities between 0.145 and 0.103 at 5% and 10% significant level. This is in contrast to the findings from developing countries where small firms are typically more financially constrained. However, using a sample of manufacturing firms in Shanghai, Chow and Fung (2000) also find evidence that small manufacturing firms are less financially constrained. They suggest this is possibly due to the fact that smaller firms are better managed and more efficient, and may be smoothing their investment with working capital. Foreign firms typically rely on their parents aboard for funds instead of obtaining funds from local market. Foreign firms' demand for finance might be easier to be satisfied by parent company for small foreign firms than large foreign firms. Foreign firms may find it difficult to access to local capital market, therefore large foreign firms might be more financially constrained.

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the equality of the cash flow coefficients for column 4 of table 4.8 indicates the cash flow coefficient for small and large firms are not significantly different.

[38] The F-test of equality of cash flow coefficients for column 5 and 6 of table 4.8 indicates that the cash flow coefficients for small and large firms are statistically different from each other.

4.7.5 Have the level of financial constraints changed overtime?

As discussed in section 4.4.6, we choose year 2003 as a cut-off point for the sample to explore whether the level of financial constraints change over time. In order to conduct the empirical analysis, we create two interaction dummies: *Pre03* equals to 1 if year is before and equal to 2003 and equal to 0 otherwise; *Po03* equal to 1 if year is after 2003, and equal to zero otherwise. We then interact the two interaction dummies to compare whether the levels of financial constraints have decreased overtime or differential impacts on firms with different characteristics have changed.

Table 4.10 presents the first piece of evidence between time and ownerships. In column 1 of table 4.10, we find that, for the full sample, firms are facing an increasing level of financial constraints, with cash flow sensitivities increased from 0.058 to 0.084. The *F-test* of equality of cash flow constraints for pre2003 and post 2003 is *F(1, 60944)* with *p-value* of 0.028. This indicates that the level of financial constraints for the full sample in the period after 2003 is significantly higher than the period before 2003. There are a number of possible reasons for this finding. First, as discussed in section 4.4.6, PBOC[39] has conducted a tightening of monetary policy between late 2003 and June 2007. This tightening is likely to have significant impacts on firms' ability to obtain finance across all

[39] People's bank of China

ownership groups. Therefore, all firms may be more financially constrained. Second, given the increasing proportion of private firms in the sample, it is likely to observe a rise in the level of financial constraints.

The coefficients for cash flow terms remain insignificant for the SOEs and COEs across both periods (column 2 and 5 of table 4.10). This indicates that the Chinese financial market continues to favour the state sectors (SOEs and collective firms) and provides them with preferential treatments. Column 3 of table 4.10 indicates that private firms are financially constrained in both periods. The inventory to cash flow sensitivity increases slightly from 0.122 to 0.137. However, the *F-test* of equality of coefficients (CFK*pr03=CFK*po03) indicates they are not statistically different from each other. Foreign firms are facing increasing level of financial constraints; while in the period prior to year 2003 foreign firms are not financially constrained, yet foreign firms become financially constrained in the post 2003 period.

In table 4.11 we examine how the level of financial constraints change over time for each region and will firms with different ownership face some change in the level of inventory to cash flow sensitivities. For this purpose we interact cash flow terms with interaction dummies for region (r1: East/coastal, r2: Central and r3: West) and time dummies *pr03* and *po03*. Column 1 of table 4.10 indicates there is a significant increase in the cash flow sensitivities from 0.059 to 0.09 in the east/coastal region from pre 2003 to post 2003 periods for the full sample. Column 2 of table 4.11 indicates that SOEs face soft budget constraints in central region prior to 2003, but this is no longer the case in the post 2003 period. Moreover, foreign firms display positive cash flow sensitivities in east/coastal region after year 2003. Based on the results from table 4.11, we see some evidence of tightening of budget constraints for SOEs and COEs, and increasing level of financial constraints for foreign firms locate in the coastal region.

In table 4.12, we explore the dynamic change of the effects of political affiliation overtime across different ownership groups. The political affiliation interaction terms for high political affiliation, low political affiliation and no political affiliation are labelled as L1, L2 and L3 respectively. Column 1 of tale 4.12 indicates that for the full sample, firms with no political affiliation are experiencing significantly higher level of financial constraints over the study period. The inventory to cash flow sensitivities for the full sample increases from 0.77 to 0.121[40]. This indicates, for the full sample, firms without any levels of political affiliation are facing higher level of financial constraints. This suggests that the political pecking order is still operating in China and obtaining finance for firms without any political affiliation become more difficult in the recent period.

[40] The *F-test* indicates the two cash flow coefficients are statistically different from each other at 1% level.

State owned firms with medium level of financial constraints were experiencing soft budget constraints prior to 2003, but this soft budget constraint appears to be weaker in the later study period. Similar result is also found for collective firms with high political affiliation. In general, SOEs and collective firms do not appear to suffer from financial constraints. Yet, there are some evidences suggesting the budget constraints are hardening over time for the SOEs and the collective owned firms.

Focusing on private firms, in column 3 of table 4.12 we again confirm that firms with high level of political affiliation show no sign of financial constraints in both sub sample periods. Yet, for private firms without any level of political affiliation are facing significantly higher level of financial constraints. The inventory to cash flow sensitivities for private firms with no political affiliation increased from 0.137 in the pre-2003 period to 0.196 in the post-2003 period. A one standard deviation increase in cash flow to capital ratio for private firms without political affiliation, would lead to a rise of 15% in inventory growth. A more interesting result is for private firms with low level of political affiliation. The cash flow coefficients (0.13) for private firms with low level of political affiliation is positive and significant in the pre-2003 period, while it becomes small and insignificant (0.061) in the post-2003 period. These evidences suggest political affiliation helps private firms to alleviate the level of financial constraints. Moreover, in the post-2003 period, low level of political affiliation also becomes an effective way to lower private firms' level of financial constraints.

	Whole sample	***State***	***Private***	***Foreign***	***Collective***
	(1)	(2)	(3)	(4)	(5)
$\Delta I_{i,t-1}$	-0.568***	-0.636***	-0.558***	-0.555***	-0.561***
	(0.01)	(0.05)	(0.01)	(0.03)	(0.04)
$\Delta S_{i,t}$	0.355***	0.447*	0.212*	0.393*	0.181
	(0.10)	(0.19)	(0.10)	(0.19)	(0.21)
$\Delta S_{i,t-1}$	0.495***	0.568***	0.471***	0.498***	0.487***
	(0.02)	(0.06)	(0.02)	(0.04)	(0.06)
$I_{i,t-2}$- $S_{i,t-2}$	-0.500***	-0.581***	-0.489***	-0.492***	-0.502***
	(0.02)	(0.06)	(0.02)	(0.03)	(0.06)
$CF_{i,t}/K_{i,t-1}$*	0.058*	-0.127	0.122**	0.064	-0.072
Pr03	(0.03)	(0.08)	(0.04)	(0.04)	(0.06)
$CF_{i,t}/K_{i,t-1}$*	0.084**	-0.019	0.137**	0.088*	-0.053
Po03	(0.03)	(0.10)	(0.05)	(0.04)	(0.07)
M2	0.135	0.493	0.203	0.22	0.529
N	251671	21788	142480	52905	22058

Table 4.10: Inventory investment regression with time period interaction across ownership groups

Notes: The dependent variable for all specification is change in log stocks. The figures reported in parentheses are asymptotic standard errors. Time dummies and industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments for all GMM estimation are all the regressors lagged 2 periods. *M2* is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1). * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level. Pr03: is the interaction dummy equals to 1 if year is less than or equal to 2003, and equals zero, otherwise. Po03: is the interaction dummy equals to 1 if year is greater than 2003, and equals zero, otherwise.

	Full Sample	State	Private	Foreign	Collective
	(1)	(2)	(3)	(4)	(5)
$\Delta I_{i,t-1}$	-0.558***	-0.659***	-0.540***	-0.558***	-0.585***
	(0.01)	(0.05)	(0.01)	(0.03)	(0.04)
$\Delta S_{i,t}$	0.307***	0.459**	0.165	0.404*	0.232
	(0.09)	(0.18)	(0.09)	(0.16)	(0.18)
$\Delta S_{i,t-1}$	0.482***	0.601***	0.447***	0.502***	0.521***
	(0.02)	(0.06)	(0.02)	(0.03)	(0.06)
$I_{i,t-2}$- $S_{i,t-2}$	-0.489***	-0.615***	-0.467***	-0.496***	-0.534***
	(0.02)	(0.06)	(0.02)	(0.03)	(0.06)
$CF_{i,t}/K_{i,t-1}$*	0.059*	0.017	0.094	0.063	-0.045
R1*Pr03	(0.03)	(0.09)	(0.05)	(0.04)	(0.07)
$CF_{i,t}/K_{i,t-1}$*	0.090*	0.189	0.105	0.087*	-0.014
R1*Po03	(0.04)	(0.13)	(0.06)	(0.04)	(0.07)
$CF_{i,t}/K_{i,t-1}$*	-0.074	-0.474*	-0.079	0.063	0
R2*Pr03	(0.08)	(0.22)	(0.09)	(0.11)	(0.09)
$CF_{i,t}/K_{i,t-1}$*	-0.104	-0.191	-0.126	0.103	0.048
R2*Po03	(0.08)	(0.16)	(0.08)	(0.11)	(0.09)
$CF_{i,t}/K_{i,t-1}$*	0.058	-0.223	0.152	0.018	-0.285
R3*Pr03	(0.11)	(0.18)	(0.11)	(0.09)	(0.27)
$CF_{i,t}/K_{i,t-1}$*	0.089	-0.083	0.143	0.029	-0.207
R3*Po03	(0.13)	(0.16)	(0.13)	(0.09)	(0.31)
M2	0.147	0.629	0.242	0.23	0.462
N	251671	21788	142480	52905	22058

Table 4.11: Inventory investment regression with time periods and regional interaction across ownership groups

Notes: The dependent variable for all specification is change in log stocks. The figures reported in parentheses are asymptotic standard errors. Time dummies and industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments for all GMM estimation are all the regressors lagged 2 periods. *M2* is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1). * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level. R1 indicates costal region, r2 indicates central region, and r3 indicates western region, pr03 indicates year<=2003, po03indicates year>2003

	Whole sample	***State***	***Private***	***Foreign***	***Collective***
	(1)	(2)	(3)	(4)	(5)
$\Delta I_{i,t-1}$	-0.571***	-0.641***	-0.562***	-0.560***	-0.580***
	(0.01)	(0.05)	(0.01)	(0.03)	(0.04)
$\Delta S_{i,t}$	0.385***	0.446**	0.235*	0.396*	0.285
	(0.09)	(0.16)	(0.10)	(0.16)	(0.18)
$\Delta S_{i,t-1}$	0.500***	0.574***	0.478***	0.504***	0.513***
	(0.02)	(0.06)	(0.02)	(0.03)	(0.06)
$I_{i,t-2}$- $S_{i,t-2}$	-0.503***	-0.588***	-0.494***	-0.499***	-0.523***
	(0.02)	(0.06)	(0.02)	(0.03)	(0.05)
$CF_{i,t}/K_{i,t-1}$*	-0.114	-0.141	-0.046	0.105	-0.161*
L1*Pr03	(0.06)	(0.10)	(0.07)	(0.08)	(0.08)
$CF_{i,t}/K_{i,t-1}$*	-0.137	-0.055	-0.06	0.103	-0.089
L1*Po03	(0.09)	(0.13)	(0.11)	(0.09)	(0.15)
$CF_{i,t}/K_{i,t-1}$*	0.052	-0.165*	0.130**	0.04	-0.062
L2*Pr03	(0.03)	(0.07)	(0.04)	(0.05)	(0.05)
$CF_{i,t}/K_{i,t-1}$*	0.034	-0.055	0.061	0.128	-0.072
L2*Po03	(0.06)	(0.09)	(0.08)	(0.11)	(0.07)
$CF_{i,t}/K_{i,t-1}$*	0.077*	-0.037	0.137**	0.064	0.01
L3*Pr03	(0.03)	(0.08)	(0.05)	(0.03)	(0.11)
$CF_{i,t}/K_{i,t-1}$*	0.121**	0.058	0.196**	0.071	0.126
L3*Po03	(0.04)	(0.22)	(0.06)	(0.04)	(0.13)
M2	0.125	0.472	0.223	0.26	0.609
N	251671	21788	142480	52905	22058

Table 4.12: Inventory investment regression with time periods and political affiliation interaction across ownership groups

Notes: The dependent variable for all specification is change in log stocks. The figures reported in parentheses are asymptotic standard errors. Time dummies and industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments for all GMM estimation are all the regressors lagged 2 periods.*M2* is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1). * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level. L1 indicates high political affiliation, L2 indicates medium level of political affiliation, and L3 indicates no political affiliation, pr03 indicates year<=2003, po03indicates year>2003

4.8 Conclusions

In this paper, we find that inventory to sales ratio decline significantly overtime in China over the study period. Part of this decline is due to improvement of inventory control methods. However we observe significant heterogeneity in the decline of inventory to sales ratio across different ownership groups. This has led us to focus on the level of financial constraints across different ownership groups. We have found that SOEs and Collectively owned firms are not financially constrained, so their inventory investment decisions are not determined by the availability of internal finance. For some case, we have identified that SOEs and COEs have negative inventory cash-flow sensitivities, which in the literature is interpreted as soft budget constraints. By dividing the study period into two periods, we also find some evidences that SOEs and COEs are no longer enjoying the soft budget constraints. But there is no evidence that they are financially constrained in any dimensions. This strongly supports the idea of political pecking order, where the state-dominated financial sector continues favour the SOEs and collectively owned firms.

On the other hand, private firms are the most financially constrained firms. Cash flow is an important determinant for private firms' inventory decisions. We find a one standard deviation increase in cash flow to capital ratio lead to an additional 2.5% inventory growth for private firms. We further shows that political affiliation helps to alleviate the problems of financial constraints for private firms. Private firms with high level of political affiliation show no signs of financial constraints. Yet, private firms without any political affiliation are facing increasing level of financial constraints over time. Our results also indicate that firms located in the coastal region are facing increasing level of financial constraints over time and this is particularly true for private firms and foreign firms. This suggests that reform of banking sector and capital market has not been completed and capital markets continue to be fractured.

Data appendix 4A1: Variable definition

Definitions of the variables used:

Inventories: firm's total stock of inventories includes finished goods and work in progress

Sales: firm's total sales

Total assets: is the sum of total fixed assets and total current assets

Capital stock: is proxy with tangible fixed assets

Durable and nondurable firms: we define durable and nondurable firms with the two-digit SIC categories. Nondurable manufacturing consists of SIC codes 20-23 and 26-31. Durable firms consists of SIC codes 24-25 and 32-38. We deleted miscellaneous manufacturing firms with SIC code 39.

Borrowing ratio: is defined as interest payment over cash flow

Coverage ratio: is defined as the sum of cash flow and interest payment over interest payment

Leverage: is the ratio of total liabilities to total assets

CF/K : is defined by real cash flow over real tangible fixed assets

Dlogstock: is the change in ln(stock), which proxies stock growth

Dlogsales: is the change in ln(sales), which proxies sales growth

Pic: the error correction terms in the regression. It is defined as the log difference of inventory and sales

Data appendix 4A2: Data structure of the unbalanced Panel

Table 4A1	Data distribution	
year	Freq.	Percent
2000	36,532	9.1
2001	35,819	8.93
2002	46,220	11.52
2003	60,069	14.97
2004	59,857	14.92
2005	56,557	14.1
2006	54,578	13.6
2007	51,615	12.86
Total	401,247	100

Table 4A1 Sample distribution for all firms

Table 4A2	Number of observations	
noy	Freq.	Percent
5	106,695	26.59
6	85,788	21.38
7	25,900	6.45
8	182,864	45.57
Total	401,247	100

Table 4A2:Number of Observations

Table 4A3	Ownership distribution over year				
year	State	Private	Foreign	Collective	Total
2000	14.39	50.44	23.21	11.96	100
2001	14.3	50.38	23.35	11.96	100
2002	12.23	53.26	23.41	11.1	100
2003	9.96	58.85	21.52	9.66	100
2004	10.1	58.78	21.5	9.62	100
2005	9.18	59.95	21.74	9.13	100
2006	8.53	60.73	22.03	8.71	100
2007	7.06	62.08	22.38	8.48	100
Total	10.34	57.52	22.26	9.87	100

Table 4A3: Ownership distribution over year
Ownership classification is based on the majority average shareholding

Inventory to sales analysis					
Table 4A4	Median inventory to sales ratio across ownership and time				
	State	Private	Foreign	Collective	Full Sample
2000	30.5%	16.3%	16.8%	15.6%	17.9%
2001	30.4%	15.7%	16.5%	15.0%	17.4%
2002	27.4%	13.9%	16.0%	13.7%	15.6%
2003	24.9%	11.6%	15.0%	12.4%	13.5%
2004	24.0%	12.1%	15.9%	12.5%	13.9%
2005	22.2%	11.1%	15.3%	11.2%	12.9%
2006	19.7%	10.3%	14.9%	10.3%	12.0%
2007	19.4%	10.4%	15.0%	9.8%	12.1%

Table 4A4 Median inventory to sales ratio across ownership

Region 1: Costal/East Region	Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan, Guangxi
Region 2: Central Region	Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan
Region 3: Western Region	Neimenggu, Sichuan, Chongqing, Guizhou, Yunnan, Shannxi, Gansu, Qinghai, Ningxia, Xinjiang, Tibet

Table 4A5 Detailed region classification

Chapter 5: *Financial factors and exports: micro-evidence from China*

5.1 Introduction

Exports have long been perceived, by the academic community and policy makers, to have a stimulating influence across the developed and developing countries in the form of technological spillovers and other positive externalities[41] leading to productivity improvements and economic growth. Exporters are typically more efficient than non-exporter, and have higher incentives to innovate and refine the production process to stand up to the increased competition from international trade. Moreover, the increase specialization of exporters also allows them to benefit from economies of scale. The export performance is now considered an important indicator of a country's economic performance. As a result, policy-makers around the world devote significant efforts into development and implement trade promotion programs. The effectiveness of these programs depends on our clear understanding of the determinants of export decision.

The determinants of trade participation have been extensively studied in recent years (Bernard and Bradford Jensen 1999; Bernard and Wagner 2001; Levinsohn and Petrin 2003). The important theoretical contribution by Melitz (2003) rationalizes the link between heterogeneous firms and industry productivity, and provides a new perspective on the study of firms' export participation. Melitz (2003) shows that both firm heterogeneity and the suck cost of entry into export market are relevant in analyzing firms export decisions. Chaney (2005) extends Melitz's (2003) model with imperfect financial markets to introduce financial constraints into the model. This shows

[41] The positive externalities include increase stock of knowledge, improve technology and local infrastructures, and human capital level in the local economy.

that not all valuable industrial projects are financed, which helps to explain why in some industry firms with high productivity do not export. This model shows financial variables can play an important role in the export decision.

