THE ROLE OF FINANCIAL DEVELOPMENT IN TOTAL FACTOR PRODUCTIVITY: EVIDENCE FROM LISTED FIRMS IN CHINA

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CHAPTER I

INTRODUCTION

1.1 Overview

This dissertation is an empirical study of the role of financial development (FD) in promoting economic growth (EG) through the channel of Total Factor of Productivity (TFP). It seeks to contribute to the literature on the FD-TFP-EG nexus and the determinants of total factor productivity by focusing on firm-level data in China.

China has experienced a high annual growth rate, especially since the initiation of the Reform and Open Door Policy in 1978. Its remarkable performance since then has received much attention and deserves further investigation in its own right. Given the increasing availability of data and the increasing role of China in the world economy, a number of case studies of China have been conducted to discover the sources of its economic growth. Some of the studies have credited significant proportions of China's spectacular growth to factor accumulation and TFP improvement. Because of the diminishing role of capital formation, increase in the TFP level becomes the key for sustainable growth (Chow, 1993; Mao and Koo, 1997 among others).

To better understand TFP, a plethora of researchers have studied the determinants of total factor productivity in China (Zheng et al., 1998, 2003; Jin et al., 2001). Among those determinants, the role of financial development in improving Chinese productivity has been overlooked until recently (Liang and Teng, 2006; Shan, 2006). Meanwhile, accompanied by an impressive growth rate, China has implemented numerous reforms

in the financial sector. While China's financial institutions have grown steadily since it adopted the Reform and Open Door Policy in 1978 and modernized its banking system, China's emerging financial market started to take off after the formation of stock exchanges in Shenzhen and Shanghai in the early 1990s. Within a decade, China's financial markets, particularly its equity market, developed significantly. Since the passage of the Securities Law in 1999, the stock market in China has played a more robust role in the nation's economy by helping raise the capital, increasing investment and improving the efficiency of the overall financial system (Xiao, 2004, 2009). Meanwhile, its banking sector adopted numerous reforms to transition into the modern banking era. Guillaumont et al. (2006), Zhang et al. (2007), and Tan (2006) among others explore the role of financial development in productivity improvement in China. However, most of those FD-TFP-EG nexus studies in China focus mainly on aggregate country data or provincial data.

Among the micro level studies, those that link firm TFP to financial development are limited. Three recent studies have examined the relationship between finance and TFP at the firm level. Du and Girma (2008) explore the relationship between financing source (formal or informal) and firm growth measured by both firm-level TFP and firm-level employment in China. Using survey data from around 2,400 Chinese firms (including both listed and non-listed firms), Ayyagari et al. (2008) compare informal financing sources with formal financing sources. They use sales growth, productivity growth (defined as sales minus total material cost divided by total number of workers), and the firm's reinvestment rate (the manager's estimate of percentage of net profits that are reinvested in the establishment) to measure firm performance. Du et al. (2009) find

that access to debt and equity is important for firm growth. However, none of these studies focus on the listed firms in China, relate a firm's financial development level to its productivity level, or study the linkage between a firm's financial structure and other firm characteristics and its productivity level.

1.2 Purpose of the Study

This dissertation studies the role of financial development in firm level growth in China. The purpose of this study is threefold.

1. To examine the effects of financial development on economic growth through the channel of total factor productivity (TFP) at firm level using listed firms in China. Positive results have been found between financial development and economic growth at the aggregate level (King and Levine, 1993; Levine and Zervos, 1998; Beck et al., 2000; Christopoulos and Tsionas, 2004), but what are the micro-driving forces of the economy's growth? My study will address this issue and seek to answer those questions. To have the correct measurement for firm-level financial development, I focus mainly on two of the main functions of financial development in economic growth—to ease financial constraints and the access to capital and to improve corporate governance.

For the first function (channel), firm-level financial constraints, I use two different approaches used in the literature (Kaplan and Zingales, 1995; Cleary, 1999, 2006; Musso and Schiavo, 2008; Hadlock and Pierce, 2009) to create two indices in order to predict the financial constraint level for Chinese listed firms. Then I use one of the traditional measures for the financial constraint level of a firm size and age (Devereux and Schiantarelli, 1990; Chrisinko and Schaller, 1995; Gilchris and Himmelberg, 1995; Whited, 2006) to find out the relationship between a firm's financial constraints and its

TFP level. For the second function (channel), corporate governance, financial structure (capital structure) and ownership structure are used as proxies. Financial structure is measured by the debt-to-asset ratio, while the ownership structure includes both ownership concentration and ownership category. These structures are critical elements defining a firm's corporate governance structure.

To estimate the firm-level TFP, a nonparametric approach by Good, et al. (1996) is chosen over both parametric and semi-parametric methods (Olley and Pakes, a.k.a. OP, 1996; Levinsohn and Petrin, a.k.a. LP, 2003). Multilateral TFP Index Number (IN) approaches to measuring productivity growth do not rely on direct estimation of underlying technology, nor do they require econometric specification and estimation of technology. Like other non-parametric methods, no specified form of production function or assumed distribution form of residuals is needed by IN approaches, and is better in coping technologies that involve multi-input and multi-output; therefore it fits a transition economy like China (Guillaumont et al., 2006). The Chinese economy, like other transition economies shows characteristics of both market imperfections and distortions. In addition, in a transition economy, large variation in production technologies is observed across firms due to different ownership structures, degrees of openness, or multiple technologies at different production cycles.

2. To explore the relationship between some firm characteristics and the firm-level TFP. Firm specifics that are examined include the capital intensity ratio and the export orientation. As a robustness check, the association between financial constraints and TFP and between financial structure and TFP are also studied in subsamples according to industry, tradable- share, and state-share ownership.

3. To examine the effects of the stock market liberalization on firm-level TFP. In the year 2001-2002, some milestones were reached in the financial sector in China. In February of 2001, domestic investors were permitted to purchase B shares if they used foreign currencies rather than Chinese currency (RMB), but they were not allowed to remit B share investment funds abroad without permission. In June, 2001, a plan to reduce the number of non-tradable shares held by state entities was revealed, causing a drop of 500 points in the market over the next three months. The market continued to fall over the next 4 years, one reason being the surplus of tradable shares that the market could absorb. In 2002, the QFII[1] scheme was introduced mainly to allow qualified foreign institutional investors to tap into the tradable A-share market that had previously been open only to domestic investors. In the early 1990s, stock market liberalization occurred in many emerging economies, and a number of studies ensued. However, China's situation was different from other emerging economies due to the market's gradual opening with certain restrictions. Good or bad, the QFII scheme shows a big step towards financial liberalization. In addition, according to the WTO agreement[2], China's banking sector would be more open to foreign banks within 5 years and those large foreign banks would be able to be strategic partners with major state-owned banks. In 2002, the China Banking Regulatory Commission (CBRC) and the Central Huijin Investment Company were set up to better monitor banking activities and restructuring and prepare for the IPOs[3] of state-owned banks. Studies show that financial liberalization has a positive impact on TFP level, so in this study, we will control for the period 2002-2004 to capture the effects of the opening up in the financial sector.

[1] QFII: Qualified Foreign Institutional Investors.
[2] China formally became a member of the World Trade Organization (WTO) in 2001.
[3] IPO: Initial Public Offering.

1.3 Contribution

This study attempts to fill the gap in firm-level studies of the role of financial development in total factor productivity in China. To my knowledge, it is the first attempt to link firm-level financial development and economic growth through firm-level TFP using listed Chinese firms. Publicly-listed firms in China are the best companies for studying the impact of financial development measured by a combination of financial intermediaries and financial markets because only those firms can borrow from financial intermediaries or raise funds through equity markets.

The study also provides the first empirical evidence from China on the relationship between a firm's total factor productivity level and its corporate governance (including its financial structure) and other firm characteristics. For financial structure, the bigger question is which financial system (bank- or market-based) is better at resource allocation. Some argue that markets and venture capitalists are better funding those riskier yet more profitable projects if they are successful. Others emphasize that financial intermediaries are better in reducing asymmetric information that will influence financing decisions (Levine, 2004). The implication behind studying the nexus between a firm's financial structure and its productivity is that firms that engage in more innovative activities usually hold more intangible assets such as patents, and R&D-related human capital. The differences in the tendency to innovate are likely translated into different TFP levels (Griliches and Lichtenberg, 1984). In corporate finance theory, two sides of the story are being told. On one hand, theories that emphasize bankruptcy costs, control rights, and conflicts of interests between equity and debt holders suggest that firms with more intangible assets are more likely to rely on equity financing (Jensen

and Meckling, 1976; Aghion and Bolton, 1992; Hart, 1995). On the other hand, theories based on agency costs and information asymmetries suggest that equity financing is subject to severe under pricing in firms holding more intangible assets, hence preferring debt financing (Myers and Majluf, 1984). The existing empirical evidence also points in two opposite directions. The current study will add to the literature with country evidence at the micro-level.[4] If the results show that firms' leverage ratio is negatively associated with their TFP levels, it might become indirect evidence that firms tend to have higher levels of productivity in market-based financial systems. The significance of this study also lies in its policy implications for the future development of China's financial sector, especially the equity market. As mentioned earlier, in 2001, China adopted a policy of converting more non-tradable shares into tradable shares and allowing more international institutional investors to invest in A-share markets (denominated in domestic currency RMB). While the effects of this policy are still being evaluated, since 2005 the Chinese government has been considering enhancing the capacity of more private and small firms to raise equity funds. In addition, the indices that are created using Chinese listed firms can provide a way for the government to predict which firms will be more or less financially constrained and that information will help the parties involved determine who needs more funds and who does not.

The current study also provides important information for similar research in other transitional economies. Further, it echoes Kehoe and Prescott (2002), who call for more micro studies in future research: "absent careful micro studies at firm and industry levels, we can only conjecture as to what these (good and bad) policies are" (p.16). In addition, from an econometrics point of view, TFP analysis at firm level avoids the

[4] Possible endogeneity issues will be addressed in later chapters.

potential aggregation bias from country- or industry-level data (Arnold et al., 2007).

The remainder of the study is organized as follows. Chapter 2 introduces the background of the financial system in China, the banking sector and financial market development in the last few decades since the Reform and Open Door Policy in 1978. Chapter 3 discusses the literature on the FD-EG nexus, the link between TFP and financial development, the channels through which financial development can impact TFP level, and FD-TFP-EG studies in China. Chapter 4 introduces the theoretical model that links FD and TFP, the literature on methodologies to measure TFP and financial development at the firm level, data source and variable construction, and the empirical models to estimate the impact of financial development on firm-level TFP. Chapter 5 discusses the empirical results while chapter 6 provides conclusions and suggestions for future research.

CHAPTER II

BACKGROUND

This chapter provides some background information on the financial development in China. Since the adoption of the Reform and Open Door Policy in 1978, China has witnessed fundamental changes and a lot of which have been in its financial sector. A centrally planned economy in which the government acted as the only agent for domestic allocation of capital has developed into a transition economy where the financial system has experienced the modernization of the banking sector, the emergence of equity markets, and the adoption of market institutions as regulatory bodies.

2.1 Overview of the Financial Development in China

Financial development usually refers to "the factors, policies, and institutions that lead to effective financial intermediaries and markets as well as deep and broad access to capital and financial services." (p.3, Roubini and Bilodeau, 2009). China's financial system has developed tremendously since 1978. Over the years, the government has embarked on a series of reforms, many of them co-occurring with the privatization of the financial sector. Currently, China's financial sector consists of banks, non-bank financial intermediaries, and financial markets, as in many other advanced economies; and the real monetary balance has expanded with the economic growth. China's financial depth measured by the M2/GDP ratio increased from 24% in 1978 to 80% in 1990, and all the way to 182 percent in 2004 (Table 1). One of the explanations for this change is the expansion of household financial savings. The majority of these pooled savings

have been channeled into banks, which provided more than 85% of total funds raised by the real sector to support GDP activities in 2006 (People's Bank of China, 2006). Table 1 shows that the loans to GDP ratio increased from 0.76 in 1990 to 1.76 in 2004. It is obvious that China's financial system is still a bank-based system, which consists of

TABLE 1 Financial Intermediaries in China, 1999–2004

Year	GDP(billion Chinese Yuan :RMB)	M2/GDP	Loans/GDP	Deposits/GDP	Private Credit/GDP
1990	18547.90	0.820	0.953	0.755	0.055
1991	21617.80	0.900	0.987	0.836	0.055
1992	26638.10	0.954	0.988	0.881	0.060
1993	34634.40	1.007	0.951	0.855	0.060
1994	46759.40	1.004	0.873	0.866	0.065
1995	58478.10	1.039	0.864	0.921	0.057
1996	67884.60	1.121	0.901	1.010	0.063
1997	74462.60	1.222	1.006	1.106	0.098
1998	78345.20	1.334	1.104	1.221	0.109
1999	82067.50	1.461	1.130	1.325	0.119
2000	89468.10	1.505	1.111	1.384	0.109
2001	97314.80	1.627	1.154	1.476	0.109
2002	105172.30	1.759	1.248	1.625	0.100
2003	117390.20	1.885	1.354	1.772	0.100
2004	136875.90	1.856	1.302	1.764	0.090

Notes:

1. Definitions: M2= money plus quasi-money; private credit=sum of credits to private-owned enterprises, township enterprises, the self-employed enterprises, and the enterprises with foreign funds.
2. Data Sources: *Almanac of China's Finance and Banking* (1992-2007) by Almanac of China's Finance and Banking Editor Board, and *China Statistical Yearbook* (1992-2004).

state-owned banks (hereafter SOBs); commercial banks owned by both state and private investors; credit cooperatives; foreign banks; nonbank financial institutions such as investment and leasing companies; and other entities such as securities, asset management, and insurance companies (Maswana, 2008).

