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Development of the Chinese

Financial System and Reform of

Chinese Commercial Banks

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Abstract

Comprehensive economic reform in China from 1978 has introduced profound restructuring of its financial system, in particular the banking sector. Recent initiatives have focused on ownership transformation via foreign participation and stock listing. China's stock markets have reacted highly positively to the Initial Public Offering (IPO) of Chinese commercial banks. As stock listing has been considered as an effective tool to enhance the corporate governance of the firms, a case study using China Construction Bank (CCB) had been conducted to get a more detailed understanding of in what aspects had the corporate governance of the listed banks been enhanced after IPO? By comparing the annual reports of CCB from 1999 to 2008, I found that the bank had made quite profound and comprehensive changes since its IPO in 2005. In all major areas required by the corporate governance principles, the CCB had displayed a very high level of compliance although flaws in some fundamental aspects still existed.

Since the end of 2007, the US credit crunch had induced turmoil in the global financial market that caused the collapse of several world banking giants. Nonetheless, Chinese commercial banks had stood apart from the rest of the world and achieved remarkable results. With improved corporate governance, we further tested whether the banks' performance had been enhance after IPO? Meanwhile, the influence of the financial crisis to China's financial market and the future reform of its banking sector had also been addressed in this thesis.

Employing data of 14 listed Chinese banks for the period 1999 to 2008, we applied both Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) to test our hypotheses. Our findings suggested that stock listing indeed could enhance the pure technical efficiency of the banks by about 5% and also improve their scale economies.

A major contribution of this thesis is that it is the first study in English to employ two different frontier approaches to evaluate the effectiveness of IPO on the efficiency of Chinese banks. It also contributes to the growing literatures on the corporate governance issues related to IPO and firm performances, in particular under the background of China.

Acknowledgement

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Abbreviations

1. Names and Abbreviations of Chinese Commercial Banks

Abbreviations	Full Name of the Banks
ABC	Agricultural Bank of China
BOC	Bank of China
BOCOM	Bank of Communications
CCB	China Construction Bank
CEB	China Everbirght Bank
CITIC	China CITIC Bank
CMB	China Merchant Bank
CMINB	China Minsheng Bank
HXB	Hua Xia Bank
ICBC	Industrial & Commercial Bank of China
Industrial	Industrial Bank
PDB	Shanghai Pudong Development Bank
SDB	Shenzhen Development Bank

2. General Abbreviations

SOEs	State-Owned Enterprises
SOBs	State-Owned Banks
NPLs	Non-Performing Loans
ROE	Return on Equity
ROA	Return on Assets
CCB	China Construction Bank
HKSE	Hong Kong Stock Exchange
IPO	Initial Public Offering
SSE	Shanghai Stock Exchange
WTO	World Trade Organization
GDP	Gross Domestic Product
PBOC	People's Bank of China
ADBC	Agricultural Development Bank of China
CDB	China Development Bank
Chexim	Export-Import Bank of China

JECBs	Joint-Equity Commercial Banks
FIB	Fujian Industrial Bank
AMCs	Asset Management Companies
CCBs	City Commercial Banks
CBRC	China Banking Regulatory Commission
CSRC	China Securities Regulatory Commission
ADB	Asian Development Bank
IFC	International Finance Corporation
BOA	Bank of America
RBS	Royal Bank of Scotland
UBS	United Bank of Switzerland
RCCs	Rural Credit Cooperatives
NIROA	Non-Interest Income to Assets
MBS	Mortgage-backed Securities
CRS	Constant Return to Scale
VRS	Various Return to Scale
IRS	Increased Return to Scale
DRS	Decreased Return to Scale
M&As	Mergers and Acquisitions
TE	Technical Efficiency
AE	Allocative Efficiency
CE	Cost Efficiency
SE	Scale Efficiency
PTE	Pure Technical Efficiency
SFA	Stochastic Frontier Approach
DFA	Distribution-Free Approach
TFA	Thick Frontier Approach
DEA	Data Envelopment Analysis
FDH	Free Disposal Hull
EFA	Econometric Frontier Approach
QFII	Qualified Foreign Institutional Investor
ML	Maximum Likelihood Method
OLS	Ordinary Least Squares
ISAs	International Accounting Standards

ECB	European Central Bank
IMF	International Monetary Fund
CCP	Chinese Communist Party
NED	Non-Executive Director

Chapter 1 Introduction

1.1 Background and Research Questions

Along with China's comprehensive economic reform from 1978, the Chinese banking system has experienced tremendous structural transformations and fundamental changes. The banking system in China has evolved from a monopolistic state agent to one with more than a hundred commercial banks, urban cooperatives and financial institutions coexisting in the market. In the past, banks served as government policy lending agencies, providing funds to state-owned enterprises (SOEs) and taking deposits from private and public savers. This was especially the case for the state-owned banks (SOBs). Encumbered with non-performing loans (NPLs), their profitability, productivity and asset quality remained quite low even after a series of banking reforms. Recently, the reform has focused on ownership diversification as reformers believed that tightened corporate governance, better budget control and partial privatization were ways to improve efficiency.

Foreign acquisition and stock listing are two major strategies for partial privatization without completely losing state control. Starting from 1999, the government had injected funds or stripped-off NPLs, which together totalled RMB 2.62 trillion from the three largest SOBs, enabling them to qualify stock listing requirements and become attractive to investors. By the end of 2008, the NPLs/total loans ratio of the SOBs had been reduced significantly from 36.23% in 1999 to just 2.45%. Apart from the improvement of asset quality, the profitability of the major Chinese commercial banks was also enhanced.

Despite relying heavily on interest incomes, the ratios of return on equity (ROE) and return on assets (ROA) of the SOBs had risen almost three times from 2002 to 2006, reaching 10.7% and 0.6% respectively.

With a cleaned balance sheet and enhanced income generating ability, stocks of the banking sector were certain to be attractive when they list on the stock exchanges. In October 2005, the China Construction Bank (CCB) was listed successfully on the Hong Kong Stock Exchange (HKSE). It was followed by the Bank of China (BOC) and Industrial and Commercial Bank of China (ICBC) in 2006. The initial public offering (IPO) of the ICBC on both the Shanghai Stock Exchange (SSE) and the HKSE was the largest IPO in the history of global capital market to that date. Stock market reacted highly positive to these IPOs, in particular from the second half of 2006.

As stock listing has been considered as an effective tool to improve the corporate governance of the firms and consequently their performance, we would like to investigate in detail that in what aspects have the corporate governance practises of listed banks been improved afetr IPO. Using CCB as an example, a case study will be conducted. As the first listed state-owned commercial bank, information of CCB before and after its IPO covers a relatively long period, which eases our comparison and analysis. The *OECD Principles of Corporate Governance* of 2004 will be employed as the analytical prism to examine the strengths and weaknesses of bank's corporate governance practices.

Since the end of 2007, the US credit crunch has disrupted the stability of the world financial markets. Share prices of some of the world's banking giants, such as Citigroup and Royal Banks of Scotland (RBS), tumbled by more than 95% from 2007 to January 2009. However, its influence to the Chinese banking sector was quite limited as Chinese banks were more conservative than their foreign counterparts in derivatives investment. By early 2009, China's three biggest SOBs had supplanted the American and European banking giants to become the world's largest commercial banks in market capitalisation, barely two years after they were listed on the HKSE and SSE.