Financial health and access to finance affects firms' export behavior for a number of reasons. First, starting to export can be very expensive for firms in the form of sunk cost, where firms needs to set up offices overseas, to learn about foreign markets, establish new distribution channels, redesign products to fit the foreign markets and so on. Das *et al* (2007) report that estimated export entry costs for Columbian exporters are as high as 430,000 USD. Secondly, although continuing to export involve substantially lower costs than the entry cost, the firms still need to devote a significant amount of resources to maintain current knowledge of foreign markets, to maintain and comply with the local and foreign regulations.

Despite the fact that a growing number of studies have formalized the link between financial constraints and firm's export behavior, only a handful of empirical papers have directly estimated the relationship. Our paper attempts to fill the gap using a large sample of micro level data from China between 2000 and 2007. China is particularly suitable for the study of this relevant question for several reasons. First, China's growth model has often been classified as export-led. Export is playing an important role in the Chinese economy, with China's total export accounting for 38.47% of its GDP in 2007. Secondly, our data indicates that only around 27% of manufacturing firms are exporters, which is substantially lower than in developed countries. Third, China's financial market is still relatively underdeveloped: a large number of firms are excluded from the formal financing channels. Private firms, small and medium firms are often financially constrained.

This paper provides a detailed analysis of the impact of financial health on firms export participation decisions, by exploring the differential impact on firms with different ownership, political affiliation and firm characteristics. The study has important policy implication. It provides a better understanding of the relationship between financial health and firms' export participation, with emphasis on firm heterogeneity. This helps to shape the export promoting policy to target firms that needs the help most.

The remainder of the chapter is organized as follows. In Section 5.2, we provide a brief overview of China's aggregate international trade trends. Section 5.3 reviews the development of the related theoretical and empirical literatures. In Section 5.4, we introduce our dataset and present some summary statistics. Section 5.5 presents our empirical analysis and results. Section 5.6 concludes the paper.

5.2 Exports in China

China's economy has experienced phenomenal level of economic growth in the past three decades. Its unique approach of experimental gradualism by gradually moving towards a market economy has helped the country to surpass many obstacles and helped to improve the living standards of over one billion Chinese citizens. The gradual trade liberalization initiated in 1978 has played an indisputable important role for china's miracle economic growth. In this section we provide a brief review of the trends and patterns of China's export and trade as a background of our empirical study of the relationship between financial constraints and exports[42].

Figure 5.1 presents the annual total exports of goods and services by China in constant 2000 US$ between 1978 and 2007. The total exports of goods and services by China increased rapidly since 1978 from merely 37.48 billion USD to 1175.5 billion USD in 2007. Exports started to play an important role in China's economy after the initial trade liberalization. Exports' share of China's GDP grew from 6.6% in 1978 to a peak of 38.41% in 2005. China's total imports of goods and services echoed those of exports. Figure 5.2 shows that the imports also rapidly increased from 27 billion USD in 1978 to 835billion USD in 2007. Imports' share of GDP has grown from 7.06% to the peak of 31.55% in 2005, and slowly declined to 29.6% in 2007.

Figure 5.3 presents the annual growth rates of imports and exports in China. The growth rates for both imports and exports have been very volatile before 1990s, and the annual growth rates for both imports and exports have stood at above 10% level. The average annual growth rates for imports and exports are 13.69% and 13.13% between 1979 and 2007. If we restrict the time period to those of 2001 and 2007, the average annual growth rates for imports and exports are 18.97% and 22.92%, respectively. This significant increase in annual growth rate reflects the effects of China's assertion to WTO.

[42] All the numbers, except percentages, reported in this section are in constant 2000 USD$.

Figure 5.4 reports the trade balance of China between 1978 and 2007. China continues to run a trade surplus over the period of 20 years after 1998. The trade surplus increased rapidly from 25 billion USD in 2001 to a staggering level of 340.4 billion USD in 2007. The trade surplus is about 13.8% of real GDP in 2007. There are two main reasons for this high level of surplus. First, the continuous tight exchange rate control of the Chinese yuan helps to maintain the competitiveness of Chinese products at the global markets. Second, a less notice factor is the possibility that the import suppliers are being replaced by domestic suppliers. This can be traced from the sharp difference in the annual growth rate of imports and exports since 2004. The imports growth rate is significantly below that of exports growth rate. After three decades of learning and exporting, china's producers now manage to domestically produce inputs, which can substitute the input that previously needs to be imported.

Last, figure 5.5 presents some brief overview of the structure of China's exports. The merchandise trade's share of GDP grows rapidly from 14.2% of GDP to around 62.3% of GDP. Moreover, manufactures exports share of merchandise exports increases drastically from 26.4% in 1985 to 93.07% in 2007. This reflects that China's exports are undergoing the process of increase sophistication. The raw materials exports share, food exports share and fuel exports share of merchandise exports are all declining significantly over the period and shift to manufactures exports. Last, Figure 5 also shows that China's merchandise exports increasingly rely on high-income economies. The share of merchandise exports to high-income economies. In 2007, 78% of merchandise exports are exported to high income countries.

Another notable fact regards to the rapid growth of inflow of foreign direct investment. Figure 5.6 reports the annual inflow of FDI to China and annual inflow of FDI as percentage of GDP between 1985 and 2007. The annual inflow of FDI to China has grown from merely 5 billion USD in 1985 to an astonishing 74.7 billion USD in 2007. If we compare figures 5.1, 5.2 and 5.6, we can see that China's total exports, imports and inflow of FDI all started to grow sharply from 1991. This suggests the high inflow of FDI may have helped China to evolve in the global trade markets and to promote China's exports. Moreover, it also reflects the fact that foreign firms are outward oriented, they invest in China with the objective to utilize China's low cost labour to produce goods which are then sold to other countries.

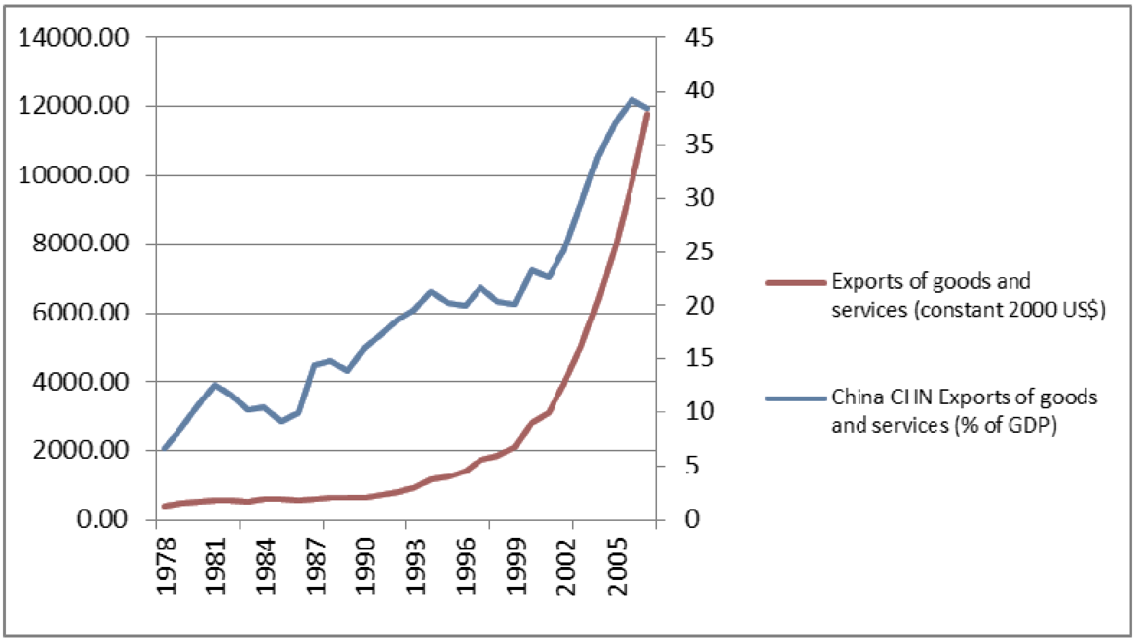

Figure 5.1: Exports of goods and services
(left axis, 100s million USD, constant 2000 USD). China's Exports of goods and services as percentage of GDP (right axis). Sources: World development indicators database, World Bank and author's calculation.

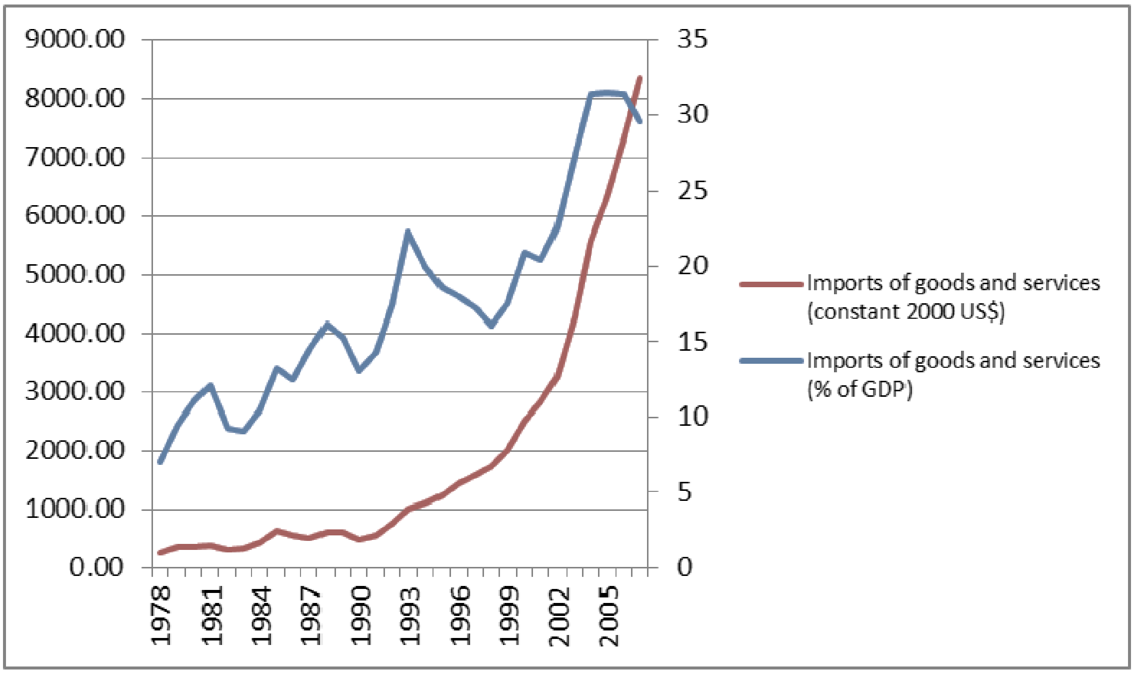

Figure 5.2: Imports of goods and services
(left axis, 100s million USD, constant 2000 USD). China's Imports of goods and services as percentage of GDP (right axis). Sources: World development indicators database, World Bank and author's calculation.

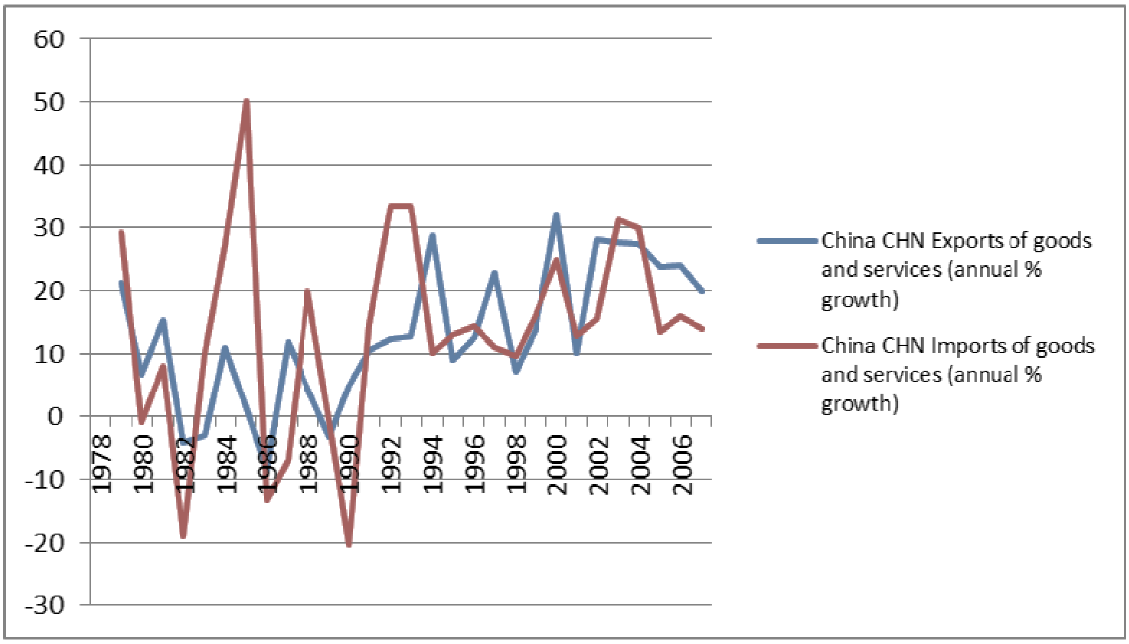

Figure 5.3: Annual growth rate of China's imports and exports
(All numbers are in percentage). Sources: World development indicators database, World Bank and author's calculation.

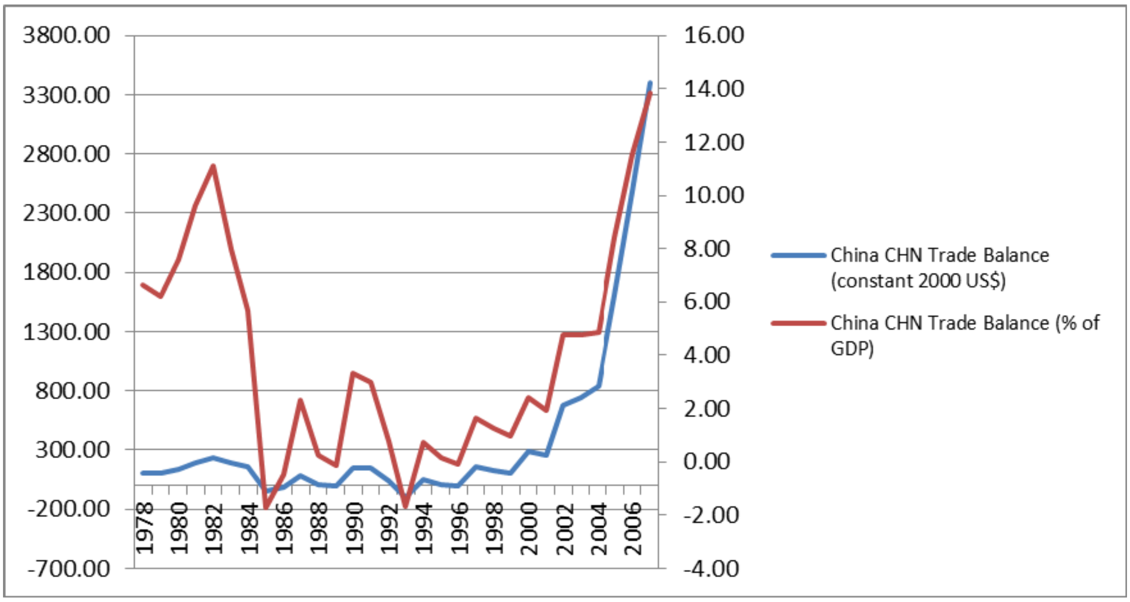

Figure 5.4: China's Trade balance:
(left scale, constant 2000 US$).China's trade balance as percentage of GDP (right scale). Sources: World development indicators database, World Bank and author's calculation.

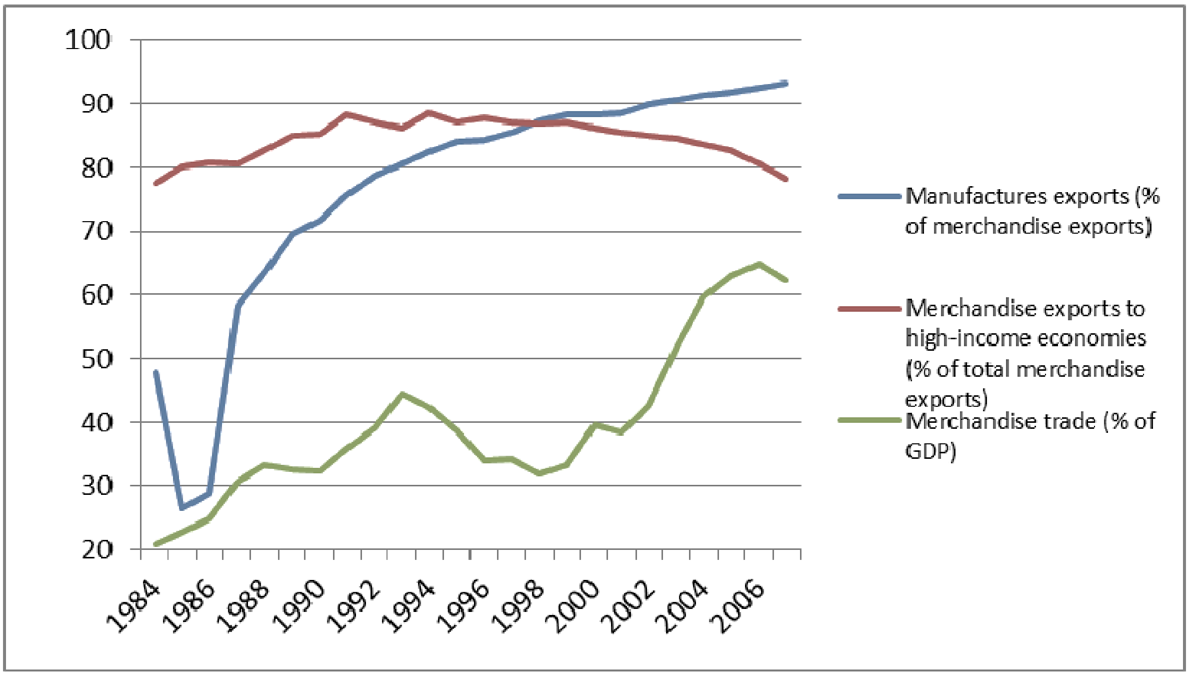

Figure 5.5: Manufactures exports as percentage of merchandise exports,
Merchandise exports to high-income economies as percentage of total merchandise exports. Merchandise trade as percentage of GDP (all number reported are percentage). Sources: World development indicators database, World Bank and author's calculation.