While banking has always been the main source for enterprise finance, the Chinese government has also tried to expand financing by channeling funds via the development of stock markets. After a trial period in the late 1970s, Shanghai and Shenzhen Stock Exchanges were established in 1991 and 1992 respectively. Later, the Companies Law in 1993 and the Securities Law in 1998 built a legitimate platform for issuance of equity (OECD 2002*).* Since then, the Chinese stock market has taken off, helping more companies raise capital both at home and abroad. It is beginning to play a more important role in the Chinese economy by easing capital constraints, promoting trade, and providing more liquidity and a better allocation of capital.

To keep a balance among the pace of market-based financial reforms, the sustained growth targets, and the government-directed public component, regulation of the system has become a key issue. Numerous regulatory bodies oversee the financial institutions and markets. PBOC, as the central bank in China, conducts monetary policy and oversees the payment system, while the National Development and Reform Commission (NDRC) sets macroeconomic policies. The China Securities Regulatory Commission (CSRC), China Insurance Regulatory Commission (CIRC), and China Banking Regulatory Commission (CBRC) are the main multiple agencies to regulate the overall financial structure of the system (Ji, 2006).

2.2 The Banking Development in China

In the early 1980s, China abandoned its mono-banking system where the People's Bank of China (PBC) acted as a one-for-all financial institution in the Chinese economy, and this move resulted in a series of financial reforms. Since then, the PBC still functions as the central bank, but China's banking is concentrated round three policy banks and the

Big Four state-owned banks (SOBs). The Big Four banks are the Bank of China, the Agricultural Bank of China, the Industrial and Commercial Bank of China, and the China Construction Bank. Those four banks represent 60-70% of domestic banks' total assets and traditionally focus on financing trade, industry, infrastructure, and rural development respectively. In 1994, three policy banks were established during the banking reform to relieve the Big Four of their state-directed lending role. They are the Agricultural Development Bank of China, which raises funds for agricultural development projects in rural areas; the China Development Bank, which is responsible for financing infrastructure such as funding for the Three Gorges Dam project; and the Export-Import Bank of China, which specializes in financing trade.

The enactment of the Central Bank Law and the Commercial Bank Law in 1995 built a foundation for a modern banking system that is more competitive and efficient. According to the Commercial Banking Law, financial institutions need to incorporate commercial criteria into their lending practices, which frees the remaining SOBs from policy-oriented lending. Therefore, from national policies that stressed only the importance of how to determine the bank credit allocation, to the modernization of lending and risk management practices, China's banking sector has experienced a huge improvement, especially in terms of quality. Gradually, domestic loans, which take the place of state budget outlays, have become the main external source for financing capital investments. By the mid 2000s, only about 10 percent of state-owned companies' total funding is from the state budget (Allen et al., 2005).

The improvement in loan quality does not mean that there are no residual problems from those old days. The Chinese government has been fighting to reduce its

non-performing loan (NPL) level. Asset Management Corporations (AMC) were set up in 1999 to reduce the NPL level for each of the Big Four. According to Maswana (2008), by 2005, NPL reduction and capital injection into the Big Four banks cost the government nearly 250 billion U.S. dollars yet at the end of 2005, the NPLs of all Chinese commercial banks still amounted to about 8 percent of China's 2005 GDP.

The late 1990s also witnessed the growth of institutional investors. Foreign institutional investors have been allowed to invest in Chinese banks since 1996. After China's entrance into the WTO in 2001, further participation of foreign banks in China and more bank competition was expected (Allen et al., 2005; Gullaumont Jeanneney et al., 2007). In 2007, 35 overseas banks had gained stakes in 23 Chinese banks with investments worth 21 billion U.S. dollars. Total assets of overseas banks in China reached 153.9 U.S. dollars by the end of October 2007 (Xinhua Agency, 2007).

Table 1 above also shows other main financial development indicators measured by financial intermediaries. The ratio of loans by financial intermediaries to GDP increased from 0.95 in 1990 to 1.3 in 2004. The Private Credit-to-GDP ratio, which is normally used to measure a country's financial development, also improved from 0.05 in 1990 to 0.09 in 2004. Here "private credit" specifically refers to the sum of credit to private-owned enterprises, township village enterprises[5], enterprises of the self-employed, and enterprises with foreign funds. Even though these four groups represent a small proportion of GDP, they are a dynamic component and play an important and vital role in the economy. The expansion of credits to these groups shows that China is

[5] Township-village enterprises (TVEs) are those enterprises that are located in rural areas (townships and villages), usually collectively-owned or with most of their investment from residents in these rural areas.

continuing its efforts to build a sound financial system that channels funds to firms with different ownership structures.

2.3 The Stock Market Development in China

2.3.1 The Emergence of the Stock Market and State-Owned Enterprise Reforms

In addition to China's large banking sector, and developing at the same time, are stock markets, bond markets, and futures markets, especially the stock market. Along with the banking sector reform, the biggest change in the financial market was the inception of two stock exchanges in the early 1990s. The Shanghai (SHSE) and Shenzhen (SZSE) stock exchanges were established to provide firms with additional fund-raising sources. The Chinese government encouraged the development of stock markets in order to mobilize the increasing household savings, and but stock markets can hedge against inflation (Rousseau and Xiao, 2007). The growth in China's stock market reflects the government's view that well-functioning exchanges could help successfully restructure those unproductive and unprofitable state-owned enterprises (SOEs) (Mookerjee and Yu, 1999). The privatization and listing of SOEs, an integral part of China's state enterprise reform, was the result of changes in socio-political ideologies and mainly the increasing need for capital. This part of the reform has two unique characteristics: 1. new capital is raised when listing takes place, and 2. the state retains voting control in the firm, although it claims to leave decision-making to the managers. Regardless, in order to attract funds and technologies, SOEs need to be less dependent on subsidized state loans, and that means they need to improve corporate governance and firm performance. The enactment of the Companies Law in 1993 and the Securities Law in 1998 (both of which were revised in 2005) formally established the "legal" platform

for issuance of equity (OECD, 2005) and corporate governance of SOEs. The listing process for a firm contains multiple steps: 1. transforming into a shareholding corporation; 2. obtaining approval for listing; 3. releasing a prospectus according to the international accounting practices and disclosing financial and accounting information; and 4. passing the evaluation until the firm is finally listed.

Table 2 shows some financial indicators measured by stock market development. As we can see, the number of firms listed on the exchange rose from 53 in 1992 to 1377 by the end of 2004. At the same time, stock market capitalization grew from 3.9% of GDP in 1992 to 53.8% of GDP in 2000 at the peak and was still 27.1% of GDP in 2004 after a bear market, which drove the Shanghai Index down at one point more than 50% (Walter and Howie, 2006). Table 2 also presents the amount of capital raised domestically in the stock market and shows that its ratio to total investment in fixed assets grew steadily from 0.59 per cent in 1995 to 4.68 percent in 2000. Between 2000 and 2004, the ratio dropped from 4.25% to 1.55% due to the bear market from 2001 to 2004. In addition, the late 1990s saw a growing number of institutional investors in the banking sector, but also in the stock market. Beginning in 1998, more effort was made to broaden the market beyond the existing "institutional" investors, most of whom were SOEs. As a result, there is an increasing presence of both open- and closed-end funds, gray market money managers, insurance companies, and pension funds, in addition to

TABLE 2 Chinese Stock Market Development, 1992–2004

Year	No. of listed firms	Total market capitalization		Market capitalization of tradable shares		Domestic Raised Capital		
		Volume (100 Million RMB)	% of GDP	Volume (100 Million RMB)	% of GDP	Volume (100 Million RMB)	Investment in Fixed Assets	% of invest ment in Fixed Assets
1992	53	1088	3.9	-	-	-	-	-
1993	183	3531	10.2			314.54	13072.3	2.41
1994	291	3691	7.9	969	2.1	138.05	17042.1	0.81
1995	323	3474	5.9	938	1.6	118.86	20019.3	0.59
1996	530	9842	14.5	2867	4.2	341.52	22913.5	1.49
1997	745	17529	23.5	5204	7.0	933.82	24941.1	3.74
1998	851	19506	24.9	5746	7.3	803.57	28406.2	2.83
1999	949	26471	32.3	8314	10.0	897.39	29475.2	3.04
2000	1088	48091	53.8	16088	18.0	1541.02	32917.7	4.68
2001	1160	43522	44.7	14463	14.9	1182.13	27826.6	4.25
2002	1224	38329	36.4	12485	11.9	779.75	32942	2.37
2003	1287	42458	36.2	13179	11.2	823.1	55118	1.49
2004	1377	37056	27.1	11689	8.5	862.67	55566.6	1.55

Note:

1. Data Sources: *China Statistical Yearbook* (1992-2004), China Securities Regulatory Commission (CSRC) (2005), and *Almanac of China's Finance and Banking* (1992-2007).

more than 100 securities companies. Also, as a part of promises made after China's entry into the WTO in 2001, China will continue to gradually liberalize its stock market including converting more non-tradable shares into tradable shares and allowing more foreign capital in tradable A-shares rather than B, H, or N shares. On November 8, 2002, CSRC and PBOC jointly introduced a program called QFII, which for the first time allowed qualified foreign institutional investors to tap into the tradable A-share market. Though there are a number of restrictions, including a quota and a holding period, QFII indicates that China is a step closer towards liberalizing the stock market liberalization, as did other emerging economies in the 1990s.

2.3.2 Corporate Ownership Structure

The background introduction is not complete without an explanation of the differences among A-, B-, H-, and N-shares or the unique characteristics of Chinese-listed firms. China's stocks and stock markets, from inception, have reflected a gradual approach and can be called equity markets with "Chinese characteristics," as Walter and Howie (2006) put it.

> In China, the markets are operated by the state, regulated by the state, and legislated by the state, and raise funds for the benefit of the state by selling shares in enterprises owned by the state. In the entire system, the only things that do not belong to the state are the actual money, or capital, put up by presumably individual investors, and the market itself. These two things, however, represent the heart of a system that, without question, has driven the political process before it. (p.4)

A typical publicly-listed firm in China has a mixed ownership structure, with three major types of shareholders: the state, legal persons (e.g. institutions), and domestic individuals ─each holding about 30 percent of the stock. If a listed firm does issue employee or foreign shares, they usually count for less than 10 percent of the outstanding shares. There are two ways to categorize the shares: first, tradable and non-tradable shares and second, shares open to domestic investors or to foreign investors. Non-tradable shares are the state shares, the legal person shares, or employee shares.[6] Until 2004, 62% of the equity market capitalization of China was represented by the value of legally non-tradable shares owned by the state. The remaining shares are tradable in the secondary market. The tradable shares embody a distinctive segmentation: tradable A-

[6] For more introduction to non-tradable shares, please refer to the appendix A.

shares, tradable B-shares, and other tradable shares like H- and N-shares.

The tradable A-shares are the common stock issued by companies from mainland China (PRC), listed on Shanghai and Shenzhen Stock Exchanges, and reserved for PRC citizens trading in RMB (Chinese currency). Most of the holders of tradable A-share are individuals and some domestic institutions. There is no restriction on the number of shares traded or holding period. However, when a company makes its initial public offering (IPO), at least 25% of its total outstanding shares are required to be tradable A-shares, the only group of equity that is traded among domestic investors at the two exchanges. Tradable B-shares are available only to foreign investors and some authorized domestic securities firms with SHSE B-shares denominated in U.S. dollars and SZSE B-shares in Hong Kong dollars. Other tradable shares are H shares and N-shares. H-shares and N-shares are like B-shares except that they are issued and traded at the Hong Kong Stock Exchange and New York Stock Exchange respectively. N-shares are either through IPOs or ADRs.[7]

We can also divide shares into two segments. One segment includes domestic shares—non-tradable and tradable A-shares. The state shares, legal person shares, employee shares, and tradable A-shares all belong to this group. The other segment is classified as foreign shares (B- , H- , and N-shares).

From the gradual approach and the unique characteristics, one can see that privatization has never been the ultimate goal of the Chinese stock market. To raise capital, and to improve management and productivity levels of Chinese firms (who will still remain state-owned) are the main objectives. China only started to reduce the state

[7] ADR: American Depositary Receipt.

share holding in 1999 and 2001 (*da xiao fei jie jing*), a process which later became part of the reason for the devaluation of the stock market due to the oversupply of tradable shares.

CHAPTER III

REVIEW OF LITERATURE

3.1 Financial Development (FD) and Economic Growth (EG)

3.1.1 Overview

To study the channel(s) through which financial development can impact economic growth, we need to first look at the relationship between finance and economic growth. The literature on the FD-EG nexus is abundant. The key issue is whether financial development and economic growth are related, and if so, how and to what degree. For over a century, this topic has been debated (Levine, 2005; Demirguc-Kunt and Levine, 2008). On one hand, some economists are skeptical about the relationship and even ignore the financial sector in economic development discussions (Jones, 2001; Weil, 2004). Economists such as Lucas (1988) think that the role of finance in economic growth is overly stressed. On the other hand, a number of economists do find a relationship between finance and economic growth. De Gregorio and Guidotti (1995) find that the impact of finance on economic growth is negative while others find it to be positive. Among those who find a positive relationship between finance and economic growth there are three mainstream explanations of this relationship.

1. Economic growth leads to financial development. Joan Robinson (1952) proposes the "enterprises lead, finance follows" idea, which means that a financial system arises only as a passive response to economic development. Financial development is a consequence of economic growth that demands more and better financial services. This

echoes the "demand following" view pointed out by Patrick in his seminal work in 1966. "Demand-following" is referred to as "the creation of modern financial institutions, their financial assets and liabilities, and related financial services that is in response to the demand for these services by investors and savers in the real economy" (p.174).