Facing extremely volatile financial environment in 2008, the performance of Chinese commercial banks outshined the rest of the world. China's banking industry reported RMB 583.4 billion ($85.79 billion) in after-tax profit, up 30.6% year-on-year. All the listed banks had made impressive improvements. For example, the net profit of the Pudong Development Bank (PDB), China CITIC Bank (CITIC) and Huaxia Bank (HXB) had increased by 127.6%, 61% and 46.2% respectively year-on-year. Three of China's biggest SOBs were among the world's five most profitable banks in 2008. With an increase in profits of 35.2%, ICBC's total profit of RMB 111.2 billion took the first place. This was followed by CCB, whose net profit grew by 34% to RMB 92.6 billion. Despite negatively influenced by the relatively large exposure of the foreign market, BOC still managed to increase its net profit by 14.4% to RMB 64.4 billion, locking its position in the fourth place. Therefore, it raised our research interest of assessing whether the efficiency/performance of Chinese commercial banks had been improved via stock listing.

To compare bank efficiency before and after their IPOs, we will employ both non-parametric approach, DEA, and the parametric approach, SFA, to examine the efficiency levels of 14 listed Chinese commercial banks. According to our best knowledge, the effect of IPO on bank efficiency has not been well studied in the literatures because most banks have been listed on the stock exchanges for a rather short period of time, not to say using two different frontier approaches for measurement. The use of two estimation techniques allows us to assess the robustness of the tested efficiency ratings and to ensure the correctness of policy implications generated afterwards. Apart from the effect of IPO, a few other research questions will also be addressed. For example, how efficient are the Chinese listed banks currently? Have the SOBs become more efficient after a series of state supports? How is the scale efficiency of the Chinese SOBs? What are the key determinants of bank efficiency in China?

Finally, the influence of the US credit crunch on Chinese banking sector will also be analyzed. Despite limited exposure of Chinese commercial banks to the US mortgage backed securities, as China's financial sector becomes more integrated into the world economy, questions have been asked about the influence of the US housing crisis on the Chinese banks and the wider economy. In 2008, the world financial market was enmeshed in bad news. Some of the US biggest names were either put up for sale, bought by the US government, or became bankrupt. Given similarities between the US, the UK and the Chinese housing markets, serious concern was triggered about how an exposure among Chinese banks might spillover into China's financial sector? And with the rapid growth in the market for domestic mortgages, another

question was whether China might also experience a similar housing crisis in the future?

In summary, this thesis will explore the development of Chinese financial system and its influence to the wider economy in three aspects: the reform of the Chinese commercial banks, in particular stock listing of the SOBs and their current performance; the development of corporate governance of Chinese listed commercial banks after stock listing; and finally, the influence of the US credit crunch on the Chinese banking system and its wider economy.

1.2 Thesis Structure

Including the introduction and conclusion, this thesis has eight chapters. Chapter 1 discusses the research background and defines the research questions. Chapter 2 presents a detailed review of the development of the Chinese commercial banks. In Chapter 3, the existing literatures about the efficiency of the banking systems, especially Chinese banking sector, will be critically reviewed. A few concepts, such as the technical efficiency of the banks and their scale economy will be introduced. Chapter 4 will focus on analysing the effect of IPO on the corporate governance improvement of the banks using CCB as a case study. The following Chapter 5 will discuss the theories and mathematical calculation of the two efficiency measurement techniques, the non-parametric approach, DEA, and the parametric approach, SFA. Their relative advantages, limitations and the special issues that need to be considered when the two approaches are applied to bank efficiency studies will be explored.

Empirical studies include Chapters 6 and 7. Chapter 6 defines the input and

output variables and assesses the efficiency of Chinese listed banks using DEA

and SFA models. Factors that influence the efficiency level of the banks and

the consistency of measured efficiency between the two approaches are tested

as well. Chapter 7 assesses the impact and the possible spillover effect of the

US credit crunch on China's financial system, housing market and its wider

economy. Chapter 8 concludes the whole thesis, clarifying the contribution to

the literatures and suggesting future research directions.

Chapter 2 Background Review

China's financial sector consists of banks, non-bank financial institutions and stock market. Economic reform since 1978 has fundamentally changed the Chinese banking sector, transforming it from a mono-bank model to a system with multi-financial institutions. The banking sector now serves as an important mechanism in resource allocation and risk diversification. This chapter will present a detailed review of Chinese banking system reform. Particular attention will be paid to the reform of the SOBs, participation of foreign investors and the stock listing of Chinese commercial banks. In addition, since 2005, China started to list the SOBs on the stock exchanges with the goal to make them subject to increased public scrutiny. The performance of the banking stocks after IPO and the relationship between banking stock prices and the overall market index will also be discussed in this chapter.

2.1 Reform of the Chinese Banking System

In 1948, the establishment of the People's Bank of China (PBOC) represented the beginning of China's contemporary banking system. The Chinese financial system thereafter had followed a mono-bank model for about 30 years, in which only one bank, PBOC, carried out two roles: policy lending and commercial operations simultaneously. China's comprehensive economic reform from 1978 also led to substantial fundamental changes to the banking system. The key objective of the banking reform was to transfer the sector from a centralized, state-owned, monopolistic and policy-driven system to a

decentralized, multi-ownership, competitive and profit-oriented system (Yao et

al, 2007). The whole restructuring process carried afterwards could be roughly

divided into four stages.

The initial banking reform period of 1979-1985 saw the establishment of a

two-tier banking system. It was believed that a more specialized banking

system could serve SOEs better and thus increase the overall productivity.

Under the new system, PBOC was divided into two parts. One component

retained name of PBOC and was responsible for supervising all specialized

banks, non-bank financial institutions and insurance companies. The other part

focused on commercial operations and was comprised of four specialized

SOBs, namely, the Agricultural Bank of China (ABC), China Construction

Bank (CCB), Industrial and Commercial Bank of China (ICBC) and Bank of

China (BOC). In the planned economy, these specialized banks served as the

lending mechanism of the government, channelling funds to SOEs and other

agencies under state plan. Instead of penetrating and competing across regions

and sectors, they only provided funding to SOEs within designated sectors. For

example, the ABC was mainly responsible for financing China's agricultural

sector. It offered wholesale and retail banking services to farmers, township

and village enterprises, and other rural institutions. The CCB was designed to

provide medium and long-term credit for urban large specialized construction

projects, such as infrastructure projects and urban housing development. The

ICBC, which was the largest bank in China in terms of total assets, total

employees and total customers concentrated on providing services to

commercial and industrial activities in urban areas. And finally, the BOC was

in charge of managing foreign exchange and dealing with foreign business transactions. These four specialized banks established provincial and local branches to facilitate the residents and local enterprises to access their services. However, these branch operations were under the guidance and administrative control of the respective local authorities rather than the central banks. Therefore, insensitive to profitability goals, they were effectively acting as lending mechanisms of local governments to fulfil the regional production and construction plans.

Several years after the preliminary restructuring, PBOC and the other four specialized banks faced substantial public criticism. Driven by policy lending, the SOBs were used by the state as the "soft lenders" to support highly inefficient and loss-making SOEs and consequently accumulated a huge amount of non-performing loans (NPLs). There was virtually no competition among the banks as they were given monopoly power over different sectors. Such arrangement breached the nation's original goal of establishing a market-oriented economy and thereby, it had been argued that greater autonomy in decision-making of the whole banking system should be given (Chen et al, 2005). As an effective financial intermediation, the banks should act more actively in economic development and resource allocation. As a result, restriction that a specialized bank should serve a designated sector was removed in 1985. The banks could then expand their business scope and compete with each other freely in areas such as loans and deposits services, fund raising and capital allocating. However, such competition remained quite limited as foreign participation was almost wholly restricted and all the SOBs

were still subjected to frequent interventions by both central and local

authorities (Yao et al., 2007).