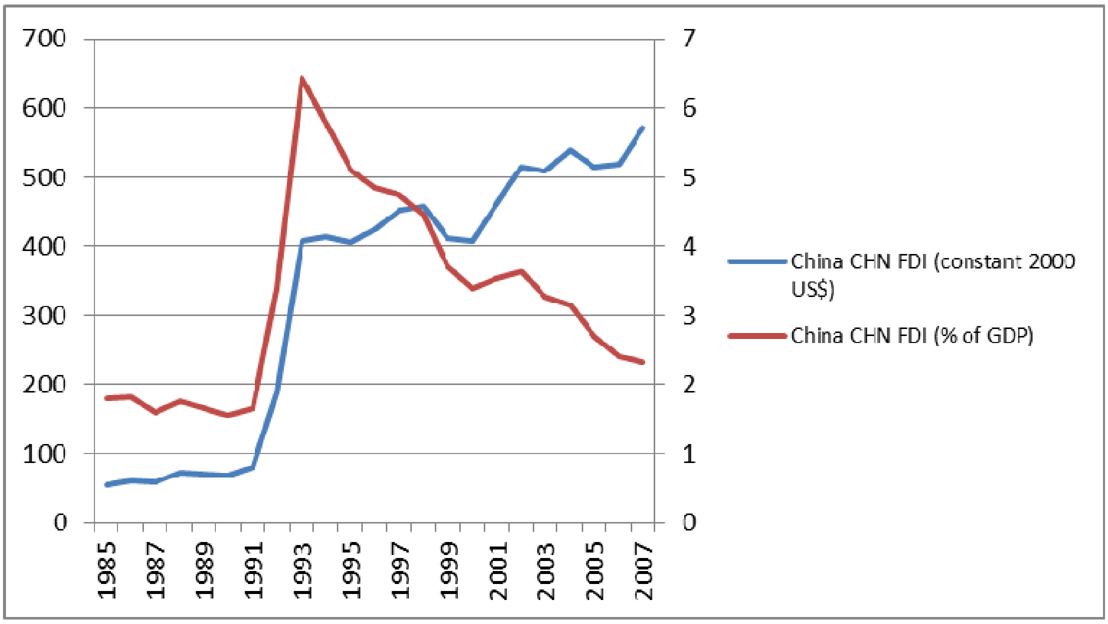

Figure 5.6: China's FDI inflow:
(left scale, constant 2000 US$). China's FDI inflow as percentage of GDP(right scale). Sources: World development indicators database, World Bank and author's calculation.

5.3 Literature Review of financial constraints and export

5.3.1 Theoretical background

In the last decade, the trade literature has recognized firm heterogeneity as an important element in the study of firm's export behavior. A number of papers have formalized firm heterogeneity the international trade theoretical models (Eaton and Kortum 2002; Melitz 2003). Melitz (2003) constructs a dynamic industry model with heterogeneous firms under the monopolistic competition assumption in a general equilibrium framework . In Melitz's (2003) model, firms are heterogeneous in productivity and face a fixed cost. Only firms with productivity above the average productivity threshold level are able to participate in the export market. This model shows the importance of firm heterogeneity and sunk cost as determinants of firms' export participation decisions.

Chaney (2005) extends Melitz's (2003) model by formally incorporating the role of financial constraints along with firm heterogeneity in firm productivity. He shows that financial constraints are a key determinant of firms' extensive margin of export when firms are facing significant sunk cost to participate in export market. Only those sufficiently productive firms that are able to overcome financial constraints can export. The ability to overcome the financial constraints is modeled as endogenously determined, and the model also assumes that firms cannot borrow externally. Firms finance the export sunk costs via liquidity inherited from the past and cash flow generate from the domestic activities. Chaney's (2005) model also proposes that the extensive margin responds differently to exchange rate fluctuation in the presence of financial constraints. An appreciation of the domestic currency may improve aggregate export as the value of firms' domestic assets abroad increases due to the currency appreciation, and they are now able to pledge more collateral to finance the sunk cost for export. This would encourage more firms to start to export, which could compensate the drop in exports from existing exporters and achieve a net increase in export at the aggregate level. Chaney (2005) also points out that financial constraints are not related to firms' intensive margins of export. Once firm overcomes the finance obstacle of export, the volume of export is determined by productivity.

Also inspired by Melitz (2003), Manova (2010) develops a model with credit constrained heterogeneous firms to study the variation of international trade flows across countries and sectors with different level of financial development. In contrast to Chaney (2005) who focuses on the impact of internal finance on exports, Manova (2008) assumes that firms can finance variable costs internally, but need to finance the export fixed costs by borrowing externally. The model predicts that larger and more productive firms are less likely to be financially constrained and are more likely to export. Firms who are productive enough to profitably export, but not productive enough to obtain the external finance necessary to fund the export fixed cost, will not participate in the export market. By extending the assumption that firm now need to finance both fixed costs and variable costs externally, Manova (2010) shows that financial constraints would also affect the intensive margin of export which is contrary to Chaney (2005). Moreover, the model also shows that firms located in more financially developed countries are more likely to export, export at a greater volume, and export to more trading partners. Essentially, credit constraints have significant impact to both the intensive and extensive margin of export.

Muûls (2008) combines the assumptions from both Chaney (2005) and Manova (2010) by considering both internal financing and external financing in one unified model. This allows a firm to have three different sources of funds to finance the sunk cost for export. Muûls's (2008) model makes similar prediction to Manova (2010), where financially constrained firms are excluded from participating in export market even if it is profitable to export. Furthermore, financial constraints also prevent firms from serving more destinations, even if it is profitable to do so. The model shows a pecking order of trade where financial constraints force firms to export according to the decreasing order of trade cost weighted market size.

A more recent theoretical contribution from Li and Yu(2009) introduces two additional sources of heterogeneous financial constraints into the Melitz's (2003) theoretical model. They introduce a project specific risk which creates heterogeneity in firm's borrowing capability. They further extend the model to allow foreign invested enterprises to obtain capital from foreign parent firms. Their model shows that firms with a higher probability of project success, easier access to external financing, and additional external funding source from parent are more likely to enter to the export market.

Despite the differences in the assumptions made on the form of the credit constraints and sources of external funds, the theoretical literature points to a consistent theme, where firm productivity and credit constraints are the main determinants of firm export behavior. As firms face significant up front fixed entry cost to participate in the export market, in the presence of credit constraints, profitable firms are prevented from exporting due to lack of funding sources to overcome the fixed cost obstacles. Credit constraints will also affects the intensive margins of export when firms face credit constraints in financing the variable costs, which leads firm to export lower volumes, serve fewer destinations, and create a pecking order of trade.

5.3.2 Empirical literature

5.3.2.1 Country level and Sector level empirical evidence

Despite the theoretical advancement in the relationship between financial constraints and firm export behavior, only a handful of papers have empirically examined the relationship due lack of suitable firm level data sources. Earlier empirical studies on the links between finance and international trade are based on aggregate data at country level and industry level. These studies use the level of financial development to proxy the level of financial constraints faced by firms.

Using 30 years of country level panel data for 65 countries, Beck (2002) studies the link between the level of financial development and the structure of international trade. They provides evidence that financial development is not only a statistically significant determinants of the trade of manufactured goods but also economically significant. His results show that a 10% increase in the financial development measurement leads to a 16% increase in the share of manufactured exports in GDP[43]. Beck (2003) uses industry level data for 36 industries and 56 countries over 1980s to further reinforce his early findings based on country level data. Adopting the techniques pioneered by Rajan and Zingales (1998), he provides evidences that sectors depending heavily on external finance in countries with better financial development have higher export share in GDP and total trade balance.

More recently, Manova (2010) explores many other aspects of international trade. Using sectorial data from 27 sectors and 107 countries, she shows the level of financial development leads to higher probability to export and conditional on the export status higher level of financial development leads to greater export volume. Consistent with Beck's (2003) finding, these results are more pronounced in sectors heavily depends on external finance or with lowers level of collateral. Moreover, more financially developed countries are able to export more types of products and to a larger number of destinations[44]. Her results also show that export starters account for one third of the total impact of credit constraints on export volume, while the other two thirds are due to adjustments in firm level exports. This indicates that financial factor is an important determinant of the intensive margin and extensive margin for firms' export decisions.

[43] Financial development is defined as credit to the private sector by deposit money banks and other financial institutions as a share of GDP.
[44] This is also known as the pecking order of trade, where firms export to additional destinations in decreasing order of market size until they exhaust their financial resources.

5.3.2.2 Firm level empirical evidence

5.3.2.2.1 Firm level empirical evidence: indirect test of financial constraints and exports

Campa and Shaver (2002) use a stratified representative sample for the Spanish manufacturing sector between 1990 and 1998 to test the link between financial constraints and exports. Under the framework of investment cash flow sensitivities studies pioneered by Fazzari *et al (1988)*, they show that exporters display a much lower fixed investment cash flow sensitivities relative to non-exporters. By focusing on firms who switch exporting status, they find that firms are significantly less constrained during periods in which they are exporting compare to the period of not exporting. They further investigate the role of the intensive margin of export and conclude that investment cash flow sensitivity is only driven by the export status. The intensive margin of export has no significant effects on firm's investment cash flow sensitivity. This is the first paper that provides evidence that exporting is not just an outcome of firm characteristics and external environment, but exporting also allows firms to overcome certain level of financial constraints.

By focusing on the inventory investment and financial variables, Guariglia and Mateut (2010) investigates the role of global engagement status of firms and their financial health with a large panel of UK firm level data of manufacturing firms between 1993 and 2003[45]. In this study, they find that financial factors only affect the inventory investment of the firm-years that do not export and conclude that exporting helps to alleviate the level of financial constraints. Using similar firm level data between 1997 and 2002, Bridges and

[45] Global engagement status includes export status, and whether the firm is foreign owned.

Guariglia (2008) explore the links between global engagement and firm survival probabilities by estimating a Logit model for the probability of firm failure augmented with financial variables. The result indicates that financial factors such as collateral and leverage either do not significantly affect the survival of firms that are exporting or are foreign owned, or have only a small impact on them than on purely domestic owned firms. These results indicate that exporting helps to shield firms from financial constraints and increase firms' survival probabilities.

The findings describe above all indicates that exporting is beneficial to firms financially. Exporting could help firms to reduce their level of financial constraints. These authors put forward three main explanations to these effects. First, exporting creates a diversification benefit. Assuming that the business cycles are not perfectly related across countries, by selling to multiple countries would reduce the cash flow volatility and allow firms to have a more stable capital expenditure path to expand the firms. Second, one of the main causes of imperfect capital market is information asymmetries. In general, only the most competitive firms with high productivity are able to export. Therefore, exporting has a signaling effect. Last, exporting also allows some exporters to gain access to international financial markets.

5.3.2.2.2 Firm level empirical evidence: direct test of financial constraints and exports

The three studies presented above can only be considered as an indirect test of the relationship between financial constraints and exports. They don't show

how financially constraints affect the decisions to export and its impact on the volume and intensity of exports. Greenaway *et al* (2007) introduce a financial dimension of firm heterogeneity in the study of the determinants of export market participation. Using a firm level panel dataset for UK manufacturing firms between 1993 and 2003, they explore the causal nexus between export and financial health. They use liquidity ratios and leverage ratios as measures of financial health. The results indicate that larger firms, foreign owned firms, firms with subsidiaries, firms with liquidity and lower leverage are more likely to export. In their results, both the total factor productivity and labor productivity are insignificant determinants of firm's decisions to export. This is in contrast with theoretical prediction and other empirical studies. By dividing firms into continuous exporters and starters, they find that the positive relationship between financial health and export participation is only applied to continuous exporters, while export starters display a negative relationship between financial health and export participation. They argue that this is due to starter having to draw down liquidity or increase borrowing to pay for the foreign market entry costs. They find no evidence that firms enjoying better ex-ante financial health are more likely to participate in export market, but they find strong evidence suggesting that export participation enhance ex –post financial health. They conclude that the causality runs from export participation to financial health. This finding is consistent with the indirect studies by Campa and Shaver (2002), Guariglia and Mateut (2010) and Bridges and Guariglia (2008) according to which exporting helps to reduce the level of financial constraints.

Bellone *et al* (2010) study the relationship between financial constraints and firm export behavior by combining the EAE survey and DIANE database from Bureau van Dijk for the French manufacturing firms for the period 1993-2005. The introduce two financial constraints score indexes using the method developed by Musso and Schiavo (2008) in addition to the two financial variables used by Greenaway *et al* (2007). The two score indexes exploit information from seven variables including: size, profitability, liquidity, cash flow generating ability, solvency, trade credit over total assets, and repaying ability. They argue these two measures capture firms' access to finance better. Contrary to Greenaway *et al* (2007), they find firms starting to export display a significant *ex ante* financial advantage compared to their non-exporting counterparts. This confirms the idea that external finance is an important determinant of export participation. They further show there is no evidence that export participation leads to improvements in the financial health of firms. They conclude that exporting is not associated with better access to external finance.

Bellone *et al* (2010) also estimate a time duration model for firm to participate in the export market. The result indicates financial constraints are statistically significant, but the economic relevance is relatively small compared to other variables such as wage, productivity and firm size. Furthermore they find a negative relationship between financial health and export intensity for export starters. They argue that export intensity can be a proxy for the number of destinations firms selling to. The negative relationship indicates that firms need to pay for large sunk cost to penetrate into new markets which leads to a deterioration of a firm's financial health. This is consistent with Greenaway *et al* (2007)'s finding of a negative relationship between financial health and export participation.

Muûls (2008) explores the impact of financial factors on export status, export destinations, and numbers of different products with manufacturing firms' balance sheet data, and with detailed trade data from Belgium for the period between 1999 and 2005. She uses Coface score supplied by a credit insurance company as a measure of financial constraints[46]. Consistent with other empirical results, there is a negative relationship between export status and financial constraints. She further shows the number of destinations firms serve and total exports are also negatively related to the level of financial constraints. Firms with better financial health will be able to serve more markets than financially constrained firms. However, the number of product is not related to the level of financial constraints. Muûls (2008) further tests the hypothesis of pecking order of trade, which predicts firms will choose to export to the largest and closest market first[47]. The results confirm that more productive and less financially constrained firms will export to more further away and smaller markets.

Berman and Héricourt (2010) construct a cross-country firm level dataset containing 5000 firms from 9 developing and emerging economies between 1998 and 2004 to examine how financial factors affect firm's export decisions and the amount exported by firms. As firms from developing

[46] The Coface score is constructed as a bankruptcy risk measure with information that banks use when making lending decision.

countries and emerging economies are more financially constrained, this dataset is particularly suitable for the empirical study related to financial constraints. They used the ratio of total debt over total assets and cash flow over total assets to proxy for the level of financial constraints and use the ratio of private credit over GDP to proxy the level of financial development of each country. The result indicates financial constraint is an important impact on firms export participation decision. Once firms become exporters, financial factors no longer have any impact on the probability to remain an exporter or on the intensity margin of export. A more interesting result provided by Berman and Héricourt (2010) is that financial constraints might create a disconnection between firms' productivity and export participation. When firms are financially constrained, productivity is no longer a significant determinant of the export decision. The importance of productivity will increase as the level of financial constraints decrease. This result could shed some lights on some earlier empirical studies that find no role of productivity on the export participation decision. This paper also provides firm level evidence that financial development helps to reduce the level of financial constraints, hence increasing the number of firms participate in export market.

Zia (2008) employs an unique loan-level dataset from the textile sector in Pakistan between 1998 and 2003. This data allows him to assess the impact of an exogenous change of credit availability due to the removal of a subsidized export credit in the Pakistan textile sector on export growth. He finds a significant heterogeneous result across different types of firms. Exports of financially unconstrained firms such as large, public listed and group affiliated firms are not affected by the removal of the subsidize export credit, but the export of private firms are significantly affected. The estimated reduction is also economically significant, where a 6% change in the market lending base due to the removal of subsidy leads to a 29% reduction in firm exports. This result reemphasizes the significant impact of financial constraints on export behavior. Moreover, Zia (2008) also find significant misallocation in subsidized export credit. This call for a more careful design of export support policies.

A recent study by Li and Yu (2009) use a large panel data of Chinese manufacturing firms for the period 2000-2007 to examine the impact of financial constraints on firms' export decisions. They use interest expenditures as an index of firms' capability to obtain loans. The results show that interest expenditure is an import determinant of the export decisions and the intensity of export. Moreover, foreign owned firms are more likely to export and export higher volumes than domestic owned firms. The export decision and the export intensity of foreign owned firms and state owned firms are less sensitive to interest expenditures. They explain this as the result of easier access to finance for these types of firms.

In general, the empirical results consistently confirm the important role of financial factors on firms' export participation decisions. However, different results are found in terms of weather there are *ex ante* or *ex post* benefit of financial health for export participation. The role of financial factors on firms' export intensity is also controversial. The literature suggests a possible interaction between productivity and financial factors. When firms face significant financial constraints, financial factors play a dominant role in export participation determination over productivity. As the financial health of firms improve, the role of productivity increases.

In this study, we use a large firm level panel data of manufacturing firms from China to study the relationship between financial constraints and exports. We aim to provide additional empirical evidence of the relationship between financial factors and exports in China. In particular, we focus on the impacts of financial constraints on the extensive margin of exports in the institutional context of China. We explore whether the effects of financial constraints different across different ownership groups.

5.4 Data and Key variables

5.4.1 The dataset

The data used in this study is a large census firm-level panel dataset produced by the National Bureau of Statistics of China (NBS). It is a survey of industrial firms conducted by NBS annually. This dataset includes all "above scale" industrial firms with sales over RMB 5 million[48]. One unique advantage of this dataset is that it includes all the state-owned enterprises (SOEs) in China. There are around 1,805,803 observations for 541,436 firms for the period between 2000 and 2007 from 31 provinces operating in 49 different two-digits manufacturing industries. The dataset starts initially with 149,606 observations in 2000 and quickly increases to 327,038 observations in 2007. This increase in coverage is largely due to the rapid growth in firm sales and firms becoming "above scale". The dataset includes all the key variables from

[48] This is equivalent to around $750,000 USD at the exchange rate of 1USD=6.6RMB.

the financial statements, measures of output, intermediate outputs, and political affiliation information. Furthermore, the data of ownership share is also included. This allows us to allocate firms into four different ownership groups: state owned enterprise (SOEs), foreign owned enterprise (FOEs), private owned enterprises (POEs) and collective owned enterprises (COEs)[49]. We use the same rules used in chapter 3 and chapter 4 to classify ownership groups. Firms are allocated into one of the four ownership groups based on the majority average ownership share[50]. For instance, a firm is classified as state owned enterprise, if the state's share of the average paid-in capital of the firm is at least 50%. The average ownership share is calculated on the basis of the fraction of capital paid in by different ownership groups in each year.

Since 1995, the NBS has used this data to compile the "Industry" section of the China Statistical Yearbook. As the data are directly collected by NBS, the dataset should be more reliable than data collected by local governments as there is no clear incentive for firm to provide false information (Cai and Liu 2009). Despite its reliability, Cai and Liu (2009) and Jefferson *et al* (2008), who use the same dataset from 2000 to 2005 to study tax evasion incentives and productivity growth respectively, point out that the data is noisy with some firms reporting abnormally large or small values for certain variables.