2. Financial development and economic growth have a two-way causality relationship. Demetriades and Hussein (1996) find little systematic evidence to support the view that finance is a major factor in the economic growth process. In addition, they find that financial development and economic growth have a two-way causality relationship in the majority of the countries they examined, and in some countries financial development follows economic growth. Using a sample of ten less-developed countries, Luintel and Khan (1999) also find a two-way causality between financial development and output growth for all of the countries in their study. From time series data gathered in Malaysia, Ang and McKibbin (2007) find that the growth of the financial sector is a result of the growth of output.[8]

3. Financial development causes economic growth. Another group of studies emphasizes the positive, causal impact of financial development on economic growth. Theoretical models show that financial development measured by financial institutions, financial markets, and financial instruments may reduce the negative effects of information and transaction costs and hence ameliorate market frictions. Financial development can influence the investment rate, technology innovation, and ultimately

[8] Later, B. Bhaskara Rao (2008) shows that when a proper specification for output is used, financial sector in Malaysia has a permanent, albeit small, growth effect.

long-run economic growth rate because incentives and constraints that the economic agents face vary under different financial arrangements at various levels of financial development (Levine and Demirguc-Kunt, 2008). Patrick (1996) calls this as "supply-leading," which means "the creation of financial institutions and the supply of their financial assets, liabilities, and related financial services in advance of demand for them, especially the demand of entrepreneurs in the modern, growth-inducing sector" (p.175). In their survey, Levine (1997, 2005) and Levine and Demirguc-Kunt (2008) summarize the positive functions of a financial system, as part of financial development, in economic growth.

3.1.2 Functions of the Financial System on Economic Growth

First, both financial intermediaries and the stock market can reduce asymmetric information with respect to investment opportunities; hence enhance the efficient allocation of capital. Holmstrom and Tirole (1993) suggest that when shares of firms are publicly traded, the larger and more liquid the markets, the more information the stock contains. The more closely the firms tie the manager's compensation to the stock price, the more incentives the managers have to enhance the firm's performance.

Second, a sound financial system can monitor investments and improve corporate governance. Corporate governance is a mechanism through which capital and resources are allocated, profits are distributed, and the performance of the corporation is monitored. Equity holders or creditors are also willing to provide more funds to firms with effective corporate governance, and better governance can promote economic growth. The threat of a corporate takeover in well-functioning stock markets can mitigate the principle-agent problem and promote efficient resource allocation and economic growth (Levine and

Zervos, 1996). Models also show that well-functioning financial intermediaries influence economic growth through improved corporate governance; they can monitor the firms at lower costs through economies of scale (Bencivenga and Smith, 1993).

Third, a healthy financial system can facilitate trade, manage and diversify risk, and increase liquidity. Financial institutions can transform riskier assets into less risky assets through diversifying portfolios to savers. Stock markets can also extend the time for investments by providing liquidity for equity holders. Risk sharing makes higher returns yet riskier investments, leading to more innovative yet riskier projects being funded (Levine, 1991; King and Levine, 1993).

Fourth, a well-functioning financial system increases saving rates, pools savings, and eases the access to capital. One of the essential functions of the financial system is to channel funds. Well-functioning financial intermediaries and markets can mobilize the funds, transferring them from savers to borrowers. They can stimulate savings, entrepreneurship, and specialization. Without a financial system that pools savings from disparate savers for investment, many production processes will be constrained or not even get started. Theories that support this function suggest that stock market development should raise the rate of return on savings, hence providing greater incentives for savings. McKinnon (1973) and Shaw (1973) find that negative real interest rates due to financial repression reduce incentives to save. Lower savings result in lower investment and economic growth. Their conclusion is that financial liberalization will result in higher interest rates and hence higher saving rates and economic growth. In addition, financial instruments with different levels of denomination that are created by the liberalized financial system can provide households with more opportunities to hold

diversified portfolios and earn higher returns too. One of the byproducts of greater financial development is the reduction of capital constraints so that more entrepreneurs can get funds for more projects that will stimulate economic growth.

In sum, the consensus in the literature with regard to the understanding of each mechanism through which the financial system could affect the real economy is that financial development can positively influence economic growth through increasing either the level or efficiency of capital and investments (see Levine 2003, 2005 for a review). One way to measure this efficiency of investments is to measure the TFP change ($\dot{A}$).

3.1.3 Financial Structure and Economic Growth

Apparently both financial intermediaries and financial markets, as structures of the financial system, stimulate the economy through the four functions mentioned above, but which one is more important? At the macro level, a country-specific financial structure is referred to as a combination of financial institutions and markets in operation. Luintel et al. (2008) provide a good review of financial structure and economic growth. At the macro level, there are four theories with regard to the relationship between financial structure and economic growth: first, the bank-based theory (Diamond, 1984; Stiglitz, 1985; Boyd and Prescott,1986; Bencivenga and Smith, 1991; and Stulz, 2002 among others); second, the market-based theory (Levine,1997; Boyd and Smith,1998; and Holmstrom and Tirole, 1993 among others); third, the financial service theory (Merton and Bodie, 1995; Levine, 1997 among others); and fourth, the law and finance theory.

Bank-based theorists (see Luintel et al., 2008 for a review) usually emphasize the

positive role of banks in economic growth while pointing out the shortcomings of a market-based financial system. They think banks are more important than markets in economic development and growth (Diamond, 1984; Boyd and Prescott, 1986; Bencivenga and Smith, 1991).

Market-based theorists, on the other hand, suggest otherwise (Levine, 1997; Holmstrom and Tirole, 1993; Boyd and Smith, 1998 among others). Market-based countries do tend to be richer than bank-based countries. Banks tend to be more important in a developing country while in a richer/developed country, markets are usually more important. The financial structure at the macro level (whether a country's financial system is more market-based or bank-based) does correlate with economic development, but each type has its own advantages and disadvantages. The two types of financial structures also share a lot in common, and both contribute to the well-functioning of the whole financial system (Stulz, 2002 among others).

Financial service theory mainly emphasizes the financial services provided by financial institutions and markets, which are the two main components of a financial system. This theory does not contradict either the bank-based or the market-based theory; the key point is that financial institutions and financial markets are not substitutes but substitutes (Merton and Bodie, 1995; Levine, 1997, etc.). In addition, financial markets and intermediaries provide different kinds of financial services for economic development.

Law and finance theorists suggest that it is the overall financial development, not the financial structure, which is crucial to economic success at both micro and macro level. They focus on the role of the legal system in promoting economic growth by

creating a sound financial sector (La Porta et al., 1998; Levine, 1999; Beck et al., 2000).

3.2 Channels through which FD Impacts EG

In traditional growth theories of financial development, the role of financial development in growth is through factor accumulation, which is considered one of the main driving forces behind economic growth. Financial development can help channel funds so as to increase the aggregate saving rate and investment level, but in traditional growth models, this role is limited due to diminishing returns of capital. Also, in traditional growth theories, financial development correlates with economic growth through level effects (investment and productivity levels for example) rather than through growth effects. Productivity growth is mainly through technical progress, which is exogenous (Goldsmith, 1969; McKinnon, 1973; Shaw, 1973).

The interests in the relationship between financial development, productivity, and economic growth rekindled after the emergence of endogenous growth literature pioneered by Romer (1986). In this literature, capital might not suffer from diminishing returns because of the endogenous technological change through research and development (R&D), plus R&D's positive externalities on aggregate productivity. Financial sector can play an active role in raising productivity either through allocating investment funds to projects with higher returns or enhancing technical progress through providing important financial resources for R&D activities (see Guillaumont et al., 2006 for a review). Several authors suggest that financial development stimulates economic growth not only by raising the funds available for factor accumulation but also by encouraging productivity growth. Theoretical papers by Acemoglu and Zilibotti (1997);

and Aghion et al. (2005) among others show that financial development may provide innovators with more credit, thereby fostering growth through technical change.

Empirical evidence has been consistent with theoretical implications. Numerous studies show the effect of development in the financial sector on economic growth and the channel(s) through which the financial sector can influence growth. There are four different branches of literature on the relationship among TFP, Economic Growth, and Financial Development. These four groups of empirical studies show how financial development impacts economic growth through the TFP ($\dot{A}$) channel.

First, cross-country aggregate TFP studies focus on heterogeneity in productivity levels across countries. Benhabib and Spiegel (1990) examine whether financial development affects growth through its positive contribution to total factor productivity growth or only to growth in "primitives" (physical and human capital) or rates of factor accumulation. Their results suggest that financial development is correlated with both investment and total factor productivity growth. King and Levine (1993a, b, c), using cross-country data, find that financial development measured by the level of financial intermediaries has a positive impact on productivity. Levine and Zervos (1998) add stock market development into the equation and argue that "the major channel through which growth is linked to stock markets and banks is through productivity growth" (p.547). Beck et al. (2000) find that financial intermediaries have a larger positive impact on total factor productivity than they have on investment and savings. Applying GMM dynamic panel techniques to a panel of 74 countries, Rioja and Valev (2004b) find evidence of the role of financial development in TFP at various stages of economic growth.

Second, cross-country, firm-level, and industry-level TFP studies investigate differences in productivity levels among firms and industries across countries. To further understand the FD-TFP-EG relationship, researchers have also employed firm-level and industry-level data. Some researchers address the causality issues and seek to find the mechanisms through which finance influences economic growth. Rajan and Zingales (1998) use industry-level data across 41 countries to study the mechanisms through which financial development may influence economic growth. They argue that market frictions are the obstacles for firms to get external finance and better-developed financial systems can alleviate those frictions. So, industries that depend more on external finance should benefit disproportionately from greater financial development than industries that are not heavily reliant on external finance. Demirguc-Kunt and Maksimovic (1998) use firm-level data and a financial planning model to show that financial systems with larger banking systems and more liquid stock markets allow firms to grow faster than the firms could finance internally. In a panel of industries across 38 countries, Tadesse (2005) finds that financial development induces technological innovations through capital mobilization and risk sharing. Ayyagari et al. (2007), using a large panel of over 10,000 firms in 47 developing countries, show that more external finance increases innovation and firm dynamism.[9] This association is in line with the cross-country finding that finance promotes growth through the channel of productivity increases (Ayyagari et al., 2006). The third group consists of aggregate TFP-level analysis within a country over a particular time period. Jeong and Townsend (2007), in their most recent paper, develop a

[9] In the paper, the authors narrowly define innovation as a firm's adoption of new technology and introduction of new product lines. The broader definition of innovation takes into account changes in the firm's operations, such as a decision to outsource certain activities or introduce a new product line. They term this broader range of activities as "firm dynamism" to differentiate from core innovation.

growth accounting method that decomposes the TFP growth into four components: occupational shifts, financial deepening, capital heterogeneity, and sectoral Solow residuals. Occupational shifts and financial deepening on average could explain 75 percent of the TFP. Their model assumes that technical change results only from improving allocation efficiency, which in turn depends on distribution of wealth and the efficiency of the financial system. A number of country studies employ Vector Autoregressive (VAR) methodologies using aggregate time series data to study the impact of financial development on economic growth, investment, and productivity (Ghirmay, 2006 etc.).

Fourth, firm-level TFP studies within a country investigate the enormous degree of heterogeneity in productivity across firms/industries within a country. Inspired by the functions of financial systems, several channels are proposed in the literature. This literature is explored in more detail in the following section.

3.3 Channels through which FD Impacts TFP at the Firm-Level

3.3.1 Firm-Level Financial Constraints

Giudici and Paleari (2000), through their survey of small, high-tech Italian firms, find that financial constraints are one of the main obstacles to the development of innovation. Gatti and Love (2008) find that access to credit has a positive influence on TFP in Bulgaria. Badia and Slootmaekers (2008) empirically link financial constraints to firm level productivity in Estonia. Using an indirect approach, they find that financial constraints considerably curtail productivity in most sectors but using a structural approach, financial constraints do not lower productivity for most sectors with the exception of R&D/other business activities and construction sectors. Benfratello et al.

(2008) find evidence that in Italy, banking development affects the probability of process innovation,[10] especially for firms in high-tech sectors and in sectors more reliant on external finance, and for small firms.

3.3.2 Corporate Governance

Corporate governance is a mechanism through which capital and resources are allocated, profits are distributed, and the performance of the corporation is monitored. Equity holders or creditors are more willing to provide funds to firms with effective corporate governance; therefore better corporate governance can promote economic growth. The threat of a corporate takeover in well-functioning stock markets can mitigate the principle-agent problem and promote efficient resource allocation and growth (Levine and Zervos, 1996). Corporate governance determines the extent to which the suppliers of funds to a firm can monitor the firm and influence the decisions that the firm takes in terms of allocation of capital and maximization of the firm's value. Different dimensions of corporate governance are reported in the literature. This study focuses mainly on two of them: the firm's financial structure and the firm's ownership structure (Mayr, 1996; Maher and Anderson, 1999)[11].

3.3.2.1 Firm's Financial Structure and TFP

Though financial structure provides a corporate governance mechanism that monitors the management at the firm level, the relationship between a firm's financial structure, usually measured by the leverage ratio (total debt divided by total equity or total assets), and the firm's productivity has not been confirmed. Two opinions are proposed in corporate finance theories.

[10] In the same paper, the evidence on product innovation is tenuous.
[11] Cited in Kim (2005).

On one hand, theories that emphasize bankruptcy costs, control rights, and conflicts of interests between equity and debt holders suggest that firms with more intangible assets are more likely to rely on equity financing (Jensen and Meckling, 1976; Aghion and Bolton, 1992; Hart, 1995). These theories predict that more innovative firms have lower leverage. Since innovative activities such as Research and Development (R&D) are positively related to productivity, there is a negative relationship between firm productivity and the firm leverage ratio (Jensen and Meckling, 1976; Aghion and Bolton, 1992; Hart, 1995). On the other side, theories based on agency problems have considered conflicts of interest between equity holders and managers (agency problems), that is, insiders and outsiders (information asymmetry). Such theories predict a positive relationship between productivity and the leverage ratio (Harris and Raviv, 1990; Stulz, 1990).