The second stage of banking reform from 1985 to 1996 can be characterized as

the founding of three policy banks, implementation of banking legislations and

further institutional restructuring. Three new policy banks, the Agricultural

Development Bank of China (ADBC), the China Development Bank (CDB)

and the Export-Import Bank of China (Chexim) were established in 1994 to

take over the government-directed lending functions of the "Big Four". These

banks were especially responsible for financing economic and trade

development and state-invested projects. In particular, the ADBC supports

agricultural development projects in rural areas; the CDB focuses on financing

infrastructure construction and pillar industries, and the Chexim is specialized

in funding export and import of capital goods.

After the foundation of the three policy banks, the former four specialized

banks were officially renamed as "commercial banks" and were expected to be

profit-oriented rather than policy-driven. In addition, the Central Bank Law and

the Commercial Bank Law were passed in 1995 to strengthen the authority of

PBOC and provide a legal framework for the operation of Chinese commercial

banks (National People's Congress, 1995).[1] Under the new regulation system,

the PBOC was given more autonomy and a legal base to formulate policy and

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[1] "Law of the People's Republic of China on the People's Banks of China" had been adopted on 18 March 1995, at the Third Session of the Eighth National People's Congress of the People's Republic of China. President Jiang Zemin signed Presidential Decree No.46 on the same day, approving the implementation of the law since the date of its promulgation. "Law of the People's Republic of China on Commercial Banks" had been adopted at the 13th Meeting of the Standing Committee of the Eighth National People's Congress on 10 May 1995. The law became effective on 1 July 1995.

supervise the financial system. Meanwhile, all other commercial banks were granted a certain degree of operational independence only except certain emergency situations. However, such separation of commercial and policy functions of the banks was far from complete and neat. With limited branch network and capital sources, service and lending activities of the "Big Four" could hardly be fulfilled by the policy banks. Under the additional pressure from the central and local government, the commercial banks continued to be engaged in policy lending.

This period also saw the emergence of the two-tier banking system. Although still dominated by the SOBs, smaller joint-equity commercial banks (JECBs) started to be set up and operate nation-wide.[2] These banks often took a mixed ownership structure including the state, SOEs, and private enterprises or individuals. In 1986, the Bank of Communications (BOCOM) was reestablished and another two banks, the Shenzhen Development Bank (SDB) and China Merchants Bank (CMB) were founded one year later. The later soon surpassed the ABC and became the fourth largest profit maker. In 1988, the Guangdong Development Bank (GDB) was established and it was listed on the SZSE stock exchange in 1992. The only private bank, China Minsheng Bank (CMINB) was established in 1996. All of its shareholders were from private industries and business. Meanwhile, some other JECBs, including China CITIC Bank (CITIC), China Everbright Bank (CEB), Huaxia Bank (HXB), Shanghai Pudong Development Bank (PDB) and Fujian Industrial Bank (FIB) were set up or restructured. Thanks to their relatively independence from the central or

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[2] In the literatures of Chinese banks, "joint-equity" and "joint stock" are equivalent in meaning.

local government, they were believed to have healthier asset quality, higher

profitability and much lower NPLs compared to their state-owned counterpart.

Since then, competition within the banking sector has intensified.

The third stage of banking reform lasted for almost five years until China's

admission to the WTO in 2001. Major events during this period included the

reorganization of PBOC, restructuring of some urban cooperatives into city

commercial banks (CCBs), the establishment of four Asset Management

Companies (AMCs) and the first round of NPL disposal.

Starting from the mid-1990s, some large cities consolidated their urban

cooperatives into city commercial banks. They adopted a shareholding

ownership structure and were restricted geographically within their own

localities. The biggest ones in this group included Beijing Commercial Bank,

Shanghai Commercial Bank and Shenzhen City Commercial Bank. By the end

of 1998, 88 such banks were operating in China, with total assets, deposits and

loans outstanding of RMB 457 billion, RMB 364 billion and RMB 220 billion

respectively (Li et al., 2001). Figure 2.1 below depicts the structure of the

Chinese banking system by the end of 1998.

Figure 2.1 Structure of the Chinese banking system
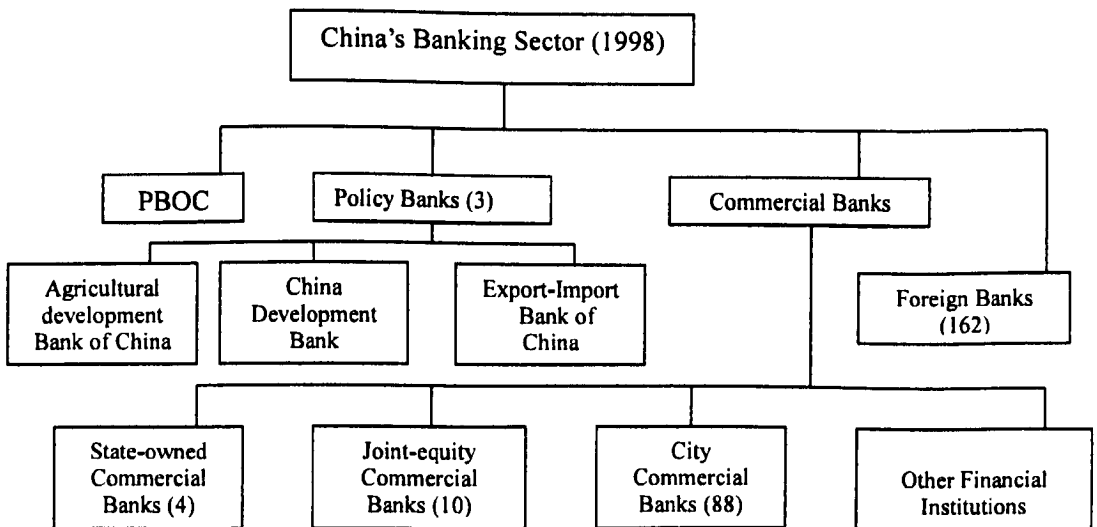
Source: Li et al., 2001.

Despite a rapid expansion of non-state banks, the four SOBs still overwhelmingly dominated the Chinese banking industry. The four firm concentration ratios of total assets, loans and deposits were 84.9%, 84.3% and 88.5% respectively in 1998, whist their profit concentration ratio was only 55.3% (Wong and Wong, 2001), indicating that the SOBs were large by size but much less profitable than the non-state banks.

The PBOC fixed the interest rate available to different kinds of depositors, so banks with higher profitability and productivity cannot repay their customers with better than average interest. Such mechanisms effectively ruled out the price competition in the deposit market. With many branches operating in all provinces and cities, the four biggest SOBs could rapidly absorb the highest amount of deposits. By the end of 2000, they had about 103,000 branches distributed nationwide and employed more than two million employees (Country Profile, China, 2000). The JECBs and CCBs, however, were

constrained in the number of the new branches that they could set up each year and had to comply strictly with the PBOC quotas. Moreover, in order to maintain public confidence in the state banks, the Chinese central government had explicitly guaranteed their deposits. All these discriminated treatments helped the SOBs expand their territory rapidly over the whole banking sector.