We clean the data and reduce outliers by the following rules: 1) the key variables, such as sales, total assets, fixed assets cannot be missing or negative; 2) the variables for export cannot be missing; 3) the total assets must be higher than liquid assets; 4) the leverage ratio cannot be less than zero; 5) we also

[49] They are also known as mixed-ownership firms or joint stock companies.
[50] See Dollar and Wei(2007) and Guariglia and Liu (2010) for similar approach.

delete the observations in the 0.5 percentile tails of each regression variables to control for outliers in the regression. This allows us to eliminate observations that might be involved in large mergers, coding errors, and special shocks to the firms. Moreover, we also delete observations with fewer than 10 employees. This is because very small firms are typically more likely to create errors in their reported financial information. Levinsohn and Petrin (2003) use a similar criterion in their study of Chilean plants where they include only firms with at least 10 workers. Using a similar dataset, Jefferson *et al* (2008)exclude firms with fewer than 8 employees in their study of productivity growth in China.

After following these strict criteria to clean the data, we have an unbalanced panel data with 1,755,477 observations for 531,700 firms spanning between 2000 and 2007. The details of the unbalanced panel are presented in appendix 5A3. The number of firms included in the data each year increases steadily over the study period from 144,502 firms in 2000 to 318,341 firms in 2007. Furthermore, there are a large number of new firms in the data. According to table 5A3.1 in the appendix, 57.91% of the firms included in our database have less than 3 observations.

5.4.2 Trends in Export at firm level data in China

27.04% of observations have positive exports in our cleaned sample between 2000 and 2007. The percentage of exporter is relatively low compared to those studies based on developed countries. In Bellone *et al* (2010) and Greenaway *et al* (2007), the number of observations that are exporter is well above 50% in France and UK respectively.

In order to have a glance of the export status of Chinese firms in our sample we differentiate the export status into four categories: 1) Starters are firms that did not export in last period (*t-1*), but export in the current period (*t)*; 2) Continuous exporters are firms that exporting in current and all previous periods; 3) Leavers are firms that exported in the previous periods but stopped exporting; 4) Non-exporters.

The percentage of firms in different categories for the full sample of each year between 2001 and 2007 is presented in table 5.1a. Due to the fact the sample starts from 2000, we report the results from year 2001 onwards. The number of starter increases steadily from 8.96% in 2001 to a peak level of 15.47% in the 2004, and declines to 5.22% in 2007. This is consistent with the idea that China's entry to WTO has encouraged firms to start exporting. However, there is a large number firms (70.29%) have never export in the study period

Table 5.1b-5.1e reports the detailed export status for each of our four ownership groups. We find striking heterogeneity in the export status and export transition dynamics across ownership groups. The number of firms that start to export is significantly lower for state owned enterprises and collective owned enterprises than for private owned firms and foreign owned firms. Only 4.91% of the state-owned firm years and 4.05% of collectively owned firms are classified as starter, while starter observations for foreign firms and private firms accounted for 20.39% and 8.21% respectively. A large number of firms start to export in year 2004 and 2005, the corresponding percentage for starters for SOEs, POEs, Privately owned firms and foreign owned firms in 2004 are 4.25%, 4.8%, 12.54% and 34.42% respectively. This is likely to be the lagged effects of China's entry to WTO in late 2001[51]. Foreign owned firms have the highest number of continuous exporters. State owned enterprise and collective owned enterprises have the lowest amount of continuous exporters with 8.02% and 7.73% respectively compared to 47.19% for foreign owned firms. The percentage of continuous exporters for privately owned firms is 13.04%. This result indicates that foreign owned firms are more export oriented and set up with the objective to export.

Moreover, there are around 84% of firm-years of state owned enterprises never export. Collectively owned enterprises and privately owned firms also display high percentage of firm-years that never export with 84.67% and 76.15%, respectively. Yet, the percentage of firm-years that never export for foreign owned enterprises is only 28.46%.

Table 5.1f presents the aggregate export status for the full sample and each of the four ownership groups. *Expdum* is a dummy equal to 1 if the firm reports a positive amount of exports in the year t and equal zero if the firm reports no export in the given year. There are 27.04% of firm-years are exporter between 2000 and 2007 in our sample. Consistent with our analysis above, foreign owned firms have the highest number of firm years classified as exporters. 67.59% of foreign owned firm years are exporters, compare to only 12.94 % and 13.57% for state owned enterprise and collective owned enterprises. The percentage of exporting firm-years for privately owned firms is 21.25%. Table 2f also shows a steady increase of the percentage of exporters

[51] It typically take two to three years for China to start the actual sales in the international market, this could explain why the number of firms start to export peaked in 2004.

between 2000 and 2005, but the percentage of firm years classified as exporter start to decline from 2006 for all ownership groups, except for SOEs.

Year	Starter	Continuous Exporter	Exit	Never export	Total
2001	8.96	17.03	2.18	71.84	100.00
2002	7.81	19.07	2.37	70.75	100.00
2003	7.85	19.77	2.07	70.32	100.00
2004	15.47	14.39	1.74	68.9	100.00
2005	7.51	21.56	4.70	66.23	100.00
2006	6.17	21.23	2.80	69.8	100.00
2007	5.22	19.14	3.62	72.06	100.00
Total	9.61	17.43	2.67	70.29	100.00

Table 5.1a: Export status for the full sample. All numbers reported are percentage.

Year	Starter	Continuous Exporter	Exit	Never export	Total
2001	2.58	9.04	1.89	86.47	100
2002	2.49	9.25	1.93	86.33	100
2003	2.14	10.68	1.72	85.46	100
2004	4.25	8.49	1.97	85.29	100
2005	5.2	11.01	2.39	81.4	100
2006	2.67	13.13	2.5	81.71	100
2007	2.37	13.59	3.94	80.1	100
Total	4.91	8.02	1.69	85.38	100

Table 5.1b: Export status for State owned firms (SOEs). All numbers reported are percentage.

Year	Starter	Continuous Exporter	Exit	Never export	Total
2001	18.63	49.2	4.1	28.07	100
2002	15.53	51.64	4.4	28.44	100
2003	16.89	50.46	3.06	29.5	100
2004	34.42	38.49	2.1	24.99	100
2005	9.49	57.52	8.18	24.81	100
2006	11.89	54.37	4.12	29.62	100
2007	12.43	52.41	3.55	31.62	100
Total	20.39	47.19	3.96	28.46	100

Table 5.1c: Export status for Foreign owned firms (FOEs). All numbers reported are percentage

	Starter	Continuous Exporter	Exit	Never export	Total
2001	9.91	12.72	1.8	75.57	100
2002	8.22	14.98	2.07	74.37	100
2003	7.52	15.08	1.95	75.45	100
2004	12.54	10.05	1.61	75.8	100
2005	7.27	15.3	4.23	73.2	100
2006	5.38	15.5	2.57	76.55	100
2007	4.1	13.29	3.58	79.03	100
Total	8.21	13.04	2.6	76.15	100

Table 5.1d: Export status for Private owned firms (POEs). All numbers reported are percentage.

	Starter	Continuous Exporter	Exit	Never export	Total
2001	4.05	10.16	1.72	84.07	100
2002	3.38	10.63	1.91	84.08	100
2003	2.53	10.89	1.58	84.99	100
2004	4.8	7.16	1.89	86.15	100
2005	6.82	8.52	2.56	82.1	100
2006	2.25	10.24	2.5	85.01	100
2007	1.42	7.66	3.58	87.34	100
Total	5.84	7.73	1.76	84.67	100

Table 5.1e: Export status for Collective owned firms (COEs). All numbers reported are percentage.

	Full Sample		SOEs		FOEs		POEs		COEs	
Year	*Expdum=0*	*Expdum=1*	*Expdum=0*	*Expdum=1*	*Expdum=0*	*Expdum=1*	*Expdum=0*	*Expdum=1*	*Expdum=0*	*Expdum=1*
2000	74.83	25.17	88.09	11.91	31.98	68.02	77.32	22.68	84.36	15.64
2001	74.01	25.99	88.37	11.63	32.17	67.83	77.36	22.64	85.79	14.21
2002	73.12	26.88	88.26	11.74	32.83	67.17	76.8	23.2	85.98	14.02
2003	72.39	27.61	87.18	12.82	32.56	67.44	77.4	22.6	86.58	13.42
2004	70.64	29.36	87.27	12.73	27.09	72.91	77.41	22.59	88.04	11.96
2005	70.93	29.07	83.79	16.21	32.98	67.02	77.43	22.57	84.66	15.34
2006	72.6	27.4	84.2	15.8	33.74	66.26	79.12	20.88	87.51	12.49
2007	75.68	24.32	84.05	15.95	35.16	64.84	82.61	17.39	90.92	9.08
Total	72.96	27.04	87.06	12.94	32.41	67.59	78.75	21.25	86.43	13.57

Table 5.1f: Export and Non-Export for full sample and different ownerships. All numbers reported are percentage.

5.4.3 Key Empirical variables:

5.4.3.1 Measures of financial constraints

In the empirical literature a number of different financial ratios are used to proxy for the level of financial constraints. In this paper, we use two different financial variables widely used in previous studies, to conduct our empirical analysis. This makes our results more comparable with previous studies. After controlling for all other important factors, if financial factors are still important determinants of export decisions, then we can conclude that financial constraints are an important determinant of export decisions.

The first measure of financial constraints is leverage, which is defined as the ratio of total debt over total assets. Leverage ratios is used by Bridges and Guariglia (2008), Greenaway *et al* (2007), Bellone *et al* (2010) and Berman and Héricourt (2010) to study the relationship between financial constraint and export decision. Leverage ratio generally turns out to be a significant impact of export decisions. There are two main interpretations for the leverage ratio. First, it is a measure of firms' indebtedness. A high leverage ratio indicates a firm has taken up too much debt, therefore the firm has limited amount of assets to pledge as collateral for extra external finance. A high leverage ratio reflects a deterioration of the firm's balance sheet; increasing the possibility of moral hazard and adverse selection problems. This would prevent firms from obtaining the finance needed for exporting. Therefore, leverage is expected to be negatively related to export participation. Firms with high leverage are less likely to start exporting as they are unable to obtain enough external finance to overcome the fixed costs of export. Second, in the context of China, a high leverage could indicate firm's ability to obtain finance. Due to the significant lending bias and less developed financial market, firms with high leverage could have superior ability to obtain external finance to overcome the fixed cost hurdle of export. If this is the case, export decisions and leverage ratio would be positively related. Therefore, the true relationship should be revealed by the empirical analysis.

The second measure of financial constraints is the liquidity ratio, which is defined as the differences of the firm's total current assets and current liabilities over total assets. In general, liquidity ratio is a measure of financial health. Firms with a high level of liquid assets are considered less risky by creditors and lenders, because the liquid assets provides additional buffer to the creditors and lenders. A higher liquidity ratio indicates the firm is in a better financial health; hence less likely to be financially constrained. They will have easier access to short terms finance. We expect export decisions to be positively related to the liquidity ratio. Firms in better financial health are more likely to be able to have enough funds to pay for the sunk costs of export. This ratio is also the main financial ratio used by Greenaway *et al* (2007), Bellone *et al* (2010). They found consistent evidence that export is positively related to liquidity for firms in the UK and France.

5.4.3.2 Measures of productivity

As discussed in section two, from a theoretical point of view, only the most productive firms would self-select themselves into the export markets. The literatures argues that a high productivity level allows firms to overcome sunk costs and start to export (see Clerides *et al* (1998) and Melitz (2003)). Bernard and Jensen (1999) use both a labor productivity measure and a Total Factor Productivity (TFP) measure show that there is significant difference in productivity between exporters and non-exporters. They further argue that productivity is positively related to firms' export participation decisions. Bernard and Jensen (2004) provide further evidence supporting similar conclusions. These studies indicate that productivity is an important determinant of export decisions. Therefore, properly controlling for the heterogeneity of productivity is crucial for our analysis of the impact of financial factors on exports.

Following Bernard and Jensen (1999), our study uses both labor productivity and total factor productivity calculated using the Levinsohn and Petrin (2003) method as key control measures of productivity for the analysis. The labor productivity is defined as the ratio of real sales to number of employees, where sales is deflated by the provincial level GDP deflator. Labor productivity is used in Bernard and Jensen (1999)and Berman and Héricourt (2010) as the main control variable for productivity.

The standard approach of estimating the TFP (total factor productivity) is by estimating a production function and generating predicted output from the estimation. The residual of the actual and predicted output is retained as the measure of firm level total factor productivity. However, traditional methods of estimation such as OLS suffer from a number of methodological issues such as simultaneity or endogeneity problems, where firms input decisions may be closely related to its level of productivity and so is the product choice (Ilke Van 2007). Olley and Pakes (1996)and Levinsohn and Petrin (2003) propose to use a semiparametric estimator with investment or intermediate inputs as proxy variables to substitute for unobserved productivity in the estimation of production function in their study to address the endogeneity and selection bias problems. Essentially, Olley and Pakes (1996) and Levinsohn and Petrin (2003) approaches are similar with the exception of the choice for proxies. Olley and Pakes (1996) approach relies on positive investment in the estimation, observations with negative level of investment will be dropped from the estimation causing significant reduction in the estimation efficiency, while Levinsohn and Petrin's (2003) approach only requires the presence of positive level of intermediate inputs. About 25% of firm observations in our dataset have a negative level of investment, which indicate that Olley and Pakes's (1996) approach is not a suitable estimator of TFP for this study. We therefore estimate TFP using the Levinsohn and Petrin (2003) approach for each of the 10 2-digit industries independently to allow for technological heterogeneity across different industry sectors. This produces consistent firm level TFP measures for the empirical analysis[52].

5.4.3.3 Other Control Variables

[52] A brief illustration of the Levinsohn and Petrin (2003) approach of TFP estimation is provided in the appendix 5B of this chapter.

As suggest by the trade literatures firms' export decisions are likely to be determined by a number of other factors. Bernard and Jensen (2004) and Greenaway and Kneller (2007) show that exporters are generally more productive, bigger in total assets, have more employees, older and more capital intensive. Moreover, firms with foreign ownership, firms with subsidiaries and part of a business group or consortium are more likely to participate in the export markets. We include the natural log of the number of employees as a control for firm size. Capital intensity is controlled for by the ratio of real fixed assets to number of employees. The empirical literature shows that firms with high capital intensity are more likely to export. Age is also included as an control variables, as older firms have higher learning ability and more established structure helps them to compete in the global market place.

Due to the Chinese institutional setting and the political pecking order, we also include ownership dummies to control for ownership status. Firms are classified into state owned enterprise (SOEs), foreign owned enterprise (FOEs), private owned enterprises (POEs) and collective owned enterprises (COEs). The classification is based on the average share of paid in capital, e.g. if 50% of a firm's average share is owned by foreigner then the firm is classified as foreign owned. The same rules apply to the other three ownership groups. As the average share of paid in capital is used to identify firm ownership, firm ownership types do not vary over the time. The ownership types for firms are fixed for the sample period.

Furthermore, earlier studies indicate that regions in China have significant differences in terms of infrastructure, institutions, level of financial developments and special policy. We generate geographical dummy variables to indicate which region the firm locates in. We divide firms into three regions: the coastal regions, the central regions and the west region[53]. Last, we also include industrial sector dummies to control for sectorial fixed effects. Annual time dummies are also included as a control for common trends and business cycle effects faced by firms.

5.4.4 Descriptive statistics

Table 5.2a-5.2b presents descriptive statistics for the key regression variables used in our empirical study, as well as for some variables related to firm characteristics. We report the descriptive statistics for each of the four ownership groups and the full sample in table 5.2a. In table.5.2b, we further differentiating firms between exporters and non-exporters. *Expdum* equals to 1 if a firm exports, and equal to 0 otherwise. Column (3), (6), (9) and (12) of table 5.2b reports the *p-values* of the test statistics for the equality of the means of each variable between exporters and non-exporters.

Column (1) of table 5.2a reports the descriptive statistics for the full samples. An average firm in our sample has real annual total sales of 79.3 million *yuan* RMB, and real total assets of 72.9 million *yuan* RMB. The average number of employees for the full sample is 271 and the average age of firms is 8.9. This reflects the fact that Chinese firms are still relatively young compared to firms in other studies based on developed countries, the average age for UK firms in their sample is 27.7 years old, e.g. in *Greenaway (2007)*. The export

[53] The details of allocation of provinces into the three regions are provided in the appendix 5A2.

ratio, which is defined as the total exports divided by total sales, is only 17.5% for the full sample. The cash flow to total assets ratio is 9.62%. The return on assets, which is defined as net income divided by total assets, is only 6.4% for the full sample.

Column (2)-(5) of table 5.2a reports the descriptive statistics across the four ownership groups. The state owned enterprises (SOEs) and foreign owned enterprises (FOEs) are much larger than privately owned enterprises (POEs) and collectively owned enterprises (COEs) in terms of real sales, real total assets and the number of employees. Moreover, SOEs and COEs are much older than POEs and FOEs. The corresponding age for SOEs, FOEs, POEs and COEs are 25.62, 6.627, 6.884 and 14.74. The export ratio, which is defined as total exports divided by total sales, is the highest for FOEs with 50.2%. The export ratio for SOEs, POEs and COEs are 6.56%, 12.7% and 8.15%. These results reflect that FOEs are more export oriented, while SOEs and COEs are less export oriented.

Mover to measures of financial health, table 5.2a shows that SOEs and COEs have much higher leverage ratio than FOEs and POEs. The liquidity ratio is negative for SOEs of -0.0795, while the liquidity ratios for FOEs, POEs, and COEs are 0.146, 0.0552 and 0.068. Furthermore, SOEs have the lowest cash flow ratio and return assets compare to other ownership groups.

Table 5.2b differentiating firms into exporters and non-exporters across the four ownership groups and compare their firm characteristics. The results indicate that exporters are much larger than non-exporters across all ownership groups. For example, for SOEs, the real total sales and real total assets of exporters are about 10 times higher than non-exporters. Moreover, exporters tend to employ more employees than non-exporters. Exporters are also older than their counter part. Based on TFP calculated by Levinsohn and Petrin (2003) methods, exporters are more productive than non-exporters across all ownership groups. This result is consistent with the trade literature, which suggests that only the most productive firms' export. Yet, the patterns are less clear cut for labour productivity measure, where for FOEs, POEs and COEs exporters are less productive than non-exporters.

In terms of financial measures, the POEs' and COEs' exporters have higher leverage ratios than non-exporters, while FOEs' exporters have lower leverage ratios. The mean leverage is not statistically different between exporters and non-exporters for SOEs. Table 5.2b further indicates that exporters of POEs and COEs have lower liquidity ratios than non-exporters, while exporters of SOEs and FOEs are in better liquidity position than non-exporters. Last, exporters appear to have lower cash flow ratio and return on assets than non-exporters for FOEs, POEs, and COEs, while exporters of SOEs have higher cash flow ratio and return on assets than non-exporters.