The empirical evidence for the impact of firm financial structure on firm TFP has been mixed. Several country case studies using firm-level data support a negative relationship between leverage and total factor productivity. Bernstein and Nadiri (1993) estimate the negative effect of financial structure, proxied by agency cost of debt and the signaling benefits of dividends, on productivity growth in US manufacturing companies. Pushner (1995) observes a strong negative relationship between leverage and productivity in Japan. More recent works include those by Nucci et al. (2005) and Nunes et al. (2007). On the other hand, Schiantarelli and Sembenelli (1990) show that firms in the UK and Italy with a larger proportion of long-term debt in their capital structure have improved total factor productivity. Similar patterns are found in Schiantarelli and Jaramillo (1999) for Ecuador using both aggregated financial data and micro level data, and in

Schiantarelli and Scrivastava (1999) for India. Nickell and Nicholitasas (1999) find that financial pressure (defined as the ratio of interest payments to cash flow) has a positive effect on productivity. Kim (2005), who uses micro-level data in South Korea, finds that a high debt ratio is negatively related to productivity in non-*chaebol* (not family owned) but positively related in *chaebol* (family controlled, debt-dependent, and diversified) firms.

3.3.2.2 Firm's Ownership Structure and TFP

For ownership structure, I focus mainly on ownership concentration and ownership category. Ownership concentration theories point in two directions. Concentrated ownership can increase incentives to monitor managers. At the same time concentrated ownership firms also tend to invest in more firm-specific activities including R&D activities (Grossman and Helpman, 1991; Lucas, 1988). However an agency problem could arise; that is, the controlling shareholders could engage in activities at the cost of minority shareholders' interests (Claessens et al., 2002). Dispersed ownership provides more risk sharing, hence allowing engagement in riskier innovative activities.

There is some empirical evidence of the impact of corporate governance on firm performance but not much on firm productivity specifically until Kim (2005) who uses micro-level data in South Korea to study the relationship between corporate governance and productivity. Focusing on family ownership and capital structure (financial structure), Kim finds that ownership concentration does have a positive relationship with firm productivity. In the empirical literature on the relationship between ownership structure and corporate performance, some studies (Fama and Jensen, 1983; Cho,1998)

raise the endogeneity issue, that is, whether the investors self select the ownership structure to maximize the market value of the corporation. Chen (2001) argues that this Wall Street rule does not apply in China because institutional investors cannot buy or sell their shares based on firm performance because institutional shares cannot be freely traded on either exchange.

3.4 FD and TFP in China's Growth

Channels through which financial development can impact economic growth in China are explored. Some scholars employ the VAR approach with quarterly or annual aggregate data to either study the role of the stock market in economic growth or compare the role of banking and market development in the real economy (Shan 2002, 2006; Rousseau and Xiao 2007, etc.). However, studies on the role of financial development through the total factor productivity channel are relatively new. Relying on provincial data from 1987 to 2001, Zhang et al. (2007) find a significant and positive relationship between financial-deepening and productivity growth. Tan (2006) finds that financial development impacts economic growth mainly through quantity effect (capital accumulation) rather than quality effect (total factor productivity) in China. Using a large panel dataset of Chinese manufacturing enterprises for 1999-2005 and robust econometric procedures, Demetriades et al. (2008) show that the Chinese banking system has been conducive to the growth of both firm value-added and TFP. The access to bank and future value-added and TFP growth is positively correlated. loans is positively correlated with In addition, firms with access to bank loans tend to grow faster in regions with greater banking sector development. The effects of bank loans on firm growth are statistically significant in the case of purely privately-owned foreign firms, state-owned

firms, and collectively-owned firms.

Discussion of the Chinese financial system also extends to the debate between formal and informal finance. Ayyagari et al. (2008), using a database of 2400 Chinese firms, find that financing from the formal financial system is correlated with faster firm growth, whereas financing from alternative channels is not. However, Du et al. (2008) focus on a hybrid financing pattern through formal and informal sectors and discover that financing sources do matter and the impact differs across firms; comparatively, foreign finance led to the highest growth rate in the 1998-2005 period. A few studies of the effect of corporate governance on firm performance in China find significant effects of ownership structure (Xu and Wang, 1999; Qi et al., 2001), but only one of them focuses on firm productivity level.

This study extends the prior studies on the effects of financial development on total factor productivity in China at the firm level. The principle indicators of firm-level financial development are derived from the main functions of the financial system. Using Chinese listed firm data from 1999 to 2004, two main channels through which financial development can affect total factor productivity at the firm level are explored: 1. financial constraints and 2. corporate governance (financial structure and ownership structure as proxies). In addition, the firm characteristics that are correlates of TFP in the literature are examined. Firm characteristic variables include the capital intensity ratio (kl) and the export orientation.

CHAPTER IV

MODEL AND METHODOLOGY

4.1 Theoretical Model that Links FD to TFP

The theoretical framework that links financial development and total factor productivity draws essentially on the recent endogenous growth literature (Romer, 1986; Lucas, 1988; Grossman and Helpman, 1991; and Pagano, 1993 among others). The role of financial development in economic growth can be explained in a simple model:

$Y_t = AK_t$, [1]

where Y_t and K_t are output and capital stock at time *t*, and *A* is a constant that measures the amount of output produced for each unit of capital. For simplicity, assume that the population is stationary, the economy is closed with no government involvement, and only a single product is either consumed or invested. If it is invested, there will be a depreciation rate denoted as δ so that

$I_t = K_{t+1} - (1 - \delta)K_t = \Delta K + \delta K_t$. [2]

Assume that only a fraction (*s*) of income is saved and a proportion of savings ($1 - \emptyset$) is lost in the process of channeling funds from savers to borrowers. Then, equation (2) becomes:

$I_t = \emptyset S = \emptyset \times s \times Y_t = \Delta K + \delta K_t$. [3]

From equation [1], the growth rate of *Y* at time *t*+1 is $g_{t+1} = (Y_{t+1}/Y_t)$-1=$\Delta K/K$. Using equation [2] and dropping the time subscripts, the steady-state growth rate can be shown as:

$$g = A\emptyset s - \delta. \quad [4]$$

Equation (4) reveals how financial development can affect growth. It can raise $\emptyset$, the proportion of savings channeled to investment; raise A, the social marginal productivity of capital (total factor of productivity); and raise s, the private saving rate.

We know that at the aggregate level, ample empirical evidence shows the positive effects of financial development on total factor productivity. Will those effects be seen at the firm level? Can the heterogeneity of firm productivity that is observed across firms and over time be explained by differences in financial development at the firm level?

4.2 Data and Main Variable Construction

4.2.1 Data Source

The firm-specific variables come from financial reports of the listed firms at both Shanghai and Shenzhen Stock Exchanges in China from 1999-2004 retrieved from the "China Stock Market & Accounting Research" (CSMAR) database that covers all firms listed on the Exchanges. The database is compiled from annual financial reports published by those firms. The format is in accordance with those of COMPUSTAT and CRSP and is widely used by scholars and policy makers worldwide. In order to check the accuracy of the data, the China Center of Economic Research (CCER) database is also employed to crosscheck the variables used in this study. Real gross output, real intermediate input, real capital stock, labor input, capital service input, intermediate input, cost shares of inputs, and TFP level by an index approach are from the EALC Database 2007 of the Japan Center for Economic Research, the Hitotsubashi University Center for Economic Institutions, the CENU Center for China and Asian Studies, and the Center for Corporate Competitiveness of Seoul National University. The financial accounting data that they draw on to estimate the TFP level is also from CSMAR.

Export-oriented firms are gathered from the Wind Database by the Finance Street Center in Beijing. Calculations of some of the variables are explained in Appendix A.

4.2.2 Measurement of the Firm-Level TFP

The ability to measure TFP at the firm level using micro data allows us to study the sources of firm level TFP and relate firm productivity, which is the key to economic growth, to changes in the operating environment. In the literature, there are three major approaches to calculating the firm-level productivity: parametric methods (Stochastic Frontier, OLS, GMM, Fixed Effects, Instrumental Variables (IV)); semiparametric methods (Olley and Parke, 1996; Levinsohn and Petrin, 2003; Ackerberg, Caves, and Frazer, 2007)[12]; and nonparametric methods (Index Number and Data Envelope Analysis (DEA)).

Parametric methods are not flexible in the sense that they explicitly specify the underlying production functions, though by doing so the sources of the productivity growth can be identified. Meanwhile, they can also incorporate the features of the market and industry structure as well as the technological features that affect the industries' or firms' productivities. Using parametric methods, the establishment-level productivity studies assume output (usually measured as deflated sales or value added) to be a function of the inputs the firm employs and its productivity (Katayama et al., 2005). The measure of TFP is then obtained as the residual in this functional relationship. If we use OLS directly to estimate the production function coefficients, there will be a simultaneity problem, because the firm's input choices are not exogenous. For example, the number of workers hired by a firm and the quantity of materials purchased may depend on

[12] The discussion of the robustness of those methods, pros and cons of those approaches can be found in "Robustness of Productivity Estimates" by Johannes Van Biesebroeck (2007).

unobserved managerial ability, which is part of TFP known to the firm but not observable by the researcher. In addition, unbalanced panel data itself will result in selection bias. These issues have been documented by Marschak and Andrews (1964), and Wedervang (1965). Bernard et al. (2005) find that product choices could also be related to the firm's productivity. Given the well-known problem of simultaneity and endogeneity among inputs and unobserved productivity, using the OLS method is generally not advisable. Traditional remedies for the problems of simultaneity and endogeneity are estimators such as Fixed Effects, IV, or the GMM system estimator that is widely used with dynamic panel data. However, Fixed Effects estimation requires time-invariant firm heterogeneity and severe restriction on firms of not choosing inputs in response to productivity shocks. Standard instrumental variables are input and output prices, but they are usually unavailable at the firm level (Ackerberg et al., 2007), so the extended GMM estimator (GMM system estimator by Blundell and Bond, 1998) instead uses lagged first-differences of the variables as instruments in the level equation, but differencing removes much of the variation in the explanatory variables and can lead to larger measurement errors in inputs (Wooldridge, 2005).[13]

An alternative remedy is to use the second approach, semiparametric methods. Olley and Pakes (abbreviated OP, 1996) are the first to solve both endogeneity and selection issues. They use the firm's investment decision to proxy for unobserved productivity shocks and build exit rules into the model. However, one of the conditions that the OP methodology has to meet is a strictly monotonic relationship between the proxy (investment) and output. In econometric estimation, any negative investment value

[13] Wooldridge (2005) shows that a semi-parametric approach (proxy variable approaches to control for unobserved productivity) can be implemented by specifying different instruments for different equations and applying GMM.

has to be dropped or adjusted to zero. To solve this issue, Levinsohn and Petrin (LP) (2003) use intermediate inputs rather than investment as a proxy. Both OP and LP have collinearity problems so Ackerberg, Caves, and Frazer (2007) introduce a hybrid of the OP and the LP methods that fixes the collinearity issues.

Nonparametric methods, such as Index Number (IN), to measuring productivity growth, have the advantage of not requiring direct estimation of underlying technology and therefore, do not require econometric specification. In addition, unless there are big measurement errors in data, or firms/industries employ very different production technologies, productivity level estimates are among the most robust as well. Both IN and DEA analyses have the flexibility to incorporate specification of technology but do not allow for unobservable technology.

This paper adopts the Multilateral TFP Index Approach by Good, Nadiri, and Sickles (1996) to measure TFP at the firm level. Multilateral TFP Index Numbers (IN) approaches to measuring productivity growth are not reliant on direct estimation of underlying technology and therefore, do not require econometric specification and estimation of technology. Like other non-parametric methods, no specified form of production function or assumed distribution form of residuals is needed by IN approaches, and is better in coping with multi-input and multi-output technologies; therefore it fits a transition economy like China (Guillaumont et al., 2006). The Chinese economy, like other transition economies shows characteristics of both market imperfections and distortions. In addition, in a transition economy, large variation in production technologies is observed across firms due to different ownership structures, degrees of openness, or multiple technologies at different production cycles. A simple

form of the modern Index Number methods uses some measure of TFP as a ratio of output to a weighted sum of inputs. Assuming the CES Cobb-Douglas Production Function, the Solow total factor productivity index can be expressed as follows:

$$TFP = \frac{Y}{Xl^{\alpha} Xk^{1-\alpha}} \ , \qquad [5]$$

where *Xl* =labor inputs*; Xk*=capital inputs*,* and α represents the cost minimizing expenditure share for labor. Where multiple outputs exist, TFP can also be described as the ratio of an index number describing aggregate output levels (y*j*) divided by an index number describing aggregate input levels (x*i*).

One of the most popular index numbers, the Tornqvist-Theil quantity index, is easier to use in that it can be derived from a translog production function of its components. This input index is

$$lnX_j^k = \frac{1}{2}\sum_{i=1}^{n}(S_{ij} + S_{ik})\big(lnX_{ij} - lnX_{ik}\big), \qquad [6]$$

where S_{ij}denotes the expenditure share of *i* at observation *j*. X_{ij} denotes the quantity of *i* at observation *j*. *n* is the number of *i*. It is important to build a point of reference comparison with other observations such as observation *k*. The most popular Tornqvist-Theil Index, the discrete Divisia, can be used in time series applications.

$$lnX_t^{t-1} = \frac{1}{2}\sum_{i=1}^{n}(S_{it} + S_{it-1})(lnX_{it} - lnX_{it-1}). \qquad [7]$$

Values of the index are "chained" off the first observation so any subsequent observation can be compared to the first one with:

$$lnX_t^1 = \sum_{s=2}^{t} lnx_s^{s-1}. \qquad [8]$$

In the first time period, the input index is typically normalized to be one. The price index or output index can be obtained assuming that the underlying utility function or revenue function has a translog form. Using revenue shares rather than expenditure

shares for weights, a TFP index can be calculated as the difference between log output and log input indices as follows:

$$lnTFP = lny_t^1 - lnx_t^1 \,. \qquad [9]$$

The Divisia "chaining" approach, however, has severe limitations with cross-sectional or panel data. It is hard to chain the index and compare between firms since "adjacent" makes little sense across firms.