On the other hand, excessive interventions from the government also impaired the profitability of the SOBs. The PBOC set up mandatory credit quotas for the SOBs to control their lending activities (Mo, 1999). Not only had the credit ceiling been specified, but also the use of funds. Instead of making lending decision freely according to the assessed risk and profit, the SOBs were always expected to support government projects and provide funding to the enterprises that had "special relationships" with the government. As a result, long times of policy lending created large amount of NPLs to the SOBs and made their operations troublesome. Such problem resulted from direct lending also existed in JECBs and CCBs but much less severe. The degree of state interference to these banks was mainly depended on the relationship between the shareholders of the banks and the government, the closer the relationship, the more likely for them to engage in policy lending. For instance, Huaxia bank was privately owned by several big enterprises, such as Shougang Group, and its shareholders were distributed over the whole country. The bank was relatively free from both central and local intervention and thus had one of the cleanest balance sheets among all major Chinese commercial banks. By the end of 1999, the NPL ratio of Huaxia bank was only 5.7% compared with the national average of 17.1%; the mean ratio of the "Big Four" was as high as 36.2%

(Bankscope, 1999). Another JECB, the SDB, had a closer relationship with the local authorities and its NPL ratio reached 23.5% during the same period.

In 1998, the PBOC abolished its credit quotas system and streamlined its 30 provincial-level branches into regional representatives distributed in nine major cities, including Tianjin, Xi'an, Shanghai and Guangdong to enhance efficiency and reduce central control (Mo, 1999). The senior officials of these new offices were directly appointed by the PBOC rather than the local government.

Meanwhile, the state started to clean up the balance sheets of the "Big Four". After more than 20 years of policy lending, NPLs of the state banks reached RMB 2.5 trillion in 1999. The ratios of NPL to total loans were as high as 45% and 39.5% respectively for ABC and ICBC. In order to unload the NPLs from the "Big Four", restore their financial health and make them more competitive, four AMCs were funded: Cinda Asset Management Company, China Great Wall Asset Management Company, Oriental Asset Management Company, and China Huarong Asset Management Corporation. They were paired with CCB, ABC, BOC and ICBC respectively. In 1999, RMB 1.4 trillion NPLs of the SOBs were stripped off, equivalent to almost 20% of China's GDP in the same year (Yao et al., 2007). Later in 2000, all domestic banks were required to adopt the five-category loan classification standard to control the creation of new NPLs. In April 2000, another banking rule, which required true names of depositors, took effect. It not only facilitated the tax collection but also enabled the establishment of personal credit record system.

The final step of the banking reform began with China's entry into the WTO in December 2001. Despite much progress had been made on reforming the banking system, the SOBs still faced many internal and external challenges, which made them less competitive than foreign banks. These included huge amount of NPLs and lack of operational experiences in a market-based economy. Compared with the foreign banks with immense financial muscles and international experiences, the competitive position of the Chinese banks was still weak. Table 2.1 compares the performance among the SOBs and three world-class banking groups in 2002.

Table 2.1 Performance indicators of Chinese SOBs and world-class banks (%)

	Net income/ equity	Net income /assets	Net interest revenue/ assets	Operating profit/ assets	NPLs/ total loans
Citibank	15.29	1.27	4.36	7.16	2.15
HSBC	12.2	0.94	2.07	3.58	2.9
Credit Agricole	7.18	0.42	1.24	2.69	4.1
BOC	0.32	4.81	1.60	0.59	23.4
ICBC	0.15	3.6	1.86	0.39	25.3
CCB	0.2	4.0	2.2	0.7	15.2
ABC	0.11	2.15	1.9	0.42	30.7

Source: Bankscope.

In all five key profitability and asset quality indicators, Chinese SOBs were greatly outperformed by the foreign banks. For example, with total assets of $1,098 trillion, Citibank generated more than $71 trillion operating income in 2002 (Bankscope, 2002). The total assets of China's biggest SOB, ICBC, was about 52% of the Citibank's but it only generated 15% of the income as the Citibank's, indicating that the income generation ability of the ICBC was less

than one-third of the Citibank's. Hence, further reform the SOBs to improve

their efficiency had become an urgent and important issue after WTO accession.

Under the accession agenda, the whole Chinese banking system would be fully

open for foreign competition by the end of 2006 (Table 2.4; Yao et al., 2007).

Since then, the Chinese commercial banks will compete with their

sophisticated foreign rivals on an international competitive market basis.

Meanwhile, further reform was also expected to give the Chinese banks

opportunities to enjoy their increasing weight in the global financial market.

NPLs of the SOBs were further stripped off (Table 2.2). In 2003, the State

Council set aside $45 billion from the country's foreign exchange reserves to

help restructuring BOC and CCB into share-holding companies. A detailed

plan which included strengthening the corporate governance, internal

organization and risk management of the banks, applying international

financial reporting standard, using external auditors and improving the

legislation of the banking system had also been announced. Later in the year,

the China Banking Regulatory Commission (CBRC) was founded to supervise

the banking industry more effectively and independently (Official Website of

PBOC).

Table 2.2 NPL disposal of the "Big Four"

Year	Amount of NPL Unloading or Capital Injection	Assistance Mechanism
1999	RMB 1.4 trillion of the NPLs from the "Big Four"	NPLs transferred to AMCs
2003	$45 billion to BOC and CCB	Granted by State Council to increase capital
	RMB 56.9 billion NPLs of CCB	NPLs written-off
	RMB 140.0 billion NPLs of BOC	NPLs written-off
2004	RMB 128.9 billion NPLs of CCB	NPLs transferred to AMCs
	RMB 149.8 billion NPLs of BOC	NPLs transferred to AMCs
2005	RMB 705.0 billion NPLs of ICBC	NPLs transferred to AMCs

Source: Yao, et al., 2008.

Transforming the SOBs into share-holding companies was not simply another round of recapitalization, but the first serious attempt to privatize them partially. It was expected that the new-shareholding banks would be no longer subject to government intervention, be entirely responsible for their own profits and losses, and be subject to the supervision and control of the shareholders rather than the government officials. Such a privatization strategy had also been proved to be successful in several developing countries, such as Argentina (Cull and Clarke, 1998).

Following the similar process of two pilot banks, the state unloaded RMB 705 billion NPLs from ICBC and injected $15 billion fresh capital to the bank in April 2005. After all these efforts, the NPLs ratio of the three biggest SOBs was reduced from 33.3% in 1999 to just below 6% by the end of 2005 (Table 2.3). In particular, NPL ratios of the CCB and ICBC were reduced to 3.5% and 4.5% respectively, well below the IMF requirement of 8% threshold for emerging economies. With a healthier balance sheet, the government pushed the banking reform to the final stage, partial privatization, by means of foreign

participation and stock listing.

Table 2.3 NPL / total loans of three SOBs, 1999-08

Year		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Banks (NPL Ratio %)	ICBC	39.5	34.4	29.8	25.7	21.2	19.0	4.5	3.8	2.7	2.29
	BOC	37.4	27.2	27.5	22.5	16.3	5.1	9.6	4.0	3.1	2.65
	CCB	23.0	15.7	19.4	15.2	9.1	3.9	3.5	3.3	2.6	2.21
Average		33.3	25.8	25.6	21.1	15.5	9.3	5.9	3.7	2.8	2.38

Source: Yao et al., 2008, for 1999-2005; Bankscope for 2006-08.