The *p-value* of the tests, of the equality of mean between exporters and non-exporters for each variable, suggests that exporters and non-exporters' characteristics are significantly different. In next section, we will formally test the relationship between financial factors and firms' export status.

	Full sample	*SOEs*	*FOEs*	*POEs*	*COEs*
	(1)	(2)	(3)	(4)	(5)
Real sales	79276.8	158641.3	136422.4	58816.4	43098.4
	(1192395.3)	(1886189.2)	(1569826.6)	(1049514.4)	(314779.8)
Real assets	72979.1	240806.0	102741.9	48988.7	32818.9
	(665740.9)	(1852151.1)	(481886.1)	(408372.0)	(207076.1)
Number of employee	271.1	753.8	351.5	200.5	227.6
	(1331.9)	(4018.1)	(946.9)	(715.8)	(569.4)
Age	8.907	25.62	6.627	6.884	14.74
	(10.51)	(17.62)	(4.294)	(8.278)	(11.49)
Capital Intensity	89.09	107.5	140.9	78.31	57.19
	(269.4)	(261.8)	(409.4)	(225.2)	(114.1)
Ln(employee)	4.758	5.187	5.123	4.614	4.786
	(1.111)	(1.499)	(1.134)	(1.024)	(1.035)
Ln(TFP)-LP	6.262	5.350	6.637	6.318	5.925
	(1.396)	(2.085)	(1.368)	(1.226)	(1.513)
Ln(Laboru Productivity)	5.127	3.979	5.339	5.245	4.887
	(1.141)	(1.478)	(1.118)	(1.005)	(1.175)
Export Ratio	0.175	0.0656	0.502	0.127	0.0815
	(2.096)	(7.026)	(0.634)	(0.934)	(0.323)
Leverage	0.577	0.706	0.498	0.575	0.608
	(0.283)	(0.329)	(0.269)	(0.271)	(0.295)
Liquidity	0.0594	-0.0795	0.146	0.0552	0.0680
	(0.302)	(0.335)	(0.292)	(0.291)	(0.314)
Collateral	34.86	42.64	30.82	35.01	34.04
	(22.27)	(23.12)	(22.31)	(21.95)	(22.14)
Cash flow/Assets	0.0962	0.0253	0.0871	0.106	0.107
	(0.145)	(0.0906)	(0.128)	(0.149)	(0.165)
Return on Assets	0.0644	0.000433	0.0499	0.0738	0.0780
	(0.137)	(0.0803)	(0.123)	(0.140)	(0.157)
Number of Observations	1755463	132434	255053	1162270	141660

Table 5.2a: Descriptive statistics. This table reports the sample mean and standard deviations (in bracket) for different ownership groups. Real sales, real assets are total sales and total assets deflated by provincial level GDP deflator. They are in 1,000s of *yuan* RMB. Age is the number of years firm has established. Capital intensity is defined as real fixed assets divided by number of employees. Ln(employee) is the natural log of number of employees. Ln(TFP)-LP is the natural log of total factor productivity calculated using Levinsohn & Petrin (2003) method. Ln(Labour productivity) is the natural log of labour productivity. Export ratio is defined as total exports/total sales. Leverage is defined as total debt divided by total assets. Liquidity is defined as (current assets-current liabilities)/total assets. Collateral is defined as tangible fixed assets/total assets. Collateral is reported in percentage. Cash flow/Assets is defined as cash flow over total assets.

	SOEs			FOEs			POEs	
	Expdum=0	*Expdum=1*	*Diff*	*Expdum=0*	*Expdum=1*	*Diff*	*Expdum=0*	*Expdum=1*
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Real sales	73587.1	731150.7	0.00	94157.4	156693.3	0.00	44412.0	112185.2
	(709701.7)	(4872320.1)		(2093735.8)	(1241993.6)		(1074829.3)	(947955.4)
Real assets	121416.5	1044430.6	0.00	79448.7	113913.7	0.00	34125.0	104059.2
	(854621.0)	(4567752.1)		(270365.1)	(555107.9)		(194221.2)	(800648.1)
Number of employee	482.1	2583.1	0.00	201.4	423.5	0.00	156.0	365.5
	(2745.6)	(8380.9)		(484.4)	(1094.6)		(437.5)	(1291.1)
Age	25.11	29.17	0.00	5.884	6.982	0.00	6.591	8.021
	(17.11)	(20.44)		(4.207)	(4.290)		(7.868)	(9.619)
Capital Intensity	103.1	137.2	0.00	185.2	119.6	0.00	81.77	65.52
	(257.1)	(289.6)		(533.2)	(332.0)		(237.9)	(169.5)
Ln(employee)	4.983	6.557	0.00	4.699	5.327	0.00	4.482	5.105
	(1.381)	(1.537)		(1.032)	(1.124)		(0.960)	(1.099)
Ln(TFP)-LP	5.132	6.766	0.00	6.569	6.670	0.00	6.263	6.520
	(2.017)	(1.966)		(1.368)	(1.367)		(1.222)	(1.216)
Ln(Labour Productivity)	3.884	4.621	0.00	5.568	5.229	0.00	5.274	5.137
	(1.488)	(1.235)		(1.124)	(1.099)		(1.025)	(0.921)
Export Ratio	0	0.507	0.00	0	0.743	0.00	0	0.596
	(0)	(19.53)		(0)	(0.645)		(0)	(1.956)
Leverage	0.707	0.700	0.20	0.501	0.496	0.0012	0.567	0.606
	(0.335)	(0.282)		(0.272)	(0.268)		(0.277)	(0.246)
Liquidity	-0.0844	-0.0465	0.00	0.139	0.150	0.00	0.0569	0.0489
	(0.342)	(0.283)		(0.303)	(0.287)		(0.295)	(0.275)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Collateral	43.31	38.10	0.00	31.56	30.46	0.00	36.22	30.53	0.00	34.36	31.98	0.00
	(23.65)	(18.59)		(28.06)	(18.94)		(22.63)	(18.56)		(22.49)	(19.64)	
Cash flow/Assets	0.0247	0.0289	0.00	0.0914	0.0850	0.00	0.109	0.0944	0.00	0.109	0.0945	0.00
	(0.0929)	(0.0732)		(0.135)	(0.124)		(0.154)	(0.130)		(0.167)	(0.154)	
Return on Assets	-0.0000205	0.00348	0.00	0.0563	0.0468	0.00	0.0761	0.0652	0.00	0.0799	0.0658	0.00
	(0.0824)	(0.0645)		(0.129)	(0.119)		(0.144)	(0.124)		(0.159)	(0.145)	
Number of Observations	115304	17130		82675	172378		915243	247027		122442	19218	

Table 5.2b: Descriptive statistics: exporters v.s. non-exporters. This table reports the sample mean and standard deviations (in bracket) for different ownership groups. Real sales, real assets are total sales and total assets deflated by provincial level GDP deflator. They are in 1,000s of *yuan* RMB. Age is the number of years firm has established. Capital intensity is defined as real fixed assets divided by number of employees. Ln(employee) is the natural log of number of employees. Ln(TFP)-LP is the natural log of total factor productivity calculated using Levinsohn & Petrin (2003) method. Ln(Labour productivity) is the natural log of labour productivity. Export ratio is defined as total exports/total sales. Leverage is defined as total debt divided by total assets. Liquidity is defined as (current assets-current liabilities)/total assets. Collateral is defined as tangible fixed assets/total assets. Collateral is reported in percentage. Cash flow/Assets is defined as cash flow over total assets. *Diff*: is the *p-value* of the test statistics for the equality of the means of each variable between exporter and non-exporter. *Expdum=1 if the firm exports, Expdum=0 otherwise.*

5.5 Empirical models and Results

5.5.1 Extensive Margin of Export: baseline specification

The firm's empirical model that we estimate focused on testing the influences of different financial factors on firms' decision to export. Given the richness of the panel dataset, we utilize both the cross-sectional and the time-series dimension of the dataset with a focus on how firm heterogeneity affects firms export decision. We not only want to examine the impact of financial factors on firms export decisions, but also explore whether financial factors have a differential impact on the export decisions due to different firm characteristics such as ownership status, location of the firms and different level of political affiliation.

Closely, following the works by *Roberts and Tybout* (1997), *Bernard and Wagner* (2001) and *Greenaway* (2007), we test the relationship between export participation and financial factors with a reduced form model of the following type:

$$\begin{aligned} Expdum_{i,t} &= b_0 + b_2 Size_{i,(t\text{-}1)} + b_3 TFP_{i,(t\text{-}1)} / LP_{i,(t-1)} + b_4 Liquidity_{i,(t\text{-}1)} / Leverage_{i,(t\text{-}1)} \\ &+ b_5 Control + industry\, dummies + time\, dummies + \varepsilon_{i,t} \end{aligned} \tag{1}$$

Expdum is a dummy variable equals to *1* if firm *i* exports in year *t*, and equals to 0 otherwise. *Size* is measured by the natural log of the number of employees. In general, larger firms tend to have a higher probability to export. *TFP* and *LP* are respectively the natural log of total factor productivities and the natural log of labour productivities.[54]. We expect productivity is positively related to export decisions. *Liquidity and Leverage* are the measures of financial health of firms. They are the focus of our empirical analysis. We expect liquidity is positively related to the extensive margins of exports, while leverage is negatively related to the extensive margins of exports.

Control is a vector of control variables including ownership, region, capital intensity, wage rate. We expect foreign ownership dummy has a positive impact on firms' export decisions, while state and collective owned firms dummy have negative impact on firms' export decisions. Moreover, it is expected firms located in the western region are less likely to be export. Therefore we expect dummy variables for this region is negatively related to export decisions, while the coastal and central regions dummy variables are positively related to the export decisions. Capital intensity reflects the sophistication of the exporting products. It is commonly accepted that exports in China are more labour intensive. Therefore, we expect capital intensity would be negatively related to export decisions. Moreover, we expect firms' age is positively related to export decisions, as older firms are typically larger, with longer track record and more likely to export. We include different sets of control variables in our empirical regressions to test the robustness and consistency of our empirical results. We also include industry dummies to control sectorial fixed effects. The annual time dummies are included to control for the business cycle effects.

[54] The details of *TFP* and *LP* are discussed in section 5.4.3.2.

Using contemporaneous variables in cross-sectional estimation could create an endogeneity problem that leads to inconsistent results. Therefore, all the explanatory variables, except the time invariant variables, in equation *(1)* are lagged once (see *Roberts and Tybout* (1997), *Bernard and Wagner* (2001), *Bernard and Jensen* (1999, 2004), Greenaway *et al* (2007) for a similar approach). Since the export decision is a long term decision, planning and implementing the decision takes time. The lagged independent variables also allow for a time lag between the financial health, firm characteristics, and firms' export decisions. All the variables in equation (1) are measured in logs, except dummy variables.

Essentially, equation *(1)* is a probability response model with the export status as the dependent variable. We want to determine how the probability *P(Expdum=1)* is related to different firm characteristics and financial variables.

5.5.2 Empirical results on Extensive Margin of Export for full sample

In this section we present our regression results for our baseline specification. We estimate the baseline specifications with the pooled probit estimator and random effects probit estimator for two reasons. First, this exercise allows us to experiment with two estimators for our study, which we subsequently able to choose one of them as our main regression method to further conduct our empirical study. Second, it also provides us a robustness test for our results.

Equation *(1)* is first estimated with a pooled probit estimator for the full sample. The estimates of equation *(1)* with liquidity as measure of financial constraints are reported in table 5.3. The pooled probit estimator is corrected for clustering at firm level. This allows the observations to be independent between firms, but with the possibility of being interdependent within firms. Column (1) and (2) are the benchmark regressions with control variables for size, ownership and productivity, time dummies and industry dummies only. As productivity has been identified as one of the most important determinants for export, we use two different measures of productivity, namely labour productivity and total factor productivity, to test the robustness of our results. We also control for ownership with ownership dummies for state, foreign and collective ownership. The private ownership dummy is the omitted reference group. The results in column (1) and column (2) of table 5.3 indicate the size control variable is positive and highly significant. This indicates that larger firms are more likely to export than smaller firms. The coefficients on ownership dummies suggest that foreign owned firms are much more likely to export than private owned firms. This reflects the export oriented objectives of foreign firms. On the other hand, the coefficients for state and collective dummies are negative and significant, which suggests that these firms are more inward oriented and are less likely to participate in the export markets. Base on the size of the coefficient, state owned firms are least likely to participate in the export markets. The labour productivity and total factor productivity calculated using Levinsohn & Petrin's (2003) method are both positive and significant in column (1) and (2) respectively. The liquidity ratios, the focus of this study, are both positive and highly significant.

The specifications of column (3) and column (4) in table 5.3 include two additional control variables: coastal region and central region. These two variables are dummy variables that indicate firms' geographical locations. The western region is the omitted group. We consider these control variables capturing a number of effects. First, they are measures of trade distance to ports. Leamer and Levinsohn (1995) suggests that distance between regions are an important determinants of the size of trade between regions. The coastal region is closer to ports and enjoys better logistic services and infrastructure than the central and western region. Therefore, firms in coastal region are facing lower trading costs and are more likely to export. Second, a large number of policies to promote international trade, initiated by the governments, focus heavily towards firms located in the coastal region, e.g. setting up special area zones, tax reduction, special policies to attract FDI *etc*. Last, coastal regions enjoy better financial development and higher income than the other two regions. These all suggests that firms located in the coastal region are more likely to export than the inland regions. It is important for us to take this into consideration. The results in column (3) and (4) of table 5.3 confirmed our predictions, where coastal regions are most likely to export follow by the central regions. The west regions are least likely to export. After adding these two additional control variables, the magnitude and sign of all the other control variables display little change, except for productivities. The magnitudes of the productivities are half of those from column (1) and (2), and the coefficient on total factor productivity is now negative. This is in contrast to the prediction that more productive firms are more likely to export. Similar results is found in

Bellone, Musso *et al* (2010) and Greenaway *et al* (2007)[55]. However, the labour productivity measures continue to be positive and highly significant. The coefficients for liquidity ratio are still positive significant with a 10% increase in magnitude.

Last, in column (5) and (6) of table 5.3 we include additional control variables: the natural log of the wage ratio (*Ln (W/L)*), the natural log of firm age (*Ln (Age)*) and the natural log of the capital to labour ratio (*Ln (K/L)*). The wage ratio captures two main effects. First, it provides a measure of productivity, firms with higher labour productivity tend to have higher wage per employee. Second, it is also a reflection of production costs, this is particular relevant for China's context. Exporters in China are mainly involved in labour intensive industry. Higher wage per labour suggests a high production cost. Yet, the wage ratio is positive and insignificant in the regressions.

The age of firm reflects firm's experience in markets. Firms with longer history have better knowledge, distribution channels, and easier access to finance. It is expected that older firms are more likely to export. The results suggest that age is positively related to export, but its magnitude is very small relative to other factors. The capital per labour (*Ln(K/L)*) coefficient is negative and significant. This suggests less capital intensive firms are more likely to export, which is consistent with Chinese special case. China is abundant with low cost labour force, early FDI operate in China to take advantages of China's labour resources and tend to focus on labour intensive industries. Given the three additional control variables, the liquidity ratios is still positive and

[55] The total factor productivity is negative, but insignificant in Greenaway (2007). The total factor is negative and significant in Bellone et al (2010) 's dynamic RE probit specification.

significant, which suggests that firms with higher liquidity are more likely to export in the future period.

Table 5.4 reports the pooled probit regression results with leverage as a measure of financial constraints. A similar approach to the liquidity measure is adapted for leverage. Column (1) and (2) of table 5.4 presents the baseline model with leverage. The size variables are positive and highly significant. Both of the productivity measures are significant with the expected signs. The coefficients of leverage ratios are negative and highly significant. The results are consistent with the theoretical prediction that more financial constrained firms are less likely to export. By adding the regional controls in column (3) and (4), we find similar results to the liquidity regression in table 5.3, the magnitudes of the coefficients for productivity and leverage decrease. The regional dummies confirm the early finding that firms located in the coastal region are more likely to export. Last, older firms and more labour intensive firms are more likely to export. The results remain largely unchanged with additional controls in column (5) and column (6). In sum, the pooled probit analysis for the full sample suggests there is a strong connection between financial factors and export decisions. The results are consistent and robust to those of various specifications with different controls.

	(1)	(2)	(3)	(4)	(5)	(6)
Ln(employee)	0.336***	0.319***	0.353***	0.351***	0.347***	0.350***
	(0.00241)	(0.00254)	(0.00245)	(0.00260)	(0.00287)	(0.00305)
Foreign Owned	1.055***	1.055***	0.981***	0.973***	0.992***	0.982***
	(0.00680)	(0.00685)	(0.00687)	(0.00693)	(0.00755)	(0.00762)
State Owned	-0.531***	-0.549***	-0.440***	-0.445***	-0.472***	-0.479***
	(0.0118)	(0.0119)	(0.0120)	(0.0122)	(0.0156)	(0.0158)
Collective Owned	-0.398***	-0.407***	-0.395***	-0.400***	-0.404***	-0.408***
	(0.0105)	(0.0106)	(0.0106)	(0.0107)	(0.0130)	(0.0132)
Labour Productivity	0.0552***		0.0246***		0.0196***	
	(0.00238)		(0.00243)		(0.00289)	
Ln(TFP)-LP		0.00919***		-0.00495*		-0.0127***
		(0.00209)		(0.00212)		(0.00240)
Liquidity	**0.112*** **	**0.121*** **	**0.124*** **	**0.133*** **	**0.114*** **	**0.128*** **
	(0.00736)	**(0.00747)**	**(0.00741)**	**(0.00752)**	**(0.00856)**	**(0.00864)**
Coastal Region			0.684***	0.695***	0.698***	0.709***
			(0.0106)	(0.0107)	(0.0124)	(0.0124)
Central Region			0.294***	0.297***	0.322***	0.326***
			(0.0116)	(0.0117)	(0.0136)	(0.0137)
Ln(W/L)					0.0000501	0.0000549
					(0.0000444)	(0.0000500)
Ln(Age)					0.000890**	0.00101**
					(0.000331)	(0.000334)
Ln(K/L)					-0.0000647***	-0.0000387**
					(0.0000150)	(0.0000131)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	1172867	1140821	1172867	1140821	870923	846241
Pseudo R-squared	0.199	0.194	0.215	0.211	0.222	0.218

Table 5.3 Pooled probit model with liquidity as measure of financial constraints for the full sample. Dependent variable is binary variable *Expdum*, Standard errors are clustered at firm levels and reported in parenthesis. *,**,***, denote significance at 1%, 5%, and 10% level. State owned, foreign owned and collective owned are dummy variables for ownership. Coastal region and Central region are geographical dummy variables. Private owned firms and western region are the omitted reference groups.