Caves, Christensen, and Diewert (1982) address this issue of cross-sectional comparisons. Their solution is to construct a hypothetical firm whose subcomponent expenditure shares are the arithmetic mean of expenditure shares for all firms ($\overline{S_i}$) and whose subcomponent quantities are the geometric means of the subcomponent ($\overline{lnX_i}$). Individual firm observations (subscripted by f) can be compared to the reference firm (denoted by *) using the following index:

$$lnX_f^* = \frac{1}{2}\sum_{i=1}^{n}(S_{fi} + \overline{S_i})\left(lnX_{fi} - \overline{lnX}_i\right). \qquad [10]$$

Good, Nadiri, and Sickles (1996) combine both the Divisia "chaining" approach and Caves, Christensen, and Diewert's "hypothetical firm" approach. They construct a hypothetical firm for each cross section and then chain the hypothetical firms over time. The resulting input quantity index describes the aggregate input at time *t* for firm *f* relative to the hypothetical firm at the base time period as follows:

$$lnX_{ft}^{*1} = \frac{1}{2}\sum_{i=1}^{n}(S_{fit} + \overline{S_{it}})\left(lnX_{fit} - \overline{lnX}_{it}\right) + \sum_{s=2}^{t}\sum_{i=1}^{n}\frac{1}{2}\left(\overline{S_{is}} + \overline{S_{i,s-1}}\right)\left(\overline{lnX_{is}} - \overline{lnX}_{is-1}\right), \qquad [11]$$

where X_{fit} is the input level of factor *i* at firm *f* in year *t*. S_{fit} is the cost share of input i at firm *f* in year *t*. The upper bar indicates the average value of that variable over all firms in

a time period. For example, $\overline{lnX_{it}}$ shows the natural log of the average quantity of input *i* overall all the firms in time period *t*. This productivity index can summarize the distribution of firms' TFP across sections and over time. So, a firm *f*'s measure of TFP relative to a hypothetical firm at the base time period can be calculated in the following equation:

$$lnTFP_{ft} = \left[\sum_{j=1}^{m}\frac{1}{2}\left(R_{fjt}+\overline{R_{jt}}\right)\left(lnY_{fjt}-\overline{lnY}_{jt}\right)+\sum_{s=1}^{t}\sum_{j=1}^{m}\frac{1}{2}\left(\overline{R_{js}}+\overline{R_{j,s-1}}\right)\left(\overline{lnY_{js}}-\overline{lnY}_{j,s-1}\right)\right]-\left[\sum_{i=1}^{n}\frac{1}{2}\left(S_{fit}+\overline{S_{it}}\right)\left(lnX_{fit}-\overline{lnX}_{it}\right)+\sum_{s=1}^{t}\sum_{i=1}^{n}\frac{1}{2}\left(\overline{S_{is}}+\overline{S_{is-1}}\right)\left(\overline{lnX_{is}}-\overline{lnX}_{is-1}\right)\right], \quad [12]$$

where R_{fjt} denotes the share of revenue of firm *f*'s output *j* in time period of *t*, the upper bar indicates the average value of that variable over all firms in that industry in that time period,but assuming that each firm produces only one product in that particular industry, this index is given by:

$$lnTFP_{ft} = \left(lnY_{ft}-\overline{lnY}_{t}\right)+\sum_{s=1}^{t}\left(lnY_{s}-\overline{lnY}_{s-1}\right)-\left[\sum_{i=1}^{n}\frac{1}{2}\left(S_{fit}+\overline{S_{it}}\right)\left(lnX_{fit}-\overline{lnX_{it}}\right)+\sum_{s=1}^{t}\sum_{i=1}^{n}\frac{1}{2}\left(S_{is}+\overline{S_{is-1}}\right)\left(\overline{lnX_{is}}-\overline{lnX}_{is-1}\right)\right], \quad [13]$$

where $Y_{ft}$is the output level of firm *f* in year *t* and X_{fit} is the input level of factor *i* at firm *f* in year *t*. S_{fit} is the cost share of input i at firm *f* in year *t*, the bar shows the average value of that variable over all firms in that industry in that time period.

Table 3 shows the summary statistics of the variables that are used to estimate TFP. Appendix B reports the structure of 33 industries, which are split into two samples—manufacturing and non-manufacturing—and their TFP growth rates from 1999 to 2004.

TABLE 3 Descriptive Statistics of Data for Estimating the Firm-Level TFP
(in million RMB)

Variable	Mean	Std. Dev.	Min	Max
rgoutput	1522.867	5953.075	0.043573	287106
rintermediate	1210.065	6631.857	1.449761	394795
realcap	1052.057	6249.297	1.3	286230
labor	7611.203	21428.36	34.36214	993334.6
tfp	-0.03485	0.291415	-5.35469	1.24057

Notes:

1. Variable Definitions: Nominal Gross Output (sales) is based on sales after adjusting for increases/decreases in inventories; real output (rgoutput) is deflated using the price index for each industry; labor input (labor) is calculated by multiplying the number of employees by the average number of hours worked in each industry, the number of employees is from CSMAR database, labor cost is obtained from the financial statements; real capital cost (realcap) is the value of capital stock multiplied by capital service; rintermediate: real intermediate input. All in 1999 prices. All the variables are in natural logarithm.

2. Data Source: EALC (East Asian Listed Corporations), 2007, retrieved from http://www.jcer.or.jp/eng/research/database070528.html. Industry classification is from International Comparison of Productivity among Asian Countries (ICPA) Project, and industries are reclassified to be in concordance with ISIC stock codes. The detailed calculation can be obtained from their website.

4.2.3 Measurement of the Firm-Level Financial Development

Proxies such as private credit/GDP, stock market capitalization/GDP, or financial depth measured by M2 deflated by nominal GDP, have been widely used to measure financial development at the country level (King and Levine, 1993a, b, c; Levine and Zervos, 1998). To measure firm-level financial development, one first considers one of the major functions of the financial system—access to capital measured by financial constraints at the firm level. Second, one considers corporate governance as the other channel. The corporate finance literature suggests that market imperfections due to an underdeveloped financial and legal system will raise the cost of external finance and therefore hamper a firm's ability to raise funds for its projects

(Myers and Majluf, 1984). The importance of the financial system for reducing a firm's external financial constraints and affecting firm growth is evaluated and shown in the work by Demirguc-Kunt and Maksimovic (1998). How does one measure the financial constraints at the firm level?

In the corporate finance literature, there are several measures of financial constraints. Traditional measures include total assets (size), the dividend payout ratio, and bond ratings (Fazzari, Hubbard, and Peterson, 1988; Almeida, Campello, and Weisbach, 2004; Almeida and Campello, 2007; Whited, 1992; Hasset, and Oliner, 2006). However, all those measures depend only on a unidementional definition of financial constraints, when in reality multiple variables can affect financial constraints. The corporate finance literature also suggests that financially constrained firms tend to be small or unprofitable, have high growth potential, or have high leverage, and hence low debt capacity. Kaplan and Zingales (KZ hereafter, 1997) are among the first who propose classifying firms into five groups according to their financial constraint status and then they use an ordered logit regression to relate the classifications to accounting variables using the Fazzari et al. (1986) sample. Lamont, Polk, and Saa-Requejo (2001) estimate similar models using the original Kaplan and Zingales (1997) sample and using the regression coefficients to construct an index called the KZ index which consists of a linear combination of five accounting ratios[14]. However their way of classifying firms into different groups according to their financial constraint status does not vary over time, so Cleary (1999, 2006) instead uses multiple discriminant analysis to create a different financial constraint index (*Zfc*). However, both the KZ index and *Zfc* may suffer from endogeneity issues due to the correlation between the predictors and the

[14] The five variables are cash flow/capital; tobin's Q; debt/capital; dividends/capital; and cash/capital.

discriminating variable that divide the groups. An alternative index of financial constraints has been proposed by Whited and Wu (2006), who use the Euler equation approach to create the WW index[15]. Even though three indices mentioned above are widely used in literature, they utilize U.S. data which cannot be generalized in other countries. Hadlock and Pierce (2009) use different data sets or larger datasets and generate different coefficients. In addition, they cast serious doubt on the KZ index and point out that both KZ index and the WW index are subject to endogeneity flaws. They introduce a new index based on two variables that have significant intuitive appeal yet are more exogenous than most of the alternatives—firm size and age. Winker (1999), using the framework of the Stiglitz and Weiss model with a panel of firm data in Germany, shows that age and size (proxied by the number of employees) reduce the risk of facing financial limitations.

In this study, a new Quadratic Size-Age Index *(Lfcsa*) inspired by Hadlock and Pierce (2009) and Cleary (1999, 2006) is calculated for listed firms in China. An alternative financial constraint index inspired by Kaplan and Zingales (1997), Cleary (2002, 2006), Whited and Wu (2006), and Musso and Schiavo (2008) is calculated for robustness. Table 4 shows descriptive statistics of variables used to predict both of the financial constraint indices. For the main financial constraint index calculation, there are several steps as follows:

[15] The six variables are cashflow, dividend payer dummy, leverage, firm size, industry sales growth, and firm sales growth, all deflated by net fixed assets.

TABLE 4 Descriptive Statistics of Data for Estimating Financial Constraints (*Lfc and Lfcsa*) at the Firm Level

Variable	Obs	Mean	Std. Dev.	Min	Max
size	6973	21.01508	0.900312	18.97921	23.62545
size^2	6973	442.4442	38.17367	360.2105	558.162
age	7904	1.887754	0.626129	0	2.890372
age^2	7904	3.955604	2.024933	0	8.354249
bmr	6852	0.320965	0.208473	-0.42764	0.922172
cratio	6852	1.687155	1.211909	0.198018	7.475777
gincome	6855	0.238093	0.830364	-0.9714	5.6995
Lfcsa	6970	-0.38493	0.396447	-1.03382	2.18265
Lfc	6849	-0.41787	0.3558	-1.52406	0.769978

Notes:

1. Variable Definitions: size=natural logarithm (total assets); age= log(current year-the year when the firm was established); bmr=log(book-to market ratio); cratio =log(current ratio)=log(current assets/current liabilities); gincome=log(growth in net income,%ΔNI). 2. All coefficient estimates are maximum likelihood estimates from a logit model estimated over annual observations. 3. All the variables are winsorized at 0.5%.

First, firms are divided into three mutually exclusive groups according to an a priori measure of financial constraints: the dividend payout ratio. Group A: dividend increasing firms; group B: dividend-decreasing firms; group C: no dividend payments or no change in dividends. Only groups A and Bare used for estimation and the same coefficients are assigned to the third group when calculating the constraints score. Second, logistic analysis estimates the coefficients that best discriminate between group A (not financially constrained=0) and group B (financially constrained= 1). The author chose logistic analysis over discriminant analysis because discriminant analysis requires more strict assumptions. The logistic regression is expressed in terms of an odds ratio, which relates the probability of the event occurring to the probability of the event not occurring:

$$\frac{Prob(event)}{Prob\ (no\ event)} = e^{\beta_0+\beta_1 X_1+\beta_2 X_2+\cdots+\beta_n X_n}. \qquad [14]$$

Thus, the logistic regression can be expressed as follows:

$$\log\left(\frac{Prob(event)}{Prob\ (no\ event)}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n. \quad [15]$$

$$\text{So, } prob(financial\ constraints) = \frac{1}{1+e^{-Z}}, \quad [16]$$

where Z is the logistic financial constraint score based on firm size and age represented by *Lfcsa*.

Table 5 sets out the results from maximum likelihood function for the determinants of firm-level financial constraints. So, the predicted financial constraint score measured by size and age are expressed as:

$$Lfcsa = 24.4277 - 1.8912 \times size + 0.0387 \times size^2 - 1.9302 \times age + 0.3874 \times age^2, \quad [17]$$

where size =natural logarithm of total assets, and age=natural logarithm of (current year-the year of its incorporation).

Third, the logistic financial constraint score (*Lfcsa*) is assigned to all the firms calculated from the weighted summation of the significant variables that are good predictors for the degree of financial constraints. Firms with a high logistic score (*Lfcsa*) are categorized as more financially constrained; firms with a low logistic score *Lfcsa* are deemed as financially unconstrained.

TABLE 5 The Logistic Procedure

Panel A Determinants of the Firm-Level Financial Constraint Score *Lfcsa*

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	24.4277	6.9137	12.4835	0.0004
size	1	-1.8912	0.6427	8.6606	0.0033
size^2	1	0.0387	0.0149	6.7592	0.0093
age	1	-1.9302	0.3194	36.5177	<.0001
age^2	1	0.3874	0.0875	19.6029	<.0001

Panel B Determinants of the Firm-Level Financial Constraint Score *Lfc*

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-0.00262	0.0661	0.0016	0.9683
bmr	1	-1.6803	0.1549	117.6561	<.0001
cratio	1	0.0768	0.0232	11.0091	0.0009
gincome	1	-0.0226	0.0105	4.5943	0.0321

Notes:

1. Variable Definitions: size=log(total assets); age= log(current year-the year of its incorporation)[16]; bmr =book-to-market ratio; cratio=current ratio=(current assets/current liabilities), a proxy for a firm's liquidity status; gincome= the growth in income. 2. All the variables are winsorized at 0.5%.

Even though there are potential endogeneity issues, as a robustness check, we use all the available predictors that are used in previous approaches by Kaplan and Zingales (1997), Cleary (2002, 2006), Whited and Wu (2006), and Musso and Schiavo (2008). Rather than employing their coefficients directly, as do numerous other studies in the

[16] In Hadlock's paper, their "age" is defined as the current year minus the first year that the firm has a nonmissing stock price on Compustat file. For China, since the Chinese Stock Exchanges are relatively young , and many of them get listed at the same time, so I use current year minus the date of incorporation , like Liu and Hsu (2006).

literature, the predictors that best fit China's data are chosen and logistic regression is used. The variables that are adopted are book-to-market ratio (bmr), current ratio (cratio), and income growth (gincome). The results for the determinants of firm-level financial constraints are set out in Table 5 Panel B. The coefficients are maximum likelihood estimates, which are used to construct an alternative financial constraint score for Chinese listed firms. The score *(Lfc)* can be calculated as follows:

$$Lfc = -0.00262 - 1.6803 \times bmr + 0.0768 \times cratio - 0.0226 \times gincome, \quad [18]$$

where bmr stands for book-to-market ratio; cratio=current ratio, a proxy for a firm's liquidity status; and gincome represents the growth in income. When a firm has a high book-to-market ratio, it is undervalued, and has a big growth potential; the higher the potential, the more funds it can raise, and the lower its financial constraint score. If a firm has a higher current ratio (more liquidity), its financial constraint score is higher, one explanation is that a firm chooses to hold a high level of cash may be a sign of being financially constrained for precautionary reasons (Hadlock and Pierce, 2009).