2.2 Foreign Investment and Participation

The Chinese banking sector was officially opened to foreign banks in 1979 when they were allowed to set up representative offices. However, various entry barriers and business restrictions, such as geographic constraints and entry requirements had been imposed to them (Ma, 2006). In 1982, foreign banks were allowed to open operational branches in special economic zones and such geographical restrictions were relaxed in 1994. Foreign banks were first permitted to do business with Chinese enterprises by offering deposit and loan services in local currency (RMB) in Shanghai Pudong New Zone (and later in Shenzhen Special Economic Zone) in 1996 based on individual licenses (Garcia-Herrero and Stantabarbara, 2008). In 1998, PBOC further allowed eight foreign banks to obtain local currency funding and later in 1999, foreign banks were permitted to conduct local currency business in neighbouring regions.

Since China gained entry into the WTO, a new set of rules were enacted, and some existing regulations and laws, such as the 1995 *Central Bank Law* and

Commercial Bank Law were revised to align with international standards (International Financial Law Review, August 2002). Under the pledge of the WTO arrangement, restrictions on foreign currency business were removed upon accession in all parts of the country, whereas for the local currency business, the opening process was gradual in terms of time and locality (US-China Bilateral WTO Agreement, 2 February 2000). Foreign banks were allowed to provide local currency services to Chinese enterprises in designated regions since February 2004 while restrictions on the retail market were supposed to be removed in December 2006. In April 2007, four foreign banks, Citigroup, HSBC, Standard Charted and Bank of East Asia obtained approval from Chinese regulators and started to accept deposits in RMB from local residents (Areddy, 23 April 2007).

The geographic restriction was phased out in six stages (Serrado and Sabadell, 2003). At the beginning, foreign banks could only operate RMB business in four large cities, including Shanghai, Shenzhen, Tianjin and Dalian. Geographical coverage was next expanded to Guangzhou, Zhuhai, Qingdao, Nanjing and Wuhan in the year after accession and to another four cities in 2003. In 2004 and 2005, six other cities were opened and finally by the end of 2006, restriction was wholly removed (Table 2.4).

Table 2.4 Schedule of the Chinese banking sector opening under WTO agreement

Year	Business Scope	Geographic Coverage	Cities Included
2001	No restriction on foreign currency business	RMB business in 4 large cities	Shanghai, Shenzhen, Tianjin and Dalian
2002	RMB business to Chinese firms	9 cities	Guangzhou, Zhuhai, Qingdao, Nanjing and Wuhan
2003		13 cities	Jinan, Fuzhou, Chengdu and Chongqing
2004		16 cities	Kunming, Beijing and Xiamen
2005		20 cities	Shantou, Ningbo, Shenyang and Xi'an
2006	Fully open RMB business	No restriction	

Source: Serrado and Sabadell, 2003.

Regulatory permission for foreign investors to hold minority stakes in domestic banks was progressed more slowly. Different from countries in Central and Eastern Europe and Latin America, which opened their banking systems by allowing full foreign control of local banks, China adopted a gradual approach. The first attempt was in 1996 when the Asian Development Bank (ADB) bought a 1.9% stake in China Everbright Bank. This was followed by a purchase of 5% stake of Shanghai Commercial Bank by International Finance Corporation (IFC) in 1998, the acquisition of 15% stake of Nanjing City Commercial Bank by ADB in 2001, and the purchase of 8% stake in Shanghai Commercial Bank by HSBC in the same year (Berger et al., 2009). However, as most of these foreign investors were non-for-profit international organizations and their shareholdings were quite limited, it was hard for them to generate any substantial impact on the operation of the investees.

In 2003, the CBRC updated its guidelines to encourage foreign investment. Under the new rules, foreigner banks were allowed to own up to a quarter stake of the Chinese domestic bank, with an upper ceiling of 20% for any single

investor (*EIU*, 3 December 2003). Such policy encouraged the foreign

investment significantly. Minority foreign investment was expected to be

effective in diversifying central control and ownership structure of the banks

and also enhancing their capital strength. Strategic investors shared their

advanced management and technology expertises with the investees and

thereby enhanced their performance.

Examples of successful strategic foreign investment during post-WTO era

included the Citigroup's purchase of 4.6% share of PDB and Hang Sheng Bank

and the IFC investment of 24.98% stake of Industrial Bank. In 2004,

Newbridge Capital bought 18% stake of SDB and this was the first time that a

foreign shareholder took the largest and controlling stake of a Chinese

domestic bank (Berger et al., 2009). In the same year, HSBC also finalized its

transaction of purchasing 19.9% stake of China's fifth-largest bank, BCOM

and secured the right to double this share when regulation permitted.[3] On 31

December 2005, the first Chinese commercial bank born with foreign minority

ownership (from Standard Chartered, 19.99% of shares), China Bohai Bank,

was established (*Wall Street Journal*, 7 September 2005; Table 2.5).

This partial privatization process through foreign strategic investment had also

spread to three of the "Big Four" banks. Investment in the SOBs was

historically deterred by the size of the investment for minority stake and

concerns about the management, corruption and bad debt of the SOBs. On 17

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[3] However, after the investment, the Ministry of Finance increased its shares and reclassified BOCOM as a "large state-owned bank" instead of a "joint-equity bank". So the state remained as the largest shareholder, indicating that the Chinese government was quite cautious about foreign investment in domestic banks.

June 2005, Bank of America (BOA) initiated the investment of $3.0 billion for

9% stake of CCB, marking the biggest foreign investment in the Chinese

banking industry. The bank has also committed to spend another $500 million

to maintain its share after the IPO of CCB in the second half of 2005

(*FinancialWire*, 20 June 2005). This deal was described by the chief executive

of BOA as paying an "entrance price" to establish a strategic partnership with

the Chinese SOB (Wighton, 17 June 2005). According to the agreement, BOA

would have one seat on the board of directors and have that candidate serve on

the audit committee and nomination and compensation committee as long as

BOA holds at least 5% of CCB's shares. In addition, BOA also agreed to

provide approximately 50 professionals to assist the CCB in several areas,

including risk management, corporate governance, credit cards, treasury

services and consumer banking. This deal represented the Chinese government

commitment of absorbing foreign investors to restructure their troublesome

SOBs (Berger et al, 2009). Equity investment from the foreign banks was not

the real concern of the Chinese SOBs, but the skills, technology and know-how

the foreign banks could bring to them (McGregor, 17 June 2005). These

intangible assets are more important for the future development of the Chinese

commercial banks. Later in the same month, Temasek invested $2.5 billion for

approximately 6% stake of the CCB.

Later in September 2005, a group of investors, including RBS, Merrill Lynch,

and Li Ka-shing, Hong Kong's richest man, announced their investment plan of

$3.1 billion for 10% ownership of BOC. In the mean time, Singapore's

state-run investment agency Temasek won the approval to buy a 5% stake in

BOC and United Bank of Switzerland (UBS) invested $0.5 billion for a 1.6%

stake of the bank. All these foreign strategic investors were required to lock up

their investment periods for three years. In January 2006, after ICBC finished

financial restructuring process, it also attracted a combined investment of $3.78

billion from Goldman Sachs, Allianz and American Express for a 10% stake of

the bank. In connection with Goladman Sachs' share purchase plan, the

investor obtained the right to nominate one director, as well as some

information rights, anti-dilution rights, and registration rights (ICBC, 2006

Annual Report). In addition, ICBC entered into a "strategic cooperation

agreement" with Goldman Sachs and established "working procedures and

process" as well as "a joint steering committee", aiming to improve the bank's

operation in various areas including staff training, risk management, internal

control and corporate governance.