	(1)	(2)	(3)	(4)	(5)	(6)
Ln(employee)	0.340***	0.320***	0.354***	0.348***	0.348***	0.347***
	(0.00242)	(0.00253)	(0.00246)	(0.00259)	(0.00166)	(0.00188)
Foreign Owned	1.054***	1.055***	0.986***	0.980***	0.998***	0.990***
	(0.00679)	(0.00684)	(0.00686)	(0.00692)	(0.00416)	(0.00424)
State Owned	-0.513***	-0.529***	-0.432***	-0.435***	-0.466***	-0.472***
	(0.0119)	(0.0120)	(0.0121)	(0.0122)	(0.00829)	(0.00844)
Collective Owned	-0.392***	-0.400***	-0.390***	-0.395***	-0.400***	-0.404***
	(0.0105)	(0.0106)	(0.0106)	(0.0107)	(0.00715)	(0.00726)
Labour Productivity	0.0572***		0.0279***		0.0227***	
	(0.00239)		(0.00244)		(0.00178)	
Ln(TFP)-LP		0.0133***		0.000814		-0.00695***
		(0.00208)		(0.00211)		(0.00166)
Leverage	**-0.526*** **	**-0.525*** **	**-0.362*** **	**-0.358*** **	**-0.352*** **	**-0.356*** **
	(0.0203)	**(0.0205)**	**(0.0204)**	**(0.0205)**	**(0.0161)**	**(0.0163)**
Coastal Region			0.676***	0.686***	0.690***	0.701***
			(0.0107)	(0.0107)	(0.00662)	(0.00669)
Central Region			0.299***	0.301***	0.327***	0.331***
			(0.0117)	(0.0117)	(0.00762)	(0.00772)
Ln(W/L)					0.0000497	0.0000544
					(0.0000449)	(0.0000503)
Ln(Age)					0.00112***	0.00125***
					(0.000174)	(0.000176)
Ln(K/L)					-0.0000654***	-0.0000406***
					(0.00000949)	(0.00000838)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	1168892	1137038	1168892	1137038	868291	843743
Pseudo R-squared	0.200	0.195	0.214	0.211	0.222	0.218

Table 5.4 Pooled probit model with leverage as measure of financial constraints for the full sample. Dependent variable is binary variable *Expdum*, where *Expdum=1*if firm is exporter, =0 otherwise. Standard errors are clustered at firm levels and reported in parenthesis. *,**,***, denote significance at 1%, 5%, and 10% level.

The results from table 4.1 and 4.2 are estimated with pooled probit with standard error correcting for clustering at firm level. However, this does not control for unobserved heterogeneity. If unobserved heterogeneities are correlated with the regressors, the pooled probit might not yield consistent result. Greenaway *et al* (2007) points out that unobserved heterogeneities typically occur due to unobserved firm-specific effects such as managerial ability, product characteristics, technology, foreign experience, which are important in firms' export decisions. Hence, we further test the relationship between financial constraints and export decision with a Random-effects probit estimator, which controls for unobserved heterogeneity into account.

Table 5.5 reports the random-effects probit result for the full sample. The results in general echo those of the pooled probit regression. Column (1) and Column (2) reports the results for specification with liquidity ratio as measure of financial constraints. The liquidity ratio coefficients are positive and precisely determined. The total factor productivity coefficients are no longer negative. It is now positive and precisely determined as expected. This is possibly due to controlling for unobserved heterogeneity by using the random-effects probit estimator. The rest of the results from column (1) and column (2) from table 5.5 are largely unchanged compared to column (5) and column (6) from table 5.3.

Column (3) and column (4) of table 5.5 report the results with leverage ratio as measure of financial constraints. Again, leverage ratio coefficients are negative and precisely determined. The total factor productivity measure is significant with expected sign. In sum, the random-effects probit model results are consistent with those estimated with pooled probit model. It shows that the cross-sectional estimates did not overestimate the impact of financial factors. The evidences consistently indicate there is a strong relationship between firms' financial health and its export decisions. Firms with higher liquidity or lower leverage are more likely to participate in the export market.

Given the fact that under the random-effects probit model estimation the coefficients for total factor productivity have the correct signs, while the coefficients for total factor productivity have the wrong signs under pooled probit model. The random-effect model is the preferred model for our study. Therefore, from the next section onwards, we will estimate all our subsamples with random-effect probit model.

	(1)	(2)	(3)	(4)
Ln(employee)	0.718***	0.685***	0.718***	0.683***
	(0.00587)	(0.00610)	(0.00586)	(0.00606)
Foreign Owned	2.799***	2.805***	2.804***	2.814***
	(0.0192)	(0.0196)	(0.0192)	(0.0196)
State Owned	-1.148***	-1.208***	-1.156***	-1.216***
	(0.0372)	(0.0381)	(0.0372)	(0.0377)
Collective Owned	-0.982***	-0.977***	-0.981***	-0.975***
	(0.0302)	(0.0306)	(0.0297)	(0.0304)
Labour Productivity	0.0976***		0.0992***	
	(0.00523)		(0.00522)	
Ln(TFP)-LP		0.0205***		0.0242***
		(0.00430)		(0.00426)
Liquidity	**0.105*** **	**0.119*** **		
	(0.0150)	**(0.0154)**		
Leverage			**-0.357*** **	**-0.369*** **
			(0.0410)	**(0.0419)**
Coastal Region	1.835***	1.857***	1.828***	1.849***
	(0.0276)	(0.0284)	(0.0275)	(0.0285)
Central Region	1.030***	1.030***	1.035***	1.035***
	(0.0302)	(0.0311)	(0.0303)	(0.0313)
Ln(W/L)	0.0000226	0.0000241	0.0000217	0.0000233
	(0.0000161)	(0.0000159)	(0.0000161)	(0.0000160)
Ln(Age)	0.00861***	0.00922***	0.00898***	0.00959***
	(0.000762)	(0.000775)	(0.000757)	(0.000758)
Ln(K/L)	0.0000279	0.0000705***	0.0000266	0.0000690***
	(0.0000171)	(0.0000159)	(0.0000169)	(0.0000163)
Time Dummies	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes
N	870923	846241	868291	843743
Rho	0.861	0.862	0.861	0.862

Table 5.5 Random-effects probit model with liquidity/leverage as measures of financial constraints for full sample. Dependent variable is binary variable *Expdum*, where *Expdum=1*if firm is exporter, =0 otherwise. Standard errors are reported in parenthesis. *,**,***, denote significance at 1%, 5%, and 10% level. State owned, foreign owned and collective owned are dummy variables for ownership. Coastal region and Central region are geographical dummy variables. Private owned firms and western region are the omitted reference group.

5.5.3 Heterogeneous effect across ownership

One of the most noticeable institutional arrangements of Chinese economy is its firm ownership structure. In the early years, the Chinese economy was dominated entirely by state owned enterprises (SOEs). Every industry was supervised by agencies of the central government. The transformation of ownership structure was initiated by a gradual decentralization which took place by shifting responsibilities from the central government and agencies to local governments. The central government subsequently opened consumer markets and industrial markets for competition. The opening of markets gave incentives to set up private owned enterprises (POEs) to compete with state owned enterprises. Compare to other transition economies, China is a special case, where the rise of the private sector is not only a result of privatization of state owned firms, but also of newly setup private businesses. Moreover the export oriented FDI policy has brought foreign ownership into the Chinese economy. As a result, the Chinese economy is now dominated by four major ownership groups: state owned enterprises, foreign owned enterprises, private owned enterprises, and collectively owned enterprise.

These different ownership groups receive very different treatments in terms of access to finance, special policies and law status. The state owned enterprises typically face soft budget constraints. They are the main beneficiaries of China's state dominated banking system. Until 1998, the state-owned commercial banks were instructed not to lend to private enterprise. There is a significant lending bias against private firms (Allen et al. 2005). This prevents private owned enterprises, now the engine of growth of China's economy, to have access to finance from the formal banking system. Moreover, private firms' property rights were not formally recognized until the passing of the new property Law in 2007. Hence, the private owned enterprises are considered the most financial constrained firms in Chinese economy (e.g. (Guariglia et al. 2010)). Huang (2003) argues that this lending bias gave rise to a large inflow of export-oriented FDI in China. The rapid rise in FDI was further fueled by China's policy of attracting FDI through special treatments and favorable policies towards the foreign investors. The collectively owned firms are typically owned by communities in urban or rural areas and managed by local governments. As partly state-controlled and managed by local governments, the COEs receive favorable treatments from local governments. Given these social, political and financial factors, we expect to observe heterogeneous responses of export decisions among the four different ownership groups. In this section, we investigate each ownership group separately.

We expect that state owned enterprises' and collective owned enterprises' export decisions are affected least by financial constraints due to the lending bias, while the private owned enterprises are affected most due to the continuous lending bias in China's banking system. Foreign owned enterprises fall between the two extremes. Foreign owned enterprises are expected to be less financially constrained, because they can obtain funds from their parent companies.

Table 5.6 reports the results of random-effect probit model estimation of the export decision for each ownership group separately with liquidity as a measure of financial constraints. All the control variables are the same as in table 5.5 except we now exclude the ownership dummies. The coefficients on the size control variable, (the natural log of number of employees) are always positive and significant across all ownership groups. This confirms that firm size is one of the most important determinants of export decisions. This is likely due to larger firms being more likely to achieve the economies of scale to make export worthwhile for their operation. The coefficients on wage are positive and significant for all ownership groups, except for privately owned firms. Age is significant for foreign owned enterprises and private owned enterprises, and is significant for SOEs in column (1) of table 5.5. The capital intensity measure is only important for SOEs, which could possibly indicate that state-owned firms tend to compete in capital intensive sectors overseas. The regional dummies continue to be positive and significant: firms located in the coastal regions are more likely to export. The central region dummy appears to be negative but insignificant for foreign owned enterprises. This is consistent with FDI's uneven regional distribution in China, where the majority of FDI were concentrated in the coastal region (Wei 2003) due to early policy restrictions (Du and Girma 2007). Productivity coefficients for both measures of productivity are positive and significant for SOEs, POEs and COEs. Yet, the coefficients of productivity are negative and significant for foreign owned firms in column (2) and (6) of table 5.6. The most striking result is that liquidity is only positive and significant for privately owned enterprises as reported in column (3) and (7) of table 5.6. Liquidity is only important in the total factor productivity specification for state owned enterprises and insignificant for foreign firms and collective owned enterprises. This is consistent with our expectation, where private owned enterprise is the most financially constrained groups, and there is a heterogeneous response to financial factors across ownership groups.

Table 5.7 presents the random effect probit regression with leverage as measure of financial constraints across the four ownership groups. Column (1)-(4) of table 5.7 use labour productivity measure as control for productivity, while column (5)-(8) of table 5.7 use total factor productivity as control for productivity. The coefficients for size, wage, age, capital intensity, productivities and regional dummies are almost identical to those reported in table 5.6. The coefficients for leverage are negative but insignificant for both the state owned enterprise group and collective owned enterprise group (column (1), (4), (5) and (8) in table 5.7). The leverage coefficients are negative and significant at 1% level for POEs as expected. Moreover, the coefficients for leverage appear to be significant at 10% level in the labour productivity specification and significant at 5% level in the total factor productivity specification for foreign owned firms.

In sum the results from table 5.6 and 5.7 indicates that financial factors are important determinants of exports mainly for the privately owned enterprise. This is consistent with the idea that private owned enterprises are financially constrained. The lending bias in the banking system prevents them from obtaining the necessary finance. Moreover, no evidence suggests that the export decisions of SOEs and COEs are affected by financial factors. There is only weak evidence indicates that financial factors are important determinants of FOEs export decisions, as only leverage is an important determinant for

FOEs' export decisions. Given the fact that export decisions of SOEs and COEs are not affected by financial factors and FOEs are only marginally affected by financial factors, we will focus our subsequent analysis on the private firms only. The POE group is the largest of our sample. It accounts for 1,162,274 observations, which represents 68.27% of the total firm-years covered in our sample.

	(1) SOEs	(2) FOEs	(3) POEs	(4) COEs	(5) SOEs	(6) FOEs	(7) POEs	(8) COEs
Ln(employee)	0.923***	0.549***	0.705***	0.757***	0.814***	0.623***	0.679***	0.704***
	(0.0271)	(0.0121)	(0.00758)	(0.0286)	(0.0302)	(0.0125)	(0.00779)	(0.0290)
Ln(W/L)	0.00698***	0.00400***	0.0000140	0.0115***	0.0124***	0.00423***	0.0000143	0.0115***
	(0.00190)	(0.000487)	(0.0000177)	(0.00222)	(0.00222)	(0.000501)	(0.0000175)	(0.00226)
Ln(Age)	0.00494**	0.0517***	0.0103***	0.00173	0.000325	0.0528***	0.0113***	0.00218
	(0.00166)	(0.00314)	(0.00109)	(0.00270)	(0.00171)	(0.00330)	(0.00110)	(0.00264)
Ln(K/L)	0.000213*	-0.0000344	-0.0000123	-0.000215	0.000716***	-0.0000503	0.0000390	-0.000143
	(0.0000946)	(0.0000255)	(0.0000341)	(0.000303)	(0.0000943)	(0.0000278)	(0.0000282)	(0.000296)
Coastal Region	1.067***	1.859***	1.971***	2.018***	1.200***	1.837***	1.987***	2.008***
	(0.0789)	(0.0994)	(0.0329)	(0.111)	(0.0740)	(0.0926)	(0.0335)	(0.110)
Central Region	0.379***	-0.0991	1.285***	0.969***	0.491***	-0.0959	1.277***	0.967***
	(0.0951)	(0.121)	(0.0358)	(0.121)	(0.0940)	(0.119)	(0.0364)	(0.126)
Labour Productivity	0.455***	-0.0692***	0.0714***	0.0833***				
	(0.0228)	(0.0116)	(0.00692)	(0.0251)				
Ln(TFP)-LP					0.200***	-0.0854***	0.0192***	0.0663**
					(0.0180)	(0.00834)	(0.00580)	(0.0203)
Liquidity	0.142	0.00658	0.109***	-0.0760	0.234**	0.0407	0.113***	-0.0933
	(0.0777)	(0.0322)	(0.0190)	(0.0706)	(0.0765)	(0.0332)	(0.0193)	(0.0718)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	59779	155729	563960	60587	56237	148139	553360	58777
Rho	0.854	0.838	0.868	0.871	0.855	0.839	0.869	0.870

Table 5.6: Random effect probit model with liquidity as measures of financial constraints for different ownerships. Dependent variable is binary variable *Expdum*, where *Expdum=1*if firm is exporter, =0 otherwise. Standard errors are reported in parenthesis. *,**,***, denote significance at 1%, 5%, and 10% level. State owned (SOEs), foreign owned (FOEs), private owned (POEs) and collective owned (COEs),. Coastal region and Central region are geographical dummy variables. Western region is the omitted reference group.

	(1) SOEs	(2) FOEs	(3) POEs	(4) COEs	(5) SOEs	(6) FOEs	(7) POEs	(8) COEs
Ln(employee)	0.934***	0.551***	0.706***	0.759***	0.810***	0.623***	0.677***	0.706***
	(0.0287)	(0.0121)	(0.00759)	(0.0286)	*(0.0311)*	(0.0124)	(0.00774)	(0.0286)
Ln(W/L)	0.00664***	0.00393***	0.0000130	0.0116***	*0.0123****	0.00419***	0.0000133	0.0114***
	(0.00193)	(0.000488)	(0.0000177)	(0.00221)	*(0.00227)*	(0.000501)	(0.0000175)	(0.00226)
Ln(Age)	0.00466*	0.0515***	0.0109***	0.00225	*-0.000144*	0.0529***	0.0121***	0.00238
	(0.00184)	(0.00314)	(0.00110)	(0.00275)	*(0.00189)*	(0.00329)	(0.00106)	(0.00268)
Ln(K/L)	0.000220*	-0.0000261	-0.0000183	-0.000101	*0.000705****	-0.0000429	0.0000333	-0.0000420
	(0.0000981)	(0.0000253)	(0.0000333)	(0.000273)	*(0.0000955)*	(0.0000274)	(0.0000305)	(0.000269)
Coastal Region	1.065***	1.837***	1.963***	2.020***	*1.201****	1.826***	1.978***	2.007***
	(0.0797)	(0.0980)	(0.0331)	(0.112)	*(0.0749)*	(0.0919)	(0.0337)	(0.112)
Central Region	0.400***	-0.112	1.292***	0.992***	*0.486****	-0.0985	1.283***	0.986***
	(0.0929)	(0.121)	(0.0361)	(0.124)	*(0.0959)*	(0.118)	(0.0367)	(0.129)
Labour Productivity	0.466***	-0.0694***	0.0734***	0.0795**				
	(0.0233)	(0.0116)	(0.00691)	(0.0250)				
Ln(TFP)-LP					*0.210****	-0.0842***	0.0226***	0.0624**
					(0.0181)	(0.00827)	(0.00576)	(0.0200)
Leverage	-0.295	-0.236*	-0.381***	-0.308	*-0.288*	-0.287**	-0.395***	-0.216
	(0.163)	(0.103)	(0.0505)	(0.174)	*(0.150)*	(0.107)	(0.0510)	(0.179)
Time Dummies	Yes	Yes	Yes	Yes	*Yes*	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	*Yes*	Yes	Yes	Yes
N	59276	155534	562458	60279	*55774*	147961	551913	58486
Rho	0.854	0.838	0.868	0.871	*0.855*	0.839	0.868	0.870

Table 5.7: Random effect probit model with leverage as measures of financial constraints for different ownerships. Dependent variable is binary variable *Expdum*, where *Expdum=1*if firm is exporter, =0 otherwise. Standard errors are reported in parenthesis. *,**,***, denote significance at 1%, 5%, and 10% level. State owned (SOEs), foreign owned (FOEs), private owned (POEs) and collective owned (COEs),. Coastal region and Central region are geographical dummy variables. Western region is the omitted reference group.

5.5.4 Heterogeneous effects across private firms characterized by different degree of political affiliations

The results above show that firms with different ownership groups face a heterogeneous response of export decisions to financial factors. This is largely due to the differential treatment faced by firms with different ownership. In order to overcome some of these biased treatments, firms in China tend to seek political affiliation with the Central, provincial and local government and the Communist Party. Huang (2003) and Du and Grima (2010) argue that firms can use political affiliation to circumvent the problems of discriminatory treatments from political settings and institutional settings, such as lending bias and lack of secure property rights. The political affiliations obtained by the firms are likely to help firms to gain additional benefits such as better access to the government officials, less bureaucratic treatments from government, easier access to finance, winning public contracts, obtaining subsidies from various levels of government. These distinctive advantages of firms with a high level of political affiliations may help them to enjoy a higher probability to export and less reliance on finance relative to firms with low or no political affiliations. In this section, we would like to analyze how the political affiliation status affects private firms' export decision. Specifically we will assess whether privately owned firms with higher level of political affiliation are more likely to participate in the export market, and whether the export market participation decisions of these firms are less dependent on financial factors than those of private firms with low or no political affiliation.