Table 6 summarizes the statistics for the predicted firm-level financial constraint score using two approaches. Those two indices provide a good prediction for a firm's financial constraint level, it could predict whether a firm will increase its dividend payout ratio (less financially constrained) or decrease its dividend payout ratio (more financially constrained) in the future. Traditional measurements—size and age, which are used to predict one of the financial constraint scores—are directly used in the following empirical models to study the role of financial constraints in total factor productivity at the firm level. The reasons I chose those two variables are as follows: 1. they are related to both financial constraints and TFP and 2. the use of these two variables as exogenous

regressors might help reduce the endogeneity problems.

Two critical elements that define a firm's corporate governance are financial structure and ownership structure. The debt-to-asset ratio is used to measure the financial structure; and the top one or top ten shareholder percentage is used to measure ownership concentration. State-ownership percentage and tradable share percentage are to proxy for ownership category.

TABLE 6 Descriptive Statistics of Firm-Level Financial Constraint (*Lfc and Lfcsa*) Scores

$$Lfcsa = 24.4277 - 1.8912 \times size + 0.0387 \times size^2 - 1.9302 \times age + 0.3874 \times age^2$$
$$Lfc = -0.00262 - 1.6803 \times bmr + 0.0768 \times cratio - 0.0226 \times gincome$$

Variable	Obs	Mean	Std. Dev.	Min	Max
Lfcsa	6970	-0.38493	0.396447	-1.03382	2.18265
Lfc	6849	-0.41787	0.3558	-1.52406	0.769978

Notes :

1. All coefficient estimates are maximum likelihood estimates from a logit model estimated over annual observations. 2. Variable Definitions: size=log(total assets); age= log(current year-the year of its incorporation). ; bmr =book-to-market ratio; cratio=current ratio=(current assets/current liabilities), a proxy for a firm's liquidity status; gincome= the growth in income; *Lfcsa* and *Lfc* are two financial constraint scores. 3. All the variables are winsorized at 0.5%.

4.3 Empirical Models

4.3.1 The Pooled OLS Model

To evaluate the role of financial development in firm productivity growth, I first estimate a firm's total factor productivity level, then regress it on variables that proxy for firm-level TFP. The empirical model is specified as follows:

$$lnTFP_{it} = \alpha_0 + \beta_0' FC_{it} + \beta_1' GOV_{it} + \beta_2' X_{it} + \beta_3' ExpDum + \beta_4' OpenDum + \lambda_t + \varepsilon_{it},$$

$$i = 1, \dots, n; t = 1, \dots T. \qquad [19]$$

where:

$\boldsymbol{lnTFP_{it}}$=the log of the TFP level of firm *i* at time *t*.

$\boldsymbol{FC_{it}}$=the financial constraint level of firm *i* in year *t* measured by size and age.

$\boldsymbol{GOV_{it}}$=a vector of variables that are proxies for corporate governance level: leverage (debt) ratio (financial structure, measured by debt- to-assets ratio), firm ownership concentration (percentage of ownership by top one and ten shareholder); and firm ownership category (state ownership and tradable share ownership percentage).

$\boldsymbol{X_{it}}$=a vector of firm-specific variables: firm's capital insensitivity (kl: ratio of capital to labor input) which is believed to be correlated with firm TFP level.

Dummy variables=the export orientation, which refers to a firm's international exposure to foreign markets (major exporters vs. non-major exporters, if 50% of the sales are in overseas markets, the firm is considered a major exporter.); industry (manufacturing vs. non-manufacturing); and 2002 year dummy to control for the effects of financial liberalization (openness). The variables are believed to be related to a firm's productivity growth. Static models (without the lagged dependent variable as a regressor) using the pooled OLS regressions with various specifications are estimated and the results provide an initial analysis of the determinants of firm level TFP. Year dummies (λ_{it})are included to control for common trends or business cycle effects.

4.3.2 The Fixed Effects Model

A Pooled OLS estimator would be a consistent and efficient estimator if μ_i (individual effects) were the same across all the firms in the study. However, some firm effects that need to be addressed. Since there is some time-invariant heterogeneity due to unobserved firm characteristics such as managerial efficiency, Fixed Effects models are proposed. Both Breusch-Pagan (BP, an LM test) and Hausman tests are conducted for random and fixed effects respectively to confirm the soundness of the empirical

specifications. Chi^2 is 225.73 with P-value>Chi^2 at 0.0000(significant) also shows that a Fixed Effects model can provide better estimates.

$$lnTFP_{it} = \alpha_0 + \beta_0' FC_{it} + \beta_1' GOV_{it} + \beta_2' X_{it} + \mu_i + \lambda_t + \varepsilon_{it},$$

$$i = 1, \dots, n; t = 1, \dots T. \quad [20]$$

where :

$\boldsymbol{lnTFP_{it}}$=the log of the TFP level of firm *i* at time *t*.

$\boldsymbol{FC_{it}}$=the financial constraint level of firm *i* in year *t* measured by size and age.

$\boldsymbol{GOV_{it}}$=a vector of variables that are proxies for corporate governance level: leverage (debt) ratio (financial structure, measured by debt- to-assets ratio), firm ownership concentration (percentage of ownership by top one and ten shareholder); and firm ownership category (state ownership and tradable share ownership percentage).

$\boldsymbol{X_{it}}$=a vector of firm specific variables: the firm's capital insensitivity (ratio of capital to labor input) which is believed to be correlated with firm TFP level. μ_i, and λ_t, are firm and year dummies, ε_{it} represents error term.

Two main econometric issues are involved in the estimations. First, endogeneity arises from reverse causality for several TFP correlates. It could be due to the correlation between the observed firm characteristics and unobserved firm heterogeneity. For example, if exporters are found to be more productive, it could be the case that more productive firms are more competitive in export markets. Or for leverage ratio (measured by the debt-to-asset ratio), firms with a certain leverage ratio are bound to a given level of intangibles, which are translated into higher TFP, while a firm wishing to innovate by increasing its share of intangible assets is bound to change its leverage or simply, firms with a higher TFP are likely to generate higher profits and therefore borrow less (lower

debt-to-asset ratio). Causality may run in both directions for financial constraints. Reverse causality from TFP to ownership structures is less likely due to the special characteristics of listed firms' ownership structures mentioned earlier. In theory, this problem could be solved by either using instrumental variables (IV) that are correlated with TFP correlates yet not with TFP, Fixed Effects models, or Fixed Effects models with IVs. In practice, such variables are hard to find. In the literature, some instrumental variables for the leverage are proposed (Nucci et al., 2004). They are tax policies that are included in the calculation of the user cost of capital. The heterogeneity across firms in their tax status makes tax policies potential instruments. Nucci et al. (2004) argue that the tax policies are likely to influence a firm's financial structure, since they can cause variation in the cost of financing, yet taxes are not necessarily driven by other factors that might influence the productivity level. My approach to address other endogeneity problems is to include control variables in the Fixed Effects models because of not enough data for some potential instrumental variables that are proposed in the literature. Since Fixed Effects-IV estimation would be more appropriate, the results from the current study need to be interpreted with caution.

Second, given the large number of possible correlates of TFP, the regression might have multicollinearity problems. The correlation matrix shows that the correlation among most of the independent variables is low except for the top one and top ten shareholder ownership variables. To address the potential problem, I estimate regressions, including them one at a time along with basic control variables. Though by doing so, the model specifications might suffer from an omitted variables' problem, if the

effects are similar to those that are estimated from the regressions that include all of the correlates, the results could be more reliable.

In the next chapter, several hypotheses are tested to determine the effects of firm-level financial development through two proposed channels: 1. a firm's financial constraints measured by firm size and age; 2. a firm's corporate governance level. The role of firm characteristics that are correlates of TFP in the literature are examined too. The variables include the capital intensity ratio (kl), the export and openness dummies. Table 7 shows the descriptive statistics for the variables that will be used in the empirical models. Table 8 summarizes the hypotheses.

TABLE 7 Descriptive Statistics of Variables in the Empirical Models

Variable	Mean	Std. Dev.	Min	Max
tfp	-0.03299	0.249997	-1.0485	0.496249
sshare	0.331305	0.265009	0	0.765958
oneshareholder	0.385062	0.21771	0	0.8
tenshareholder	0.543506	0.235671	0	0.919315
tshare	0.384731	0.116876	0.145318	0.724302
dtar	0.487281	0.239943	0.083705	1.81658
kl	0.309109	2.673326	0.003284	90.43124
size	21.02284	0.9697678	15.75939	27.12479
age	1.88838	0.6271937	0	3.135494

Notes:

1. Variable Definitions:tfp=log(TFP);sshare=log(state share/total share);oneshareholder=log(shares held by the top one shareholder/total shares); tenshareholder=log(shares held by the top ten shareholders/total shares); dtar=log(debt to total asset ratio); kl=log(real capital/real labor); tshare=log(tradable shares/total shares); size=log (total assets); age= log (current year-the year of its incorporation).
2. All of the variables are in natural logarithm.
3. All the variables are winsorized at 0.5%.

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TABLE 8 Summary of Hypotheses

Statement of Hypotheses
Financial Development at the firm-level
Channel 1: Access to capital
Hypothesis 1: The more easily the firm accesses capital, the higher TFP of a firm.
(higher firm-level financial development is positively associated with firm-level TFP)
Channel 2: Corporate Governance
Financial Structure (leverage or debt ratio)
Hypothesis 2: Debt-to-Asset Ratio is either positively or negatively associated with firm-level TFP
Ownership Structure
Ownership concentration (top one or top ten shareholder ownership percentage)
Hypothesis 3: Ownership concentration is positively associated with the firm-level TFP.
Ownership Category
Hypothesis 4: State-ownership has a negative relationship with firm-level TFP.
Share Type
Hypothesis 5: Tradable-share ownership has a positive relationship with firm-level TFP.
Firm Characteristics (other correlates of TFP and control variables)
Capital Intensity (capital-to-labor intensity ratio)
Hypothesis 7: Firms with higher capital-to-labor intensity ratios have higher TFP levels.
Other Control Variables
Industry Dummy (Manufacturing =1,Non-manufacturing=0)
Export Orientation Dummy (Export=1; Non-Export=0)
Openness Dummy (The year 2002-2004 to control for financial liberalization)
Hypothesis 8: Firms with more export orientation, after 2002 or in manufacturing industries, are more productive than those otherwise.

Note: Hypotheses 1-8 are all alternative hypotheses.

CHAPTER V

FINDINGS

5.1 Pooled OLS Models

Empirical results are reported in this section. Table 9 summarizes the results from Equation [19] using pooled OLS regressions. The financial constraint measures−size and age−are used in all the specifications. In the literature, bigger and older firms are found to have easier access to the capital (Winker, 1999), so firm size and TFP or firm age and TFP is expected to be positively related. However, since younger firms tend to be more innovative than older firms, the sign of the age variable could be mixed. The coefficients estimated from all the specifications in Table 9 (Panel A and B) show that financial development is positively associated with TFP at the firm-level. Financial structure, measured by debt-to-asset ratio, is negatively associated with firm TFP level. Firms with lower leverage are on average more productive. The estimated coefficient is -0.11. All of the coefficients are significant at 1% level. In China's case, the findings support the hypothesis that financial structure is negatively related with TFP, which is consistent with the findings in the literature based on two groups of theories (Myers and Majluf, 1984; Jensen and Meckling, 1976; Aghion and Bolton, 1992; Hart, 1995). In addition, if a firm is more capital intensive, its productivity level is higher (kl is significant at 1% significance level). In Table 9 Panel A, ownership concentration proxied by top one shareholder ownership is positively related with a firm's productivity level. However, top ten shareholder ownership's association with the firm-level TFP is insignificant.

TABLE 9 Pooled OLS Models from Equation [19]

Panel A. Estimates using Financial Constraints, Financial Structure, and Ownership Concentration

Dependent Variable: ln (TFP)

VARIABLES	(1) Pooled OLS	(2) Pooled OLS	(3) Pooled OLS	(4) Pooled OLS	(5) Pooled OLS	(6) Pooled OLS	(7) Pooled OLS
size	0.06***	0.05***	0.05***	0.06***	0.06***	0.05***	0.05***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
age	-0.04***	-0.06***	-0.07***	-0.04***	-0.04***	-0.07***	-0.07***
	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)
dtar	-0.11***			-0.11***	-0.11***		
	(0.007)			(0.008)	(0.008)		
oneshareholder		0.01*		0.01			
		(0.008)		(0.007)			
tenshareholder			0.02		0.01		
			(0.012)		(0.012)		
kl						0.01***	0.01***
						(0.003)	(0.003)
exportdum						0.07***	0.07***
						(0.024)	(0.024)
manufac						0.02***	0.02***
						(0.007)	(0.007)
opendum							0.03***
							(0.007)
constant	-1.24***	-0.89***	-0.90***	-1.20***	-1.21***	-0.86***	-0.93***
	(0.088)	(0.095)	(0.095)	(0.096)	(0.095)	(0.093)	(0.091)
Observations	4940	4154	4154	4146	4146	5147	5147
R-squared	0.097	0.060	0.059	0.104	0.104	0.063	0.060

Notes:

1. Variable Definitions: tfp=log(TFP); sshare= log(state share/total share); exportdum=1 if the companies' overseas sales >50% of their total sales, 0 otherwise; manufac=1 if they belong to manufacturing industries, 0 otherwise; opendum=1 if firm-year observations are from year 2002-2004, 0 if they are from years 1999-2001; dtar=log(debt to total asset ratio); size=log(total assets); age= log(current year-the year of its incorporation); kl=log(real capital/real labor); oneshareholder=log(shares held by the top one shareholder/total shares); tenshareholder=log(shares held by the top ten shareholders/total shares)
2. All of the variables are in natural logarithm.
3. All the variables are winsorized at 0.5%.
4. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.01.