Table 2.5 Foreign direct investment in Chinese commercial banks

Year	Target Name	Acquirer Name	Equity Investment
2007	Qingdao CCB	Intesa Sanpaolo	$ 135m (19.9%)
		Rothschild	$ 33m (5.0%)
2007	Chongqing CCB	Dah Sing Bank	$ 89m (17%)
2007	Dalian CCB	SHK Financial	$ 19m (10.0%)
		Bank of Nova Scotia and IFC	$ 24m (24.9%)
2006	CITIC	BBVA	$ 648m (5.0%)
2006	Ningbo CCB	OCBC	$ 70.6m (12.2%)
2005	ICBC	Goldman Sachs, Allianz and American Express	$ 3.78bil (8.5%)
2005	GDB	Citigroup	$ 3.0bil (19.9%)
2006	Tianjin CCB	Australia and New Zealand Bank	$ 110m (19.9%)
2005	Nanchong CCB	German Investment and Development Bank	$ 6m (13.3%)
2005	BOC	RBS, Merrill Lynch, Li Ka-shing,	$ 3.1bil (10.0%)
		UBS	$ 500m (1.6%)
		ADB	$ 75m (0.2%)
		Temasek	$ 1.5bil (5.0%)
2005	CCB	BOA	$ 2.5bil (9%)
		Temasek	$ 1.46bil (5.1%)
2005	BOCOM	HSBC	$ 1.75bil (19.9%)
2005	Bohai CCB	Standard Chartered Bank	$ 123m (19.9%)
2005	Huaxia Bank	Deutsche Bank	$ 233m (9.9%)
2005	Hangzhou CCB	Commonwealth Bank of Australia	$ 78m (19.9%)
2005	Bank of Beijing	ING and IFC	$ 270m (24.9%)
2005	CEB	IFC	$ 19m (4.9%)
2004	Jinan CCB	Commonwealth Bank of Australia	$ 17m (11.0%)
2004	CMINB	IFC	$ 23m (1.1%)
		Temasek	$ 100m (4.6%)
2004	Xi'an CCB	IFC	$ 20m (12.4%)
		Bank of Nova Scotia	$ 20m (12.5%)
2004	SDB	Newbridge Capital Ltd.	$ 150m (18.0%)
		General Electric	$ 100m (7.3%)
2004	Minsheng Bank	IFC and Temasek	$ 458m (6.2%)
2004	Industrial Bank	Hang Seng Bank, IFC and GIC	$ 326m (24.98%)
2002	PDB	Government of Singapore Investment Co.	$ 65m (5.0%)
2002	Nanjing CCB	Citigroup	$ 73m (4.6%)
		IFC	$ 27m (15.0%)
2002	CEB	BNP Paribas	$ 84m (19.2%)
2002	Shanghai CCB	IFC	$ 19m (4.9%)
		IFC, HSBC, HK Shanghai Com. Bank	$ 133m (18.0%)
Total		Approximately	$ 21.14billion

Source: Ma, 2006; Garcia-Herrero and Santabarbara, 2008;
Notes: RBS: Royal Bank of Scotland; IFC: International Finance Corporation; ING: International Nederlanden Groep; ADB: Asian Development Bank; BOA: Bank of America; CCB: City Commercial Bank.

2.3 Current Performance of the Chinese Banking Sector

After a series of state interventions, the amount of NPLs of the state owned commercial banks decreased significantly in recent years. The NPL ratio of the SOBs had been reduced significantly from 36.23% in 1999 to just 2.45% by the end of 2008 (Table 2.6; Table 2.7). The same ratio of JECBs had also decreased sharply to 1.51%, indicating that most of the Chinese commercial banks had improved their risk management and credit control abilities.

Table 2.6 NPLs in major Chinese commercial banks (RMB billion, %)

Years	2003	2004	2005	2006	2007	2008
NPL/Total Loan	17.8%	13.21%	8.61%	7.09%	6.17%	2.45%
	2440.6	1717.6	1313.4	1254.9	12684.2	5681.8
SOBs	20.1%	15.6%	10.49%	9.22%	8.05%	2.81%
	1852.7	1575.1	1072.5	1053.5	11149.5	4208.2
JECBs	8.1%	5.0%	4.22%	2.81%	2.15%	1.51%
	197.0	142.5	147.2	116.8	860.4	736.6

Source: CBRC 2003-2008; Bankscope, 2003 and author's calculations.

Table 2.7 NPLs of the "Big Four", 1999-08 (RMB billion, %)

Year	ICBC		BOC		CCB		ABC	
	NPL ratio	Total NPL	NPL ratio	Total NPL	NPL ratio	Total NPL	NPL ratio	Total NPL
1999	39.5	958.0	37.4	605.5	23.0	281.0	45.0	680.0
2000	34.4	831.0	27.2	409.6	15.7	218.2	33.2	493.4
2001	29.8	792.0	27.5	436.0	19.4	291.4	42.1	693.4
2002	25.7	759.9	22.5	408.5	15.2	268.0	36.7	701.1
2003	21.2	720.8	16.3	351.7	9.1	193.5	30.7	695.5
2004	19.0	703.6	5.1	109.9	3.9	87.3	26.7	692.3
2005	4.5	210.0	9.6	195.0	3.5	86.1	23.5	740.4
2006	3.8	137.8	4.0	98.2	3.3	94.4	23.4	735.6
2007	2.7	111.8	3.1	88.8	2.6	85.2	23.5	818.0
2008	2.3	104.5	2.7	87.5	2.2	83.9	4.32	134.1

Source: Bankscope, 1999-2008.

After the conversion of the three biggest SOBs into joint stock companies,

reform of ABC was also initiated. With NPL ratio of 23.5% by the end of 2007,

ABC was believed to be worst hit by massive policy lending to country's

impoverished rural sector (Bankscope, 2007). Moreover, the bank also had the

largest workforce of any bank, which added to the heavy burden in organising

the restructuring process.[4] The shareholding reform of the ABC was expected

to be pushed forwards in a smooth and steady manner because of the nature of

the bank's operation (Dyer et al., 2 February 2009). In the past, the ABC was

directed to support the agricultural sector and thereby, its transformation would

be carried out in line with the overall rural financial institution reform. In

addition, it was also the least transparent bank among all the SOBs, so the state

was quite cautious (Podpiera, 2006). From 2003, the restructuring of rural

credit cooperatives (RCCs) had been implemented to provide some references

to the following ABC reform. On 21 October 2008, the State Council finalized

the comprehensive shareholding reform plan of the ABC and injected RMB

130 billion ($19 billion) into the bank, reducing its NPL ratio sharply to 4.32%

(Areddy, 24 October 2008). Following the steps of government capital

injections, dealing with NPLs, and transforming into shareholding companies,

the ABC has also sought strategic foreign investors. However, the collapse of

western banking giants and cash-depletion of world financial institutions made

such arrangement hard to realize. Further capital injection was expected and

the bank is being prepared to list on the SSE and HKSE in the near future

(Dyer et al., 2 February 2009). It marks the final stages of country's banking

reform which started decades ago.