Our data provides ten different categories of political affiliation, from high political affiliation to low political affiliation as follow: affiliated at central level, at provincial level, city or district level, street level, town level, township level, community level, village level and no political affiliation. We reclassified firms into one of the three categories: high political affiliation (affiliated at provincial level and above), medium political affiliation (affiliated from village level up to and include city or district level) and no political affiliation. We will estimate equation (1) separately for each level of political affiliation. There are 2.41% of private firms have high level of political affiliation, 27.84% of private firms have medium level of political affiliation and 69.75% of private firms have no political affiliation in out sample.

		High	***Medium***	***No***	
		(1)	(2)	(3)	Total
Expdum=1	N	8,129	63,918	172,554	244,601
	%	29.42%	20.02%	21.57%	21.33%
Expdum=0	N	19,502	255,320	627,413	902,235
	%	70.58%	79.98%	78.43%	78.67%
Total	N	27,631	319,238	799,967	1,146,836
	%	100.00%	100.00%	100.00%	100.00%

Table 5.8: Number of observations and percentage of exporters for private owned enterprises for each level of political affiliations. *Expdum=1*if firm is an exporter, =0 otherwise. Column (1) is firms with high level of political affiliation. Column (2) is for medium level of political affiliation, and column (3) is firms with no political affiliation.

Table 5.8 presents the distribution of exporters and non-exporter for private owned enterprises with high, medium and low level of political affiliations. 29.42% of the private firms with high level of political affiliation are exporter, while only 20.02% and 21.57% of firms with medium level and low level of political affiliation are exporters respectively. This indicates that firms with high political affiliation are more likely to export. The difference in terms of percentage of exporters between firms with medium level and no political affiliations is also statistically significant (the *p-value* of the t-test of equality of mean is 0.00).

Table 5.9 reports the regression results of equation (1) with liquidity as measure of financial constraints for the three different levels of political affiliations. Most of the coefficients associated with the control variables are consistent with early regression results, where size, age, and regional control variables are positive and significant for all levels of political affiliation. However, the coefficients for liquidity are only positive and significant as expected for column (2), (3), (5) and (6) of table 5.9, for firms with medium and low levers of political affiliations. For private firms with high level of political affiliation (column (1) and column (3)), the liquidity coefficients are positive but insignificant. This is consistent with the expectations that high level of political affiliations help to reduce the level of financial constraints faced by firms. Hence the export decisions of private firms with high level of political affiliation are not correlated with the financial factors. Table 5.10 conducts a similar analysis with leverage as a measure of financial factors. The same patterns as those of table 5.9 emerge in table 5.10. The leverage coefficients are only negative and significant for firms with medium and no level of political affiliation. The leverage coefficients for firms with a high level of political affiliation are insignificant. Another interesting result is that productivity appears to have smaller impact on the export decisions for private firms with no political affiliation (column (3) and (6) of table 5.9 and 5.10). Berman and Héricourt (2010) shows that financial constraints could create a disconnection between productivity and export. Our results in table 5.9 and 5.10 provide some support to this argument.

To further test the consistency of the findings in this section, we create two interaction terms, namely Liquidity**high affiliation and Liquidity* (1-high affiliation)* to allow us to directly compare the differential impacts of financial factors on the export decisions of firms with high level political affiliation against firms with medium and no level of political- affiliation. *High affiliation* is a dummy variable equal to one if the firm has a high level of political affiliation, and zero otherwise. Column (1) and column (2) of table 5.11 indicate the interaction terms of liquidity and high affiliation are positive but insignificant, while the interaction terms of liquidity and *(1-high affiliation)* are positive and significant at the 1% level. The *chi- square test* indicates the two coefficients are significantly difference at 1% level. Column (3) and column (4) report the results for a similar analysis with leverage as the measure of financial constraints. The results suggest that the leverage interaction terms are negative and significant as the theory predicts for firms with medium and no level of political affiliations only. Again the *chi-square test* also indicates that leverage interaction terms are significantly different for the firms with different levels of political affiliations.

Moreover, table 5.11 also reports the marginal effects for the interaction terms. The results indicate that financial factors are only significant for firms with low or no political affiliations. In sum, the results suggest that the export decisions of private owned enterprises with high level of political affiliation are not affected by financial factors. This is consistent with the idea that firms with high political affiliation are less financially constrained than firms with low level or no political affiliation.

	High	*Medium*	*No*	*High*	*Medium*	*No*
	(1)	(2)	(3)	(4)	(5)	(6)
Ln(employee)	0.946***	0.779***	0.712***	0.874***	*0.702****	0.734***
	(0.0366)	(0.0156)	(0.00950)	(0.0438)	*(0.0158)*	(0.00963)
Ln(W/L)	0.000520	0.00000112	0.0113***	0.00148	*0.00000308*	0.0118***
	(0.00102)	(0.0000334)	(0.000540)	(0.000872)	*(0.0000316)*	(0.000542)
Ln(Age)	0.00640**	0.00528**	0.0193***	0.00677**	*0.00458**	0.0198***
	(0.00227)	(0.00173)	(0.00157)	(0.00225)	*(0.00184)*	(0.00157)
Ln(K/L)	0.0000907	0.0000412	-0.000232***	0.000202**	*0.0000458*	-0.000212***
	(0.0000657)	(0.0000265)	(0.0000645)	(0.0000673)	*(0.0000260)*	(0.0000518)
Coastal Region	1.520***	1.895***	2.127***	1.171***	*1.960****	2.120***
	(0.139)	(0.0562)	(0.0436)	(0.167)	*(0.0569)*	(0.0444)
Central Region	0.378*	1.044***	1.556***	-0.0596	*1.063****	1.547***
	(0.162)	(0.0612)	(0.0467)	(0.173)	*(0.0617)*	(0.0474)
Labour Productivity	0.328***	0.156***	-0.00465			
	(0.0363)	(0.0148)	(0.00864)			
Ln(TFP)-LP				0.153***	*0.0817****	-0.0416***
				(0.0288)	*(0.0123)*	(0.00720)
Liquidity	**0.0874**	**0.134****	**0.0868*****	**0.188**	**0.142*****	**0.100*****
	(0.126)	**(0.0413)**	**(0.0225)**	**(0.138)**	***(0.0424)***	**(0.0227)**
Time Dummies	Yes	Yes	Yes	Yes	*Yes*	*Yes*
Industry Dummies	Yes	Yes	Yes	Yes	*Yes*	*Yes*
N	15263	134693	414004	14543	131220	407597
Rho	0.869	0.879	0.875	0.876	*0.878*	0.876

Table 5.9: Random effect probit model with liquidity as measures of financial constraints for different level of political affiliation. Dependent variable is binary variable *Expdum*, where *Expdum=1*if firm is exporter, =0 otherwise. Standard errors are reported in parenthesis. *,**,***, denote significance at 1%, 5%, and 10% level. Coastal region and Central region are geographical dummy variables. Western region is the omitted reference group. Column (1) is firms with high level of political affiliation. Column (2) is for medium level of political affiliation, and column (3) is firms with no political affiliation.

	High	***Medium***	***No***	***High***	***Medium***	***No***
	(1)	(2)	(3)	(4)	(5)	(6)
Ln(employee)	0.945***	0.787***	0.710***	0.861***	*0.703****	0.731***
	(0.0352)	(0.0157)	(0.00946)	(0.0413)	*(0.0159)*	(0.00960)
Ln(W/L)	0.000576	0.000000193	0.0113***	0.00156	*0.00000220*	0.0118***
	(0.000995)	(0.0000327)	(0.000543)	(0.000928)	*(0.0000312)*	(0.000546)
Ln(Age)	0.00636**	0.00555**	0.0195***	0.00578*	*0.00483**	0.0200***
	(0.00216)	(0.00192)	(0.00158)	(0.00239)	*(0.00211)*	(0.00158)
Ln(K/L)	0.0000617	0.0000399	-0.000242***	0.000186**	*0.0000448*	-0.000224***
	(0.0000828)	(0.0000280)	(0.0000575)	(0.0000654)	*(0.0000266)*	(0.0000678)
Coastal Region	1.553***	1.899***	2.121***	1.196***	*1.957****	2.110***
	(0.135)	(0.0559)	(0.0438)	(0.271)	*(0.0564)*	(0.0446)
Central Region	0.414*	1.065***	1.565***	-0.0291	*1.076****	1.555***
	(0.165)	(0.0608)	(0.0469)	(0.282)	*(0.0611)*	(0.0476)
Labour Productivity	0.334***	0.163***	-0.00423			
	(0.0361)	(0.0148)	(0.00859)			
Ln(TFP)-LP				0.164***	0.0874***	-0.0389***
				(0.0285)	*(0.0122)*	(0.00715)
Leverage	**0.524**	**-0.545*****	**-0.423*****	**0.460**	***-0.531*****	**-0.439*****
	(0.281)	**(0.103)**	**(0.0624)**	**(0.298)**	***(0.105)***	**(0.0631)**
Time Dummies	Yes	Yes	Yes	Yes	*Yes*	Yes
Industry Dummies	Yes	Yes	Yes	Yes	*Yes*	Yes
N	15171	134193	413094	14455	*130737*	406721
Rho	0.870	0.879	0.875	0.876	*0.878*	0.876

Table 5.10: Random effect probit model with leverage as measures of financial constraints for different level of political affiliation. Dependent variable is binary variable *Expdum*, where *Expdum=1*if firm is exporter, =0 otherwise. Standard errors are reported in parenthesis. *,**,***, denote significance at 1%, 5%, and 10% level. Coastal region and Central region are geographical dummy variables. Western region is the omitted reference group. Column (1) is firms with high level of political affiliation. Column (2) is for medium level of political affiliation, and column (3) is firms with no political affiliation.

		(1)	(2)	(3)	(4)
Ln(employee)		0.679***	0.706***	0.676***	0.705***
		(0.00779)	(0.00758)	(0.00775)	(0.00759)
Ln(W/L)		1.43E-05	1.40E-05	1.33E-05	1.30E-05
		-1.75E-05	-1.77E-05	-1.75E-05	-1.77E-05
Ln(Age)		0.0113***	0.0102***	0.0122***	0.0111***
		(0.00111)	(0.00109)	(0.00107)	(0.00114)
Ln(K/L)		3.92E-05	-1.23E-05	3.12E-05	-2.22E-05
		-2.79E-05	-3.41E-05	-2.93E-05	-3.35E-05
Coastal Region		1.987***	1.971***	1.974***	1.964***
		(0.0335)	(0.0329)	(0.0339)	(0.0333)
Central Region		1.277***	1.285***	1.280***	1.291***
		(0.0364)	(0.0358)	(0.0369)	(0.0362)
Ln(TFP)-LP		0.0192***		0.0228***	
		(0.00580)		(0.00576)	
Labour Productivity			0.0714***		0.0734***
			(0.00691)		(0.00691)
Liquidity*high affiliation		**0.161**	**0.182**		
		(0.130)	**(0.122)**		
Liquidity*(1-high affiliation)		**0.113*****	**0.107*****		
		(0.0194)	**(0.0191)**		
Leverage*high affiliation				**0.374**	**0.285**
				(0.281)	**(0.248)**
Leverage*(1-high affiliation)				**-0.417*****	**-0.405*****
				(0.0517)	**(0.0513)**
Time Dummies		Yes	Yes	Yes	Yes
Industry Dummies		Yes	Yes	Yes	Yes
N		553360	563960	551913	562458
Rho		0.869	0.868	0.868	0.868
Chi2-test		0.00	0.00	0.00	0.00
Marginal effects	***High affiliation***	0.0364	0.0406	0.0644	0.0857
		(0.0294)	(0.00273)	(0.00562)	(0.0643)
	(1-High affiliation)	0.0255***	0.0240***	-0.0917***	-0.0954***
		(0.00444)	(0.00431)	(0.0119)	(0.0122)

Table 5.11: Random effect probit model with liquidity/leverage interaction with different level of political affiliation. Dependent variable is binary variable *Expdum*, where *Expdum=1*if firm is exporter, =0 otherwise. Standard errors are reported in parenthesis. *,**,***, denote significance at 1%, 5%, and 10% level. Coastal region and Central region are geographical dummy variables. Western region is the omitted reference group. *High affiliation* is a dummy variable equal to 1 if the firm has high level of political affiliation, and zero otherwise. *Chi2-test:* reports the *p-value of the test of the equality of coefficients for the interaction terms.* Marginal effects are marginal effects of the probit model calculated at the mean.

5.5.5 Heterogeneous effects across firm characteristics

5.5.5.1 Firm size

Firm size is often perceived as an important *a priori* criterion to sort firms into groups of financially constrained and financially unconstrained (see Farzzari *et al(1988)*, Carpenter *et al*(1998b)). Small firms are typically younger, have a shorter track record, and are more risky than their large counterpart. They are typically excluded from the formal financing sector, and this is particularly true in China.

Moreover, small and medium sized enterprises are the engine of growth for the Chinese economy. They provide many job opportunities for the economy. Therefore, it is interesting analyze whether their export participation decisions are differently affected by financial factors compared to large firms. Following, the literature on financial constraints and investment, we sort firms into large and small groups based on real total assets. If a firm-year falls in the top 25% of the real total assets distribution in its industry in a given year, it is classified as large firms. This method of classification allows firms to transit between size classifications. As a robustness test, we also use the number of employees to classify firms into large and small groups. If a firm-year falls in the 25th percentile of the number of employees in its industry in a given year, it is classified as large firms.

We create two interaction dummies to conduct the empirical study for this section. Large equal to 1 if the firm-year is in the top 25th percentile of real total assets/number of employees in its industry in a given year, and equal to 0 otherwise. Small is an interaction dummy variable equal to 1 if the firm-year is in the bottom 75th percentile of real total assets/number of employees in its industry in a given year, and equal to 0 otherwise. In table 5.12 only the results using total factor productivity are presented. The estimations with labour productivity produced similar results.

In column (1) of table 5.12, we classified firms as large and small based on the number of employees. The results suggested that liquidity is an important determinant for both small and large firms, while its impact is significantly higher than large firms. The marginal effects of liquidity calculated at the mean for small firms are 0.057 compare to 0.0148 (the marginal effects calculated at the mean for the financial variables are reported at the bottom of the table 5.12). In column (2) of table 5.12, we use firms' real total assets to classify firms into large and small group. The results from column (2) are similar to those of column (1). The coefficients for the liquidity ratio are positive and significant for both large and small firms, while it is significantly higher for small firms. Most of the control variables are significant with the expected signs for both specifications presented in column (1) and column (2) of table 5.12.

In column (3) and column (4) of table 5.12, we use leverage as a measure of financial health. We find that leverage is negative and significantly related to firms' export decisions for both small and large private firms, while the coefficients for leverage ratio of small private firms (-0.507) are significantly larger than for large firms (-0.267). The marginal effects of leverage ratio for large and small firms in column (3) are -0.0762 and -0.144 respectively.

In sum, the results from table 5.12 are consistent with the argument of financial constraints. The exports decisions of financially constrained firms will be affected more by financial factors. The results indicate that the marginal effects of liquidity/leverage for small firms are about at least twice higher than large firms. This suggests that by improving small firms financial health may increase their probability to participate in the export markets. These results are robust to using different cutoff points as size classification.

		Number of Employee	Real Assets	Number of Employee	Real Assets
		(1)	(2)	(3)	(4)
Ln(employee)		0.345***	0.346***	0.342***	0.344***
		(0.00391)	(0.00390)	(0.00393)	(0.00393)
Ln(W/L)		0.0000370	0.0000366	0.0000357	0.0000357
		(0.0000348)	(0.0000347)	(0.0000348)	(0.0000348)
Ln(Age)		0.000657	0.000620	0.000853	0.000869*
		(0.000435)	(0.000436)	(0.000438)	(0.000438)
Ln(K/L)		-0.000162***	-0.000159***	-0.000157***	-0.000164***
		(0.0000351)	(0.0000348)	(0.0000349)	(0.0000366)
Coastal Region		0.744***	0.745***	0.736***	0.735***
		(0.0149)	(0.0149)	(0.0149)	(0.0149)
Central Region		0.417***	0.418***	0.422***	0.422***
		(0.0162)	(0.0162)	(0.0162)	(0.0162)
Ln(TFP)-LP		-0.00144	-0.00175	0.00201	0.00182
		(0.00315)	(0.00315)	(0.00312)	(0.00312)
Liquidity*		0.0519***	0.0704***		
Large		(0.0117)	(0.0116)		
Liquidity*		0.200***	0.146***		
Small		(0.0212)	(0.0221)		
Leverage*				-0.267***	-0.297***
Large				(0.0503)	(0.0527)
Leverage*				-0.507***	-0.493***
Small				(0.0350)	(0.0347)
Time Dummies		Yes	Yes	Yes	Yes
Industry Dummies		Yes	Yes	Yes	Yes
N		553360	553360	551913	551913
Rho		0.835	0.854	0.836	0.847
Chi2-test	***p-value***	0.00	0.00	0.00	0.00
Marginal effects	***Large***	0.0148***	0.0201***	-0.0762***	-0.0847***
		(0.00333)	(0.00330)	(0.0143)	(0.0150)
	Small	0.0570***	0.0415***	-0.144***	-0.141***
		(0.00605)	(0.00630)	(0.00997)	(0.00988)

Table 5.12: Random effect probit model with liquidity/leverage as measure of financial factors for small and large firms for private owned enterprises. Firm-year in the top 25% tile of real assets/number of employees in each industry in a given year is classified as large. Dependent variable is binary variable *Expdum*, where *Expdum=1*if firm is exporter, =0 otherwise. Standard errors are reported in parenthesis. *,**,***, denote significance at 1%, 5%, and 10% level. Coastal region and Central region are geographical dummy variables. Western region is the omitted reference group. *Chi2-test:* reports the *p-value of the test of the equality of coefficients for the interaction terms.* Marginal effects are marginal effects of the probit model calculated at the mean.

5.5.5.2 Firm age

Similar to firm size, firm age is also a widely used criterion to differentiate firms as *a priori* financially constrained. Firm age is defined as firms' years of establishment. Older firms typically have a longer track record, and a longer relationship lender which help them to secure external funds. On the other hand, young firms are more likely to be financially constrained because of the lack of knowledge in obtaining external funds and more often restricted to their internal funds only. We classify firms as old if the firm year is in the top 25th percentile of the age distribution of its industries, and as young otherwise[56].

Table 5.13 reports the regression results for privately owned firms with different ages. Firm size continues to be an important determinant for both young and old firms. Productivity is only marginally significant at 10% level for young firms in the liquidity regression, while it is insignificant for young firms in the leverage ratio specifications (column (4) of table 5.13). Again, this further supports the idea that financial constraints could create a disconnection between export behavior and productivity.