Panel B. Estimates using Financial Constraints, Financial Structure, and Ownership Category

Dependent Variable: ln (TFP)

VARIABLES	(1) Pooled OLS	(2) Pooled OLS	(3) Pooled OLS	(4) Pooled OLS	(5) Pooled OLS	(6) Pooled OLS	(7) Pooled OLS
size	0.06***	0.05***	0.05***	0.06***	0.06***	0.06***	0.05***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
age	-0.04***	-0.09***	-0.07***	-0.06***	-0.04***	-0.09***	-0.08***
	(0.008)	(0.010)	(0.008)	(0.010)	(0.008)	(0.010)	(0.010)
sshare		-0.01**		-0.01**		-0.01**	-0.01**
		(0.006)		(0.006)		(0.006)	(0.006)
tshare			0.00		0.00	-0.01	-0.00
			(0.012)		(0.012)	(0.014)	(0.014)
exportdum						0.08***	0.08***
						(0.027)	(0.027)
manufac						0.02*	0.02**
						(0.008)	(0.008)
dtar	-0.11***			-0.12***	-0.11***		
	(0.007)			(0.008)	(0.007)		
kl							0.01***
							(0.004)
opendum							0.03***
							(0.008)
constant	-1.24***	-0.99***	-0.97***	-1.31***	-1.23***	-1.02***	-0.96***
	(0.088)	(0.099)	(0.089)	(0.100)	(0.090)	(0.102)	(0.108)
Observations	4940	3868	5147	3718	4940	3868	3868
R-squared	0.097	0.067	0.058	0.116	0.097	0.069	0.068

Notes:

1. Variable Definitions: tfp=log(TFP); sshare=log(state share/total share); exportdum=1 if the companies' overseas sales >50% of their total sales, 0 otherwise; manufac=1 if they belong to manufacturing industries, 0 otherwise; opendum=1 if firm-year observations are from years 2002-2004, 0 if they are from year 1999-2001; dtar=log(debt to total asset ratio); size=log(total assets); age= log(current year-the year of its incorporation); kl=log(real capital/real labor); sshare=log(state share/total share); tshare=log(tradable shares/total shares).
2. All of the variables are in natural logarithm.
3. All the variables are winsorized at 0.5%.
4. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

In Table 9 Panel B, firms with higher state ownership percentage tend to be less productive than those with less state-share ownership, which is in line with the results from the literature. However, tradable-share ownership does not appear to be significant.

The reason could be that firms with more tradable shares have, on one hand, more access to capital through the stock market but on the other hand, suffer more from the bear market than those with fewer tradable shares.

Table 9 also shows the effects of the industry dummy, export dummy, and openness dummy. It is found that manufacturing industries have higher TFP levels at a 1% significance level. The export dummy controls the effects of a firm's international orientation. The results show that exporters more productive than non-exporters, which is consistent with findings in Fernandes (2009) using data from manufacturing firms in Bangladesh. The years 2001-2002 witnessed significant changes: China's accession to the WTO; introduction of programs opening up the financial market more to investors at home and abroad; and more liberalization in the banking sector. Results show that the TFP level from 2002-2004 is higher than that from 1999 to 2001 on average. This finding is in line with the findings by Bekaert et al. (2009) using cross-country data. Year dummies are included to control for the possible trend effects.

5.2 Fixed Effects Models

Table 10 shows the relationship between financial development and productivity at the firm level using the specifications in equation [20]. Regressions are estimated using Fixed Effects Panel Regression Models. By including firm fixed effects, I can also control for any other unobserved firm characteristics that can affect the relationship between the firm-level TFP and the independent variables. Year dummies are added to control for the temporal effects of financial development on productivity at the firm level. Financial constraint proxies are included in all the specifications. Table 10 Panel A column (1) shows the results using the base model, where size and age are examined.

Results show that firm size and age are entered with the expected signs at 1% level of significance.

TABLE 10 Fixed Effects Regressions from Equation [20]

Panel A Estimates: Financial Constraints, Financial Structure, and Ownership Concentration

Dependent Variable: ln (TFP)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	FE	FE	FE	FE	FE	FE	FE
size	0.07***		0.11***	0.06***	0.06***	0.09***	0.09***
	(0.010)		(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
age	-0.14***		-0.13***	-0.15***	-0.15***	-0.13***	-0.14***
	(0.026)		(0.025)	(0.027)	(0.027)	(0.026)	(0.026)
dtar		-0.12***	-0.15***			-0.15***	-0.15***
		(0.011)	(0.011)			(0.012)	(0.012)
oneshareholder				0.01		0.01	
				(0.009)		(0.009)	
tenshareholder					0.03**		0.04***
					(0.013)		(0.013)
constant	-1.28***	-0.11***	-2.07***	-0.90***	-0.91***	-1.77***	-1.79***
	(0.224)	(0.010)	(0.231)	(0.242)	(0.241)	(0.248)	(0.248)
Observations	5147	4942	4940	4154	4154	4146	4146
R-squared	0.023	0.038	0.066	0.025	0.026	0.068	0.070
Number of company	1165	1165	1165	1160	1160	1160	1160

Notes:

1. Variable Definitions: tfp=log (TFP); sshare= log (state share/total share); dtar=log (debt to total asset ratio); oneshareholder=log(shares held by the top one shareholder/total shares); tenshareholder=log(shares held by the top ten shareholders/total shares).
2. All of the variables in natural logarithm.
3. All the variables are winsorized at 0.5%.
4. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Panel B Estimates: Ownership Category, Financial Structure, Financial Constraints, and TFP

VARIABLES	(1) FE	(2) FE	(3) FE	(4) FE	(5) FE	(6) FE	(7) FE
size	0.07***		0.11***	0.08***	0.09***	0.12***	0.12***
	(0.010)		(0.011)	(0.012)	(0.011)	(0.013)	(0.011)
age	-0.14***		-0.13***	-0.13***	-0.15***	-0.12***	-0.14***
	(0.026)		(0.025)	(0.031)	(0.026)	(0.030)	(0.025)
dtar		-0.12***	-0.15***			-0.16***	-0.16***
		(0.011)	(0.011)			(0.013)	(0.011)
sshare				-0.02*		-0.02	
				(0.014)		(0.013)	
tshare					-0.16***		-0.20***
					(0.027)		(0.027)
constant	-1.28***	-0.11***	-2.07***	-1.49***	-1.64***	-2.34***	-2.60***
	(0.224)	(0.010)	(0.231)	(0.264)	(0.231)	(0.272)	(0.240)
Observations	5147	4942	4940	3868	5147	3718	4940
R-squared	0.023	0.038	0.066	0.027	0.032	0.075	0.080
Number of company	1165	1165	1165	915	1165	915	1165

Notes:

1. Variable Definitions: tfp=log(TFP); dtar=log(debt to total asset ratio); size=log(total assets); age= log(current year-the year of its incorporation); sshare=log(state share/total share); tshare=log(tradable shares/total shares).
2. All of the variables are in natural logarithm.
3. All the variables are winsorized at 0.5%.
4. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

model. In column (2), financial structure proxied by the debt-to-asset ratio (*dtar*) is included in the model. When a firm's debt ratio is 10 percent higher than other firms, its total factor productivity level is 1.2% lower than others, which is consistent with the findings in literature based on one group of theories.

While a firm's financial structure is one indicator of financial development, it is crucial to define a firm's corporate governance, as mentioned earlier. An effective corporate governance also reflects one aspect of the financial system. Besides the financial structure, other variables that could proxy for a firm's corporate governance are

financial ownership concentration and ownership category. Because of the special characteristics of Chinese listed firms, state share percentage, tradable A share percentage, and top one and top ten shareholder percentage are used to gauge the ownership structure. Column (3) in Panel A of Table 10 presents the results of the impact on TFP at the firm level of financial constraints and financial structure while columns (4)-(6) show the impact of financial constraints, financial structure, and corporate governance proxied by ownership concentration percentage on TFP at the firm level respectively and jointly. The results are still significant. The effects of leverage (debt-to-asset) ratio, firm size and age are consistent with those seen in the base model. However, the effects of ownership concentration between top one and top ten shareholder ownership percentages are mixed. Top one shareholder concentration has an insignificant relationship with firm-level TFP but top ten shareholder concentration has a significant positive relationship. If ownership is too concentrated, firms might tend to lose efficiency but if ownership is sufficiently concentrated, owners can monitor corporate governance more effectively, which is more beneficial for the productivity level.

In Table 10 Panel B, ownership category (state-share and tradable-share percentage) are used to proxy for corporate governance. Financial constraints are measured by size and age. The results on financial constraints proxies are similar to those in Panel B. Corporate governance measured by state-share ownership has no significant impact on TFP level consistently across different econometric specifications, while corporate governance measured by tradable-share ownership has a significant negative relationship with productivity level. That means firms with more tradable

shares are more prone to the ups and downs of the stock market. From 1999 to 2004, the Chinese stock market experienced a long bear market, which affected the firms with more tradable-shares in a negative way. The results for the main hypotheses are listed in Table 11.

TABLE 11 Summary of Results

Hypotheses	Full Sample
Financial Development at the firm-level	
Channel 1: Access to capital	
Hypothesis 1: The more easily the firm accesses capital, the higher TFP of a firm.	**Supported**
Channel 2: Corporate Governance	
Financial Structure (Debt ratio)	
Hypothesis 2: Debt-to-Asset Ratio is either positively or negatively associated with firm-level TFP.	**Supported (negative relationship)**
Ownership Structure	
Ownership concentration (top one or top ten shareholder ownership percentage)	
Hypothesis 3: The more concentrated the shareholder ownership, the higher TFP level.	**Supported**
Ownership Category (ownership type and share type)	
Hypothesis 4 State-ownership has a negative relationship with the firm-level TFP..	**Supported**
Hypothesis 5: Tradable-share ownership has a positive relationship with the firm-level TFP.	**Not Supported**

Note: Hypotheses 1-8 are all alternative hypotheses.

TABLE 11 (cont'd)

Hypotheses	Full Sample
Firm Characteristics (other correlates of TFP and control variables)	
Capital Intensity (kl)	
Hypothesis 7: Firms with higher capital to labor intensity ratio have higher TFP level.	**Supported**
Other Control Variables	
Industry Dummy (Manufacturing =1,Non-manufacturing=0)	
Export Orientation Dummy (Export=1; Non-Export=0)	
Openness Dummy (Year 2002 to control for financial liberalization)	
Hypothesis 8: Firms with more export orientation, after the year 2002, or in manufacturing industries are more productive than those otherwise.	**Supported**

Note: Hypotheses 1-8 are all alternative hypotheses.

5.3 Robustness Check: Sample Split

For a robustness check of whether the role of financial development differs across different types of firms, I split the sample into two subsamples according to industry, state-ownership, and tradable-share type. In Table 12 Panel A, we compare the effects of financial constraints and financial structure on TFP level in manufacturing and non-manufacturing industries. Size (a measure of financial constraints) has different degree of association with the firm-level TFP for manufacturing and non-manufacturing industries. The Chow test shows that the two coefficients of size between those two subsamples are different at 1% significance level.

Considering the special characteristics of Chinese listed firms, we find that ownership category matters for the financial constraints. Chow et al. (2002) find that

firms with more state shares usually have an advantage of a soft budget (preferential subsidy from the government, for example). Therefore, Table 12 Panel B compares the results between firms where more than 33% of the shares are state owned and firms where fewer than 33% of the shares are non-state-owned. Interestingly, we find that the relationship between age and firm-level TFP differs between those two subsamples (with the threshold being 33% of state-share ownership, the mean value of the total sample). Financial development matters more for firms with less than 33% state share ownership. While the state-owned enterprises are more prone to managerial inefficiency, the older the firms are, the lower their productivity level. The Chow test shows that the coefficient of age is different across those two subsamples at 10% level of significance.

In addition, also because of the special characteristics of share type of listed firms in China, how many shares are tradable among investors could show the extent to which the firms are open to the stock market. Between 2001 and 2005, the period when China was searching for the Big Fix, the biggest movement was to reduce the state's holding of non-tradable shares. So splitting the whole sample into two subsamples based on tradable shares is a way to examine the impact of financial development on TFP level. Table 12 Panel C shows that the TFP level of firms with more tradable shares is more responsive to financial constraints than that of firms with those with fewer tradable shares. That is expected according to the hypothesis that financial development affects a firm's TFP level more during stock market expansion. The Chow test shows that the coefficients of financial structure are different between firms with more tradable shares and those with fewer tradable shares, while the coefficients of size and age are about the same. That means the stock market is still relatively small compared to financial

intermediaries. The study finds evidence that financial development is associated with firm-level TFP through two of the channels that are embodied in the functions of a sound financial system—to ease access to financing and to improve corporate governance. The effects of those two proposed channels could differ across industries (manufacturing versus non-manufacturing), ownership type (>33% of shares being state-owned vs. <33% of shares being state-owned), and share type (firms with more than 38% of their shares that are tradable vs. those with fewer than 38% of shares that are tradable).