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[4] By the end of 2008, ABC had 441,883 employees while the number of employees of CCB, BOC and ICBC were 298,581, 249,278 and 385,609 respectively.

Apart from the improvement of asset quality, the profitability of major Chinese

commercial banks has also been enhanced (Table 2.8). Despite relying heavily

on interest incomes, ratios of ROE and ROA of SOBs had raised almost three

times from 2002 to 2006, reaching 10.7% and 0.6% respectively (Bankscope,

2002-06). Compared with banks in other developed nations, the ratio of

non-interest income to asset (NIROA) of the Chinese commercial banks

remained quite low. For instance, the average NIROA ratio of the three major

UK banks —RBS, Standard Chartered and HSBC was 1.35% in 2006 while

such ratios for the Chinese SOBs and JECBs were only 0.24% and 0.21%

respectively (Bankscope, 2006). Therefore, the Chinese commercial banks

would have to explore new income sources continuously to enhance their

competitive strength and overall efficiency.

Table 2.8 Profitability ratios of major Chinese commercial banks, 2002-06

Year	ROE (%)		ROA (%)		IROA (%)		NIROA (%)	
	SOBs	JECBs	SOBs	JECBs	SOBs	JECBs	SOBs	JECBs
2002	3.84	13.91	0.23	0.43	2.01	1.74	0.10	0.04
2003	4.89	15.62	0.37	0.37	2.14	1.73	0.09	0.03
2004	8.82	9.48	0.45	0.32	2.19	2.22	0.13	0.03
2005	10.85	16.35	0.56	0.45	3.11	3.77	0.12	0.04
2006	10.68	15.96	0.63	0.56	3.74	3.92	0.24	0.21

Source: Bankscope 2002-2006.
Notes: ROE: return on equity; ROA: return on assets; IROA: interest income to asset and
NIROA: non-interest income to assets.

With a cleaned balance sheet and enhanced income generating ability, stocks of

the banking sector will doomed to be attractive when they list on the stock

exchanges. Such strategy is also welcomed by the authorities because foreign

acquisition and stock listing are the two major ways to realize quasi- or partial

privatization without completely losing state control. On 20 October 2005,

CCB became the first SOB which listed on the stock market. It issued 26.49

billion shares in the HKSE, raising approximately $8 billion. This was

followed by BOC, which listed on both the HKSE and SSE simultaneously in

May 2006, raising $11.2 billion. The last but the most important one was the

IPO of the ICBC in October, 2006. It was regarded as a cornerstone of China's

banking reform. The IPO of ICBC raised $21.9 billion and set a new world

record, surpassing the $18.4 billion record set by Japan's NTT Mobile

Communications Network Inc. in 1998 (Yao et al., 2008). This period also saw

the listing of several JECBs (Table 2.9).

Table 2.9 IPO of Chinese commercial banks

Name of the Bank	IPO Date	Name of the Bank	IPO Date
Shenzhen Development Bank	03/04/1991	Bank of China	05/07/2006
Pudong Development Bank	10/11/1999	ICBC	27/10/2006
Minsheng Bank	19/12/2000	Industrial Bank	05/02/2007
China Merchant Bank	09/04/2002	CITIC	27/04/2007
Huaxia Bank	12/09/2003	Ningbo Bank	19/07/2007
China Construction Bank	27/10/2005	Nanjing Bank	19/07/2007
China Bank of Communications	23/06/2005	Beijing Bank	19/09/2007

Stocks of the banking sector contributed greatly to the rocketing market index

especially after the double listing of ICBC. By the end 2006, the domestic

market value of ICBC reached $250 billion, more than 20% of the SSE

Composite Index. Aggregated by other nine listed banks, they accounted for

about half of the index.

Besides the high share of market capitalization, price performance and trading

volume of banking stocks were also strong. Figure 2.2 depicts the share price movements of ICBC and two other fast growing JECBs, PDB and CMB. Share price of CMB increased from about RMB 15 to more than RMB 40 within a year whilst the share price of PDB doubled to almost RMB 50 over the same period. Although share prices of ICBC did not rise as much as those of the JECBs, it had increased more than two times since its IPO. It is worth noting that on 23 July 2007, ICBC's A share price reached RMB 5.75, which made it the world's biggest bank by market value of over $251 billion, overtaking the US's Citigroup. As for trading volumes on the SSE, banks were among the most traded stocks during 2006-2007. For instance, CCB, BOC, CMINB and ICBC with a total traded value of RMB 167 billion were among the top 10 most active shares by transaction value in the A-share market, accounting for 7% of the total market transaction values (SSE Statistic Yearbook, 2007).

Figure 2.2 Share prices of three representative banks
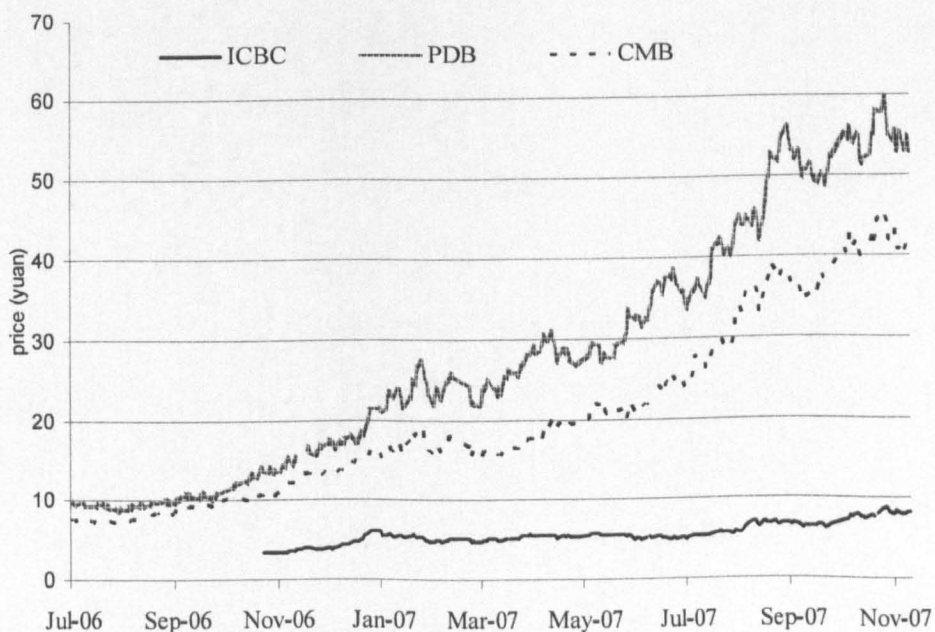
On 25 March 2008, BOC and ICBC issued 2007 annual reports simultaneously

and later followed by CCB. It was their first complete financial year after IPO.

All the banks showed significant improvements by all means of performance

measurements (Table 2.10).