The coefficient for liquidity ratio is only significant for young firms in column (1) of table 5.13, but insignificant for older firms. This result is consistent with the financial constraints prediction that financial factors only matter for firms that are financially constrained, in this case young firms. In column (3) and (4), the coefficients for leverage ratios are negative and significant for both young and old firms. Yet, the impact of leverage for export is stronger for young firms in column (3) than old firms in column (4). In sum, our

[56] Our results are robust to different cutoff point to classify firm ages.

result indicates that young firms' export decisions are more likely to be affected by financial factors than older firms. This suggests that young firms are more financially constrained than older firms. They may find it harder to gather enough resources to participate in the export market.

	young	old	young	old
	(1)	(2)	(3)	(4)
Ln(employee)	0.667***	0.979***	0.670***	0.982***
	(0.00924)	(0.0161)	(0.00924)	(0.0162)
Ln(W/L)	0.0101***	-0.000000630	0.0101***	-0.000000812
	(0.000531)	(0.0000286)	(0.000532)	(0.0000286)
Ln(Age)	0.0729***	-0.0189***	0.0732***	-0.0191***
	(0.00293)	(0.00210)	(0.00293)	(0.00208)
Ln(K/L)	-0.000134**	0.000168***	-0.000130**	0.000173***
	(0.0000471)	(0.0000471)	(0.0000452)	(0.0000450)
Coastal Region	2.067***	1.996***	2.056***	2.025***
	(0.0390)	(0.117)	(0.0393)	(0.121)
Central Region	1.380***	1.258***	1.386***	1.285***
	(0.0421)	(0.122)	(0.0426)	(0.126)
Labour Productivity	-0.0175*	0.190***	-0.0155	0.192***
	(0.00843)	(0.0144)	(0.00840)	(0.0143)
Liquidity	0.100***	0.0118		
	(0.0222)	(0.0407)		
Leverage			-0.451***	-0.277**
			(0.0609)	(0.102)
Time Dummies	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes
N	424929	139031	423793	138665
Rho	0.877	0.878	0.877	0.878

Table 5.13: Random effect probit model with liquidity/leverage as measure of financial factors for young and old firms for private owned enterprises. Firm-year in the top 25% tile distribution of firm age in each industry in a given year is classified as old, and zero otherwise. Dependent variable is binary variable *Expdum*, where *Expdum=1*if firm is exporter, =0 otherwise. Standard errors are reported in parenthesis. *,**,***, denote significance at 1%, 5%, and 10% level. Coastal region and Central region are geographical dummy variables. Western region is the omitted reference group.

5.6 Conclusions

This chapter uses a large sample of manufacturing firms from China for the period of 2000-2007 to study the impact of financial factors on firms' export decision. Specifically, we use firms' liquidity and leverage as measures of firms' financial health. In general, we find firms that are larger, older, with higher productivity and located in the coastal region are more likely to export. These results are consistent with the existing empirical results based on developed economies. After controlling for all the above factors, financial health is still a significant determinant of firms' export decisions. Firms with higher liquidity ratio and lower leverage ratio are more likely to export.

We further explore the importance of financial health to export for different ownership groups. Foreign owned firms are more likely to export than privately owned firms, while state owned firms and collective owned firms are less likely to export. We further find that financial health is only a significant determinant of export decisions for private owned firms. As there is a political packing order at work in China, private firms are in a disadvantaged position in accessing finance and government supports. Some private firms try to overcome these problems by establishing political affiliation with different level of government.

Focusing on private firms only, we classify private firms into three groups with different levels of political affiliation. Our results indicate that high political affiliation private firms' export decisions are not affected by their financial health. However, financial factors are important determinants of export decisions for private firms with low and no political affiliation. This suggests that high level of political affiliation may help private firms to alleviate the lending bias and financial obstacles.

In order to assess the differential effects of financial health across firms, we divide firms into different groups using firm size and firm age. Our results indicate smaller and younger firms' export decisions are affected more by their financial health. There are also evidences that financial constraints create a disconnection between productivity and exports. Productivity is less important for firms' export decisions for more financial constrained firms, such as firms with no political affiliation or young firms. This suggests that financial constraints prevent productive firms to compete and participate in the international markets.

Our findings have important policy implications. First, export promotion policies should consider firms' financial health. By alleviating the financial constraints faced by firms would help to improve firms' extensive margins of export. Second, firm heterogeneity is important in firms' export participation decision. The help should specifically aim at small and medium private firms, who are more likely to face financial constraints. Moreover, the export promotion policies should also divert to the inland regions (central region and western region) in China, where there are less foreign direct investment and a lower level of financial development. Promoting exports in these regions would help to improve the economic developments of these regions. Successful export promotion policies should therefore endeavor to identify firms that are most needed the help.

Appendix 5A

5A1 Definitions of variables
Leverage ratio: firm's total debt to firm's total assets ratio

Liquidity ratio: the differences of firm's current assets and current liabilities to total assets ratio.

Capital intensity: the ratio of real fixed assets to the number of employees

Deflators: the provincial level deflators are extracted from the China Statistical Yearbook published by the National Bureau of Statistics of China. The capital stock (*i.e. firm's tangible fixed assets*) is deflated with the provincial capital goods deflator. All other variables are deflated with the provincial *GDP* deflator.

Labour productivity: is defined as real sales divided by number of employees.

Total factor productivity (TFP): total factor productivity calculated using Levinsohn & Petrin (2003) methods with intermediate inputs as proxy.

ROA: is return on total assets. It is defined as net income divided by total assets.

Collateral: is defined as tangible fixed assets divided by total assets.

Age: is the number of year the firm has established.

Export Ratio: is defined as total exports divided by total sales.

Wage rate: is the real wage divided by the number of employees.

5A2 Regions allocation

China consists of 31 provincial units, which are classified into three categories: 22 provinces; 4 autonomous regions; and 4 municipal cities which are under direct supervision of the central government (Shanghai, Tianjin, Beijing, and Chongqing). We allocated them into three groups according to their geographical locations.

Coastal region	*Beijing, Fujian, Guangdong, Hainan, Hebei, Jiangsu, Liaoning, Shandong, Shanghai, Tianjin, Zhejiang,*
Central region	*Anhui, Heilongjiang, Henan, Hubei, Hunan, Jiangxi, Jilin, Shanxi*
West region	*Chongqing, Gansu, Guangxi, Guizhou, Neimenggu, Ningxia, Qinghai, Shaanxi, Sichuan, Xinjiang, Yunnan,*

5A2 Regional allocation

5A3 Structure of the unbalanced panel

Number of observations per firm	**Number of firms**	**Percent**	**Cumulative %**
1	145,501	27.37	27.37
2	92,449	17.39	44.75
3	69,941	13.15	57.91
4	98,476	18.52	76.43
5	35,169	6.61	83.04
6	24,913	4.69	87.73
7	25,980	4.89	92.61
8	39,271	7.39	100
Total	531,700	100	

5A3.1 Number of observations per firm

year	Number of observations	Percent	Cumulative %
2000	144,502	8.23	8.23
2001	152,410	8.68	16.91
2002	165,393	9.42	26.34
2003	180,985	10.31	36.64
2004	256,277	14.60	51.24
2005	254,404	14.49	65.74
2006	283,165	16.13	81.87
2007	318,341	18.13	100
Total	1,755,463	100	

5A3.2 Number of observations per year

Appendix 5B **Levinsohn and Petrin's (2003) approach for TFP (total factor productivity) estimation**

A detail description of TFP of the Levinsohn and Petrin (2003) is beyond the scope of this chapter. In this appendix, we briefly illustrate the key steps of Levinsohn and Petrin's (2003) approach for TFP estimation. The following illustration follows Levinsohn and Petrin (2003) and Petrin *et al*(2004) closely.

Assuming the production function as follow:

$$y_t = \beta_0 + \beta_l l_t + \beta_k k_t + \beta_m m_t + \omega_t + \eta_t . \qquad (1)$$

All the variables are expressed in logarithmic form. The three inputs for the production function (1) are: freely variable labor (l_t), state variable capital *(k_t)*, and an additional freely variable intermediate input *(m_t)*(e.g. materials and energy expense). There are two components in the error term: a state variable transmitted component, (ω_t) which impacts the firm's decision rules and i.i.d component (η_t), which do not impact on firms' decisions.

Demand for the intermediate input is assumed to depend on the firm's state variables k_t and w_t: m_t=m_t(k_t, w_t). Assuming the intermediate input demand function is monotonically increasing in w_t, we can obtain w_t as a function of k_t ,and m_t :

$$w_t=w_t(k_t , m_t) \qquad (2)$$

Equation (2) has expressed the unobservable productivity term as a function of two observable inputs. We can now write the production as follows:

$$y_t = \beta_0 + \beta_l l_t + \beta_k k_t + \beta_m m_t + \omega_t + \eta_t .$$

$$y_t = \beta_l l_t + \phi_t(k_t,m_t) + \eta_t . \qquad (3)$$

Where $\phi_t(k_t,m_t) = \beta_0 + \beta_k k_t + \beta_m m_t + \omega_t$

By taking expectation of equation (3) conditional on i_t *and* k_t, we can obtain:

$$E[y_t \mid i_t , k_t] = \beta_l E[l_t \mid i_t , k_t] + \phi_t (i_t , k_t) \qquad (4)$$

Subtracting (4) from (3) yields:

$$y_t - E[y_t \mid i_t, k_t] = \beta_l (l_t - E[l_t \mid i_t, k_t]) + \eta t \quad (5)$$

Assuming that ηt is mean independent of l_t, we can obtain consistent estimates of βl. The second step of the process is to estimate βk. Assuming w_t follows a first-order Markov process and capital does not immediately respond to d_t , the innovations in productivity over the last period's expectation, given by $d_t = w_t - E[w_t / w_{t-1}]$. Let y_t* be the output net of labour's contribution:

$$y_t* = y_t - \beta l\, l_t = \beta 0 + \beta k\, k_t + E[w_t \mid w_{t-1}] + \eta t + d_t \quad (6)$$

By regression y_t* on k_t and $E[w_t \mid w_{t-1}]$, we can obtain a consistent estimate of βk. Finally, we can calculate the TFP as the difference between the actual output and estimated output derived with the Levinsohn and Petrin (2003) estimates.

Chapter 6: Conclusion

6.1 Introduction

The main objective of this thesis is to empirically investigate the effects of financial constraints on firms' activities in China. In the last two decades, fixed investment and exports have been identified as Chinese economy's main drivers to success. Using two large panels of Chinese manufacturing firms, we study the effects of financial constraints on firms' fixed investment, inventory investment and the export participation decisions. These three activities are closely related to key drivers of the Chinese economy. Our empirical study provides some insights about the determinants of the fixed investment, inventory investment and exports decisions.

This chapter provides a summary of the key findings from our thesis and the limitation of our study. We will then discuss the corresponding policy implications from these findings in the context of Chinese economy. Last, we will provide some suggestions for future research. The remainder of this chapter is organized as follows: section two provides the summary of the main findings from each chapter, section three discuss the policy implications from our findings, and the last section provide some suggestions for the future research

6.2 Summary of main findings

6.2.1 Financial constraints and fixed investment

In chapter 3, using a large panel data of Chinese manufacturing firms with 114,098 observations between 1998 and 2005, we estimate two versions of fixed investment models derived from the Euler equation model to study the relationship between financial constraints and fixed investment for Chinese firms.

Estimation results based on the full sample suggests that cash flow is an important determinant of the fixed investment of Chinese firms. Motivated by the unique institutional settings of China, we classify firms into five categories: state owned enterprises, privately owned enterprises, foreign owned enterprises, collectively owned enterprises and listed firms. We find that cash flow is an important determinant only for privately owned firms, foreign owned firms and listed firms. The results are consistent with the hypothesis of "lending bias", where SOEs and COEs receive preferential treatments from China's banking sector. We then extended the model by including the coverage ratios and leverage ratios in the estimation. We find that coefficients for coverage ratio are only positive and significant for SOEs, while the coefficients for the leverage ratio is positive and significant for privately owned firms and listed firms. These results suggest that privately owned firms and listed firms' fixed investment are financially constrained. Yet, there is no evidence of financial constraints for SOEs and COEs.

We then investigate the regional disparities in China. By dividing firms into Eastern, Central and Western region, we find that cash flow is an important determinant for eastern region only. This is possibly the result of the central government relocating resources from the eastern region inwards to facilitate the central and western regional development policy. By jointly consider both ownerships and regional disparities. We find that private firms and foreign firms locate in the eastern region display significant cash flow sensitivities to investment. Yet, for the case of listed firms, all three regions displayed significant cash flow sensitivity to investment. Furthermore, the listed firms in the eastern region appear to be least financially constrained, while listed firms in the western appear to be most financially constrained. This result is consistent with the prediction of the financial development that better financial development will lower the levels of financial constraints faced by firms located in that region.

In the last part of chapter 3, we test the hypothesis that whether the presence of foreign ownership helps to alleviate the level of financial constraints. The results indicate that the presence of foreign ownership helps to alleviate the levels of financial constraints faced by firms. This result is robust for both the full sample and sub-sample of privately owned firms

6.2.2 Financial constraints and inventory investment

In chapter 4, we study the effects of financial constraints on another key activity of firms, the inventory investment. Using a large census data from China national bureau of statistics between year 2000 and 2007, we estimate an error-correction model to test the effects of financial constraints on firms' inventory investment in China. From a descriptive analysis we find that inventory to sales ratio decrease significantly over the study. The decline in inventory to sales ratio is dramatically across ownership groups, where inventory to sales ratios for privately owned firms, collectively owned firms decline significantly more than state owned enterprises. This is possibly due to the different levels of financial constraints faced by firms belong to different ownership groups.

The estimated results based on the full sample indicate no significant relationship between inventory investment and cash flow. However, this is due to the failure to recognize the importance of the difference across ownership groups. Once we classified firms into four different ownership groups, we find that cash flow is negatively related to the inventory growth for the state owned enterprises and positively related to the inventory growth for private firms. These results suggest that state owned firms is possibly still facing soft budget constraints, while privately owned firms are financially constraints. We find no evidence of financial constraints for collectively owned firms and foreign firms.

When we sort firms into three groups according to geographical regions, we find that cash flow is a significant determinant of inventory growth for firms in the coastal region, while the coefficients are insignificant for the central and western regions. This result is consistent with the finding from chapter 3 that firms located in the coastal region tend to face a higher level of financial constraints.

We also find evidence that privately owned and foreign owned firms operate in the durable sector are more likely to be financially constrained than their counterparts operate in the nondurable sector. Furthermore, we also find that private firms with low levels of political affiliation and no political affiliation display a positive and significant inventory investment and cash flow sensitivities, while privately owned firms with high levels of political affiliation appear to be not financially constrained. This suggests that political affiliation may help to alleviate the levels of financial constraints faced by private firms.

In the last part of chapter 4, we also assess whether the levels of financial constraints faced by firms have change over time. Use year 2003 as a cutoff point, we find some evidences that suggest the levels of financial constraints have increased for privately owned firms, foreign firms and the full sample. Furthermore, the evidences also suggest that privately owned firms with low level of political affiliation are no longer financially constrained in the second period. Yet, privately owned firms with no political affiliation are facing increasing levels of financial constraints.

6.2.3 Financial constraints and exports

In chapter 5, we study the impacts of financial factors on firm's export market participation decisions in China. Using a large panel of census data from the China national bureau of statistics, we estimate a random-effects probit model of firms' exports participation decisions.

The results indicate that financial health of firms is an important determinant for firms' exports decisions in China. We also find it is important to take consideration of the heterogeneous effects of financial health on firms' exports decisions across ownership groups.

Similar to the study in chapter 3 and 4, we find that financial health is mainly an important determinant of exports participation decisions for privately owned firms. We then further analysis whether private firms can alleviate the effects of financial constraints through obtaining political affiliation to the central and local governments. Our results suggest that the exports decisions of private firms with high level of political affiliation are not affected by their financial health, while financial health is an important determinant of export decisions for private owned firms with only medium level or no political affiliation. This result is consistent with the result obtain from chapter 4, where private firms may be able to alleviate their levels of financial constraints through establish political affiliation.

Last, we also consider the heterogeneous effects of financial health on private firms export participation decisions. Using two popular criteria, firm size and firm age, to sort firms into groups of financially constrained and financially unconstrained firms. We find that financial health is important for both small firms' and large firms' exports participation decisions, while study based on firm age shows that financial health is only important for young private firms' exports participation decisions.

6.3 Policy implications

First of all, the empirical study of this thesis suggests that financial factors are highly important factors for firms' fixed investment, inventory investment and export participation decisions. Firm's activities are strongly relying on their internal source of funds. Therefore it is crucial for China to speed up its financial market development in order to facilitate Chinese firms demand for financial resources. Failure to do so would slow down the phenomenon economic growth that China has been experiencing in the last two decades. The finding of the listed firms being more financially constraints suggests that China's stock markets have not been an effective tool for firms to obtain finance to their expansion, such as funding their fixed investment. This call for a review of the current setting of the stock market in China, to better facilitate firms needs and channel the substantial savings into the financial markets.

Secondly, our results indicate there is a strong lending bias against privately owned firms. Given the fact that privately owned firms are the future engine of growth for China, it is important for the policy makers to promote substantial reform of the banking sector to stop the lending bias. Special policy should be designed and implemented aiming to facilitate the fast growing private sectors in China.

Third, our study indicates foreign ownership of firms or foreign direct investment helps to alleviate the levels of financial constraints faced by private firms. The current policy aims to attract foreign investors and foreign direct investment should continue to be implemented.

Last, our study suggests there are significantly heterogeneous effects of financial constraints across firms with different firm characteristics. If policy-makers aim to increase firms activities (such as fixed investment, inventory investment and exports) by making more finance available to them, it is important to take into account the firm heterogeneities we have identified in this thesis. In this way, the policy maker can help firms that are most needed the help, and make the policy more effective.

6.4 Suggestions for future research

The study on the effects of financial constraints continues to be an interesting topic for both the theoretical and empirical researchers. In this section, we aim to briefly suggest some possible future research direction to extend our research.

First, there is a large number of firm-year in our sample have negative fixed investment during the study period. It is interesting to examine whether financial constraints are the main reasons to conduct divestment. Furthermore, we can jointly consider the effects of financial constraints on fixed investment and inventory investment to consider whether financial constrained firms adjust their inventory investment to facilitate firm's fixed investment. We can further analyze to what extent firms can use good inventory investment management to alleviate the problems of financial constraints on fixed investment.

Second, in this study we rely on time invariant ownership indicators to sort firms into different ownership groups. We can use the detailed ownership information to study whether change of ownership types will significantly affect the level of financial constraints faced by the firm. This will further facilitate our understanding about the importance of ownership types in China's special institutional setting.

Last, in chapter 5 we analyze the effects of financial constraints on firms' extensive margins of exports. This work can be extended to study the intensive margins of exports. We can test whether financial constraints are also important determinants of the intensive margins of exports for firms in China.

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