TABLE 12 Fixed Effects Models: Sample Split

Dependent Variable: ln (TFP)

	Panel A		**Panel B**		**Panel C**	
VARIABLES	Manufac	Non-Manufac	State Share	Non State-Share	Tshare	Non-Tshare
size	0.04**	0.14***	0.11***	0.10***	0.12***	0.10***
	(0.019)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
	size_M=size_NonM		size_S=size_NonS		size_T=size_NonT	
	F(1,4922)=1.49		F(1,3758)=0.11		F(1,3758)=1.59	
	P>F=0.2226		P>F=0.7430		P>F=0.2080	
age	-0.13***	-0.13***	-0.14***	-0.08***	-0.14***	-0.12***
	(0.044)	(0.030)	(0.029)	(0.030)	(0.026)	(0.041)
	age_M=age_NonM		age_S=age_NonS		age_T=age_NonT	
	F(1,4922)=2.41		F(1,3758)=3.38		F(1,3758)=0.19	
	P>F=0.1203		P>F=0.0659		P>F=0.6631	
dtar	-0.12***	-0.16***	-0.14***	-0.16***	-0.14***	-0.17***
	(0.019)	(0.014)	(0.015)	(0.016)	(0.014)	(0.015)
	dtar_M=dtar_NonM		dtar_S=dtar_NonS		dtar_T=dtar_NonT	
	F(1,4922)=10.63		F(1,3758)=1.01		F(1,3758)=3.60	
	P>F=0.0011		P>F=0.3138		P>F=0.4228	
Observations	4940	4940	4940	4940	4940	4940
Number of company	1165	1165	1165	1165	1165	1165
R-squared	0.072	0.072	0.070	0.070	0.077	0.077

Notes: 1. Variable definition: size=log (total assets); age=log(current year-the year of the incorporation); dtar=log(debt/asset). 2. All variables are in natural logathrim. 3. Chow tests are conducted to check the difference between the coefficients. 4. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

CHAPTER VI

CONCLUSION

6.1 Summary of Results and Policy Implications

This study explores the relationship between financial development and total factor productivity level, using firm-level data from listed firms in China over the period of 1999-2004. The results show that financial development is positively associated with total factor productivity at the firm level in the case of China. Different from previous studies that use country-level financial development, this study focuses mainly on two of the major functions of financial system–to ease financial constraints and improve corporate governance–as proxies for firm level financial development. Following the common approach in the literature, the calculations of a Chinese listed firm's financial constraint index to predict whether firms are financially constrained or not were based on firm size and age (*Lfcsa)* for each year. Other measures included the logistic discriminant score (*Lfc*) for a robustness check. Firm size and age are entered directly in the regressions as measures for firm-level financial constraints. The firm-level TFP calculated using a non-parametric method (Multilateral TFP Index Approach) was retrieved from East Asian Listed Companies (EALC) Database 2007 of the Japan Center for Economic Research.

Regression estimates show that financial development measured by financial constraints at the firm level is positively associated with TFP: i.e., the easier the access to capital, the higher a firm's TFP.

In addition to the channel of financial constraints, the channel of corporate governance on firm-level TFP is also examined. The results show that a high debt-to asset ratio is associated with a lower firm productivity level, which is consistent with one line of literature. Our findings are consistent with the findings that concentration of ownership is good for monitoring daily activities and innovative investment. Ceteris paribus, the higher the percentage of top one shareholder ownership, the more productive the firm; however, the impact of the percentage of top one shareholder ownership is not significant in the Fixed Effects models. In addition, I also find that firms with high capital intensity tend to have a higher TFP level. The study investigates other correlates of TFP and finds that exporters, those firms whose overseas sales are more than 50% of their total sales, are more productive than non-exporters. To control for the effects of the opening of China's financial sector both in the stock market and banking sector, a year 2002 dummy is added to our specification and the results show that after 2002 firms are more productive. In addition, the impact of financial constraints on firm-level TFP varies across manufacturing and non-manufacturing industries; firms with different state share ownership; and firms with different tradable share ownership. The magnitude of the impact of financial constraints is greater in manufacturing industries. In addition, financial constraints caused by financial frictions affect the firms disproportionally with different state share and tradable share ownership structure financial development matters more for firms with less than 33% state share ownership. Moreover, due to the special characteristics of share type of listed firms in China, the number of shares that are really tradable among investors could show the extent to which the firms are open to the stock market.

In the literature, there is a finance-growth puzzle in China. Reform in the formal financial system cannot catch up with China's rapid economic growth. Some argue that it is the hybrid system that sustains the growth (Allen et al., 2005). While it is true that the informal financial sector like private firms, township-village enterprises does play a vital role in China's economic growth, we find that China is not a counter example, but a perfect example for explaining the positive relationship between finance and economic growth. There is a Chinese saying: regardless the color of the cat, if it can catch a mouse, it is a good cat. What this study considers is the overall financial system and its function to provide access to capital. In fact, a recent paper by Demetriades et al. (2008) shows that access to bank loans is positively related with a firm's future value-added growth, and productivity growth and firms with access to bank loans tend to grow faster in regions with greater banking sector development.

The findings from the current study can provide valuable policy implications for the Chinese government for future financial sector reforms especially those in stock markets. Though listed firms account for only a small proportion of GDP, the results point to a future direction for the firms. More and more firms will get listed to raise more capital. More tradable shares will be open to retailer investors. During the period 2001-2005, China was searching for the Big Fix and began reducing the state's holding of non-tradable shares. Though that led to a big drop in the stock market and a bear market in the following years, the pain needs to be endured before it gets better. Our results show that firms respond more to financial constraints during a more open stock market. The government has already talked about relaxing more restrictions and permitting more good firms to be listed. The positive relationship between financial development and total

factor productivity at the firm level implies that the sound financial system that China is trying to build will eventually put the country on the path to more sustained economic growth. In addition, the indices that are created using Chinese listed firms can provide a way for the government to predict which firms will be more or less financially constrained, and that information will help decision makers determine who needs more funds and who does not.

6.2 Future Research

Future studies could explore the dynamics of TFP across firms within an industry and across industries during the sample period. The Multilateral Index Approach by Good et al. (1996) can be decomposed into two parts: (1) the unweighted average firm TFP (within-firm) and (2) a term measuring the covariance between firm market share and firm TFP (between-firm). The between-firm component measures the allocative efficiency. If it is positive, that means the more productive firms in the industry have higher market shares and the allocation of resources is efficient. The Multilateral Index Approach by Good et al. (1996) can also be decomposed into two components: (1) change in TFP between firms over time and (2) change in TFP for the typical firm.[17] Hence, the relative importance of allocative efficiency within an industry and TFP growth of an industry can be evaluated. In addition we can examine the impact of financial development on those two components and see which one plays the more important role; the results could provide more important policy implications. Fixed Effects-IV approach or GMM dynamic panel approach will be used to correct the endogeneity issues. The possible IVs could be tax policy for example and with more data available, we can have better estimators and see the direction of causality between financial development and total

[17] A typical firm is defined in Good et al. (1996).

factor productivity at the firm level and the effects of financial development on TFP growth rates will be examined in the future research.

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APPENDIX A
List of Data variables:

1. Real Gross Output (sales): Nominal output is based on sales after adjusting for increases/decreases in inventories. For wholesalers and retailers, instead of sales, the difference between sales and purchases was used as output. Real output and real intermediate inputs are obtained by deflating nominal value using the price index for each industry. Real values are from the EALC 2007 database.

2. Labor input: multiplication of number of employees and the average number of hours worked in each industry. Number of employees is from CSMAR database; labor cost is obtained from the financial statements. Labor input is from the EALC 2007 database.

3. Capital cost: capital stock times capital service price which can be obtained from the EALC 2007 database.

4. Firm size: natural logarithm of total assets. Other measures are natural logarithm of total employee number, natural logarithm of total market capitalization.

5. Age: current year minus the year when the firm was incorporated.

6. Dividend Ratio: (Dividends from Common stock +preferred stock)/Net Income

7.Current Ratio: Current Asset over Current Liabilities.

8. Cash: Cash plus Cash Equivalent

9. Leverage: Debt-to-Asset Ratio

10. Cashflow: Net cash flows from operations.

11. State shares are those held by the central government, local governments, or solely government-owned enterprises. State shares are not allowed for trading but transferrable to domestic institutions, upon approval of CSRC. Legal person shares are those sold to institutional holders such as securities companies and other SOEs during the corporation process. Employee shares are those sold to the employees in the same process.

APPENDIX B
List of Industries

Manufacturing Industries and their TFP growth rates, 1999–2004

	Industry Name	1999	2000	2001	2002	2003	2004	1999–2004
6	Food and kindred products	0.02	0.05	0.00	0.05	0.13	0.08	0.05
7	Textile mill products	0.02	0.02	-0.01	0.03	0.02	0.02	0.02
8	Apparel	0.02	0.07	0.00	0.02	0.05	0.06	0.04
9	Lumber and wood							
10	Furniture and fixtures	0.00	0.13	0.12	-0.11	-0.13	-0.07	-0.01
11	Paper and allied	0.02	0.05	-0.03	0.02	0.05	0.08	0.03
12	Printing, publishing and allied	0.01	0.00	0.01	0.02	-0.10	-0.01	-0.01
13	Chemicals	0.03	0.03	0.04	0.13	0.11	0.08	0.07
14	Petroleum and coal	0.00	0.10	-0.03	-0.01	0.02	0.11	0.03
15	Leather	0.00	-0.04	-0.02	-.0.01	0.01	0.00	-0.01
16	Stone, clay, glass	0.04	0.15	0.15	0.12	0.19	0.20	0.14
17	Primary metal	0.01	0.03	0.05	0.08	0.11	-0.01	0.05
18	Fabricated metal	0.16	0.23	0.25	0.22	0.09	0.30	0.21
19	Machinery, non-elect	0.04	0.04	0.06	0.07	0.11	0.16	0.08
20	Electrical machinery	0.02	0.04	0.05	0.09	0.14	0.16	0.08
21	Motor vehicles	0.01	-0.01	-0.01	0.03	0.08	0.14	0.04
22	Transportation equipment & ordnance	0.02	0.01	0.01	0.11	0.14	0.18	0.09
23	Instruments	0.07	0.13	0.13	0.08	0.13	0.19	0.12
24	Rubber and misc plastics	0.01	0.02	0.02	0.06	0.06	0.07	0.03
25	Misc. manufacturing	0.08	0.11	0.11	-0.03	-0.02	0.03	0.04
Manufacturing Industries		0.0325	0.0611	0.0474	0.0544	0.0626	0.0936	0.0574
Number of firms		424	481	572	621	668	707	

Non-Manufacturing Industries and their TFP growth rates, 1999-2004

	Industry Name	1999	2000	2001	2002	2003	2004	1999-2004
1	Agriculture	0.05	0.11	-0.04	-0.05	-0.04	-0.09	-0.01
2	Coal mining	0.03	0.03	-0.07	-0.18	-0.20	-0.32	-0.12
3	Metal and non-metallic mining	0.02	-0.06	-0.11	-0.23	-0.19	-0.12	-0.12
4	Oil and gas extraction	0.05	-0.20	-0.31	-0.57	-0.21	-0.78	-0.34
5	Construction	0.03	-0.01	-0.05	-0.01	-0.04	-0.05	-0.02
26	Transportation	0.04	0.09	0.18	0.20	0.19	0.29	0.16
27	Communication	0.04	0.08	0.10	0.08	0.17	0.29	0.13
28	Electric utilities	0.03	-0.05	-0.04	-0.04	-0.01	0.00	-0.02
29	Gas utilities	0.01	0.06	0.08	0.03	0.06	0.12	0.06
30	Trade	0.04	0.06	0.11	0.10	0.14	0.12	0.09
31	Finance Insurance and Real Estate	0.07	0.09	0.10	0.14	0.14	0.15	0.11
32	Other private service	0.06	0.22	0.16	0.09	0.14	0.15	0.13
33	Public service							
Non-manufacturing Industries		0.0392	0.035	0.0092	-0.037	0.0125	-0.02	0.0042
Number of firms		236	265	297	319	332	335	

VITA

Junhui (Grace) Yan Johnson

Candidate for the Degree of

Doctor of Philosophy

Thesis: THE ROLE OF FINANCIAL DEVELOPMENT IN TOTAL FACTOR PRODUCTIVITY: EVIDENCE FROM LISTED FIRMS IN CHINA

Major Field: Economics

Biographical:

Personal Data: Born in Hangzhou, China; the daughter of Dongyang Yan and Naikang Shen.

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Name: Junhui (Grace) Yan Johnson Date of Degree: July, 2010

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: THE ROLE OF FINANCIAL DEVELOPMENT IN TOTAL FACTOR PRODUCTIVITY: EVIDENCE FROM LISTED FIRMS IN CHINA

Pages in Study: 88 Candidate for the Degree of Doctor of Philosophy

Major Field: Economics

Scope and Method of Study: This study empirically investigates the relationship between total factor productivity (TFP) and financial development at the firm-level using listed firms in China over the period of 1999 to 2004. Two main channels through which financial development can affect total factor productivity at the firm level are explored: 1. financial constraints and 2. corporate governance. A nonparametric approach by Good et al. (1996) is chosen to estimate the firm-level TFP. Traditional measures such as size and age are used as proxies for the first channel−financial constraints. Inspired by Hadlock and Pierce (2009), size and age are also chosen as predictor variables to calculate a financial constraint score. For the second channel, two dimensions of the corporate governance are examined: financial structure measured by the debt-to-asset ratio and ownership structure proxied by ownership concentration and ownership category. The paper also evaluates the relationship between a firm's characteristics (capital intensity and export orientation) and its TFP level. Pooled OLS and Fixed Effects estimators are used and the Chow tests are conducted to see whether the role of financial development differs across different types of firms.

Findings and Conclusions: This study finds that financial development measured by financial constraints at the firm level is positively associated with TFP: i.e., the easier the access to capital, the higher a firm's TFP. The results show that a high debt-to-asset ratio is associated with a lower firm productivity level, which is consistent with one line of literature. Top ten shareholder concentration has a significant positive relationship, while state-ownership has a significant negative relationship with firm-level TFP.

The positive relationship between financial development and total factor productivity at the firm level implies that the sound financial system that China is trying to build will eventually help the country get on a more sustained economic growth path. In addition, indices created for Chinese listed firms using a more comprehensive set of company factors can provide a way to predict which firms will be financially constrained.

ADVISER'S APPROVAL: Dr. Michael Applegate