Table 2.10 Key performance highlights of CCB, BOC and ICBC in 2007 (billion, %)

Financial Indicators	CCB	BOC	ICBC
Total Assets	6598 (21.1)	5996 (12.4)	8684 (15.6)
Total Loan	3183 (13.8)	2754 (17.8)	3958 (12.0)
Interest Income	285 (32.4)	262 (21.6)	357 (31.5)
Profit before Tax	113 (51.5)	99 (33.2)	130 (56.1)
Cost / Income (%)	39.4 (3.1)	38 (-8.2)	36.8 (-2.9)
NPL / Total Loan (%)	2.6 (-20.7)	3.1 (-22.8)	2.74 (-38.3)
Capital Adequacy (%)	12.6 (4.1)	13.3 (-2.2)	13.1 (-7.1)
ROA (%)	1.15 (25)	1.1 (15.8)	1.01 (42.3)
ROE (%)	18.38 (22.5)	14.2 (0.6)	16.1 (20.0)

Source: Bankscope, CCB, ICBC and BOC, 2006, 2007.
Note: figures in the brackets represent the percentage change of 2007 to 2006 data; the
negative sign, "-", means a decrease in 2007 compared with 2006.

In 2007, net profit of CCB, ICBC and BOC were RMB 69.1, 82.3 and 56.2

billion respectively, representing an increase of 49.3%, 64.9% and 31.3%

year-on-year. Such outstanding improvement was mainly attributed to the rapid

increase of banks' fee-based service charges and commission incomes. By the

end of 2007, China had issued 1.5 billion bank cards, growing by 32.6% on the

same period of last year. The total included 1.41 billion debit cards and 90.26

million credit cards, up by 30.4% and 82% respectively. Increased market

competition after foreign entry forced Chinese commercial banks to expend

their services into more profitable emerging areas rapidly.

The global credit crunch since the second half of 2007 had disrupted the stability of the world financial market. However, its influence on the Chinese banking sector was quite limited as Chinese banks were more conservative than their foreign counterparts in derivatives investment. The BOC was believed to hold the largest portion of the US Mortgage-backed Securities (MBS). Nevertheless, by the end of 2007, it had already settled most of its MBS and entire Collateralized Debt Obligations (CDO).[5] The remaining MBS balance was just $4.99 billion (RMB 36.4 billion), representing only 2.13% of the group's total securities investment and 0.61% of the total assets. The bank had provided $1.3 billion (RMB 9.5 billion) loan loss provisions to cover the expected losses and it was no doubt that future performance of the bank would remain stable (BOC Annual Report, 2007). For the other banks which engaged limited foreign transactions and business settlements, influence of the US credit crunch was less obvious.

Facing extremely volatile business environment in 2008, the performance of Chinese commercial banks outshined the rest of the world. China's banking industry reported RMB 583.4 billion ($85.79 billion) in after-tax profit, up by 30.6% year-on-year (*Xinhua Net*, 14 April 2009). All the listed banks had made impressive improvements. For example, compared with 2007, net profit of PDB, CITIC and HXB had increased by 127.6%, 61% and 46.2% respectively in 2008. Three of China's biggest SOBs were among the world's five most profitable banks in 2008 (*The Banker*, July 2009). Increased by 35.2%, ICBC

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[5] CDO is an unregulated type of asset-back security and structured credit product. It is constructed from a portfolio of fixed-income assets. On 30 June 2007, the balances of BOC's MBS and CDO were $8.965 billion and $0.682 billion. On 31 March 2008, the balances of BOC's MBS and Alt-A were $4.43 billion and $2.21 billion respectively.

with total profit of RMB 111.2 billion took the first place (Hawser, 2009). This

was followed by CCB whose net profit grew by 34% to RMB 92.6 billion. On

25 March 2009, BOC disclosed that net profit of the group was up by 14.4% to

RMB 64.4 billion, far inferior to other two SOBs due to bank's relatively larger

exposure to foreign markets but still locked its ranking in the fourth place

(Piggott, September 2009).

Meanwhile, the world financial crisis reduced the stature of some world's

banking giants, such as Citigroup and RBS, as their share prices tumbled by

more than 95% from 2007 to January 2009. China's three largest SOBs had

replaced the American and European giants to become the world's largest

commercial banks in market capitalisation in early 2009 after they were listed

on the Hong Kong and Shanghai stock exchanges only two years earlier

(Anderlini, 17 March 2009; Table 2.11).

Table 2.11 Market value of selected world largest banks 2005-09 ($ billion)

Banks	Dec-05	Dec-07	Dec-08	Mar-09
BOC	n.a.	229.7	110.3	129.6
ICBC	n.a.	371.8	173.0	192.5
CCB	n.a.	315.1	131.0	147.7
RBS	31.2	99.6	11.9	5.8
HSBC	177.1	195.0	112.3	94.7
Citigroup	265.8	147.1	38.9	13.9
BOA	156.9	183.1	70.6	43.7

Source: http://finance.yahoo.com; http://www.google.com/finance;
Note: RBS = Royal Bank of Scotland; HSBC = Shanghai and Hong Kong Bank; BOA = Bank
of America; All the values are measured in US dollars using official foreign exchange rates at
each of the time period.

In 2009, continue worsening global financial crisis, sluggish capital markets

and interest rate adjustment had added greater downward pressure to Chinese banking sector. Banks needed to accelerate business innovation, adjust corporate structure, broaden income sources and cut expenditures to maintain healthy and robustness growth. In response to the current situation, government unveiled a series of key adjustment policies to expand domestic demand and promote development, which also in turn proposed great opportunities to the further development of banks. For instance, increased investments in infrastructure were especially beneficial to banks advantage business, such as infrastructure loans and engineering cost consultancy business. An increase in money supply in 2009 enabled the banks to absorb more deposits from wider founding sources under more favourable market conditions. In the process of continued globalisation, Chinese commercial banks need to further strengthen their risk management ability to become more resistant to the increasingly complicated and volatile business environment. Table 2.12 summarized the major events of the Chinese banking sector since its evolution.

Table 2.12 Highlights of Chinese banking sector development, 1948-08

Year	Event
1948	The establishment of People's Bank of China (PBOC);
1954	The establishment of China Construction Bank (CCB);
1979	The establishment of Agricultural Bank of China (ABC);
	Foreign banks were allowed to open representative offices in China;
1984	The establishment of Industrial and Commercial Bank of China (ICBC);
1985	Specialized banks were allowed to operate outside their designated sectors;
1991	SDB started to listed on the Shenzhen Stock exchange;
1992	Foreign banks were allowed to open operational branches in Special Economic Zones;
1994	The establishment of three "Policy Banks";
1995	Four SOBs were officially renamed as "commercial banks";
	Central bank Law of China and Commercial Bank Law of China were officially released;
	The central government began to allow local government to establish local banks;
1996	Establishment of China Minsheng Banking Corporation, first private bank in China;
	Foreign banks were first permitted to make deposits and loans in local currency;
1998	PBOC's 30 provincial branches were replaced by nine cross-province regional branches;
	Four asset management companies were established to deal with NPLs of the SOBs;
	PBOC removed the credit plan for both working capital loans and fixed investment loans;
	Major SOBs started to provide money-managing services, such as foreign exchange transactions;
1999	Foreign banks were allowed to conduct local currency business in neighboring regions;

	Liberalization of Interbank market rates;
	RMB 1.4 trillion NPLs of the "Big Four" were transferred to AMCs;
2000	Adoption of new loan classification standard;
	China Association of Banks was established to promote self-discipline and cooperation;
2003	Establishment of China Banking Regulatory Commission (CBRC);
	State Council granted $45 billion to BOC and CCB to increase capital;
	Revision of the 1995 Central Bank Law and 1995 Commercial Bank Law;
	RMB 56.9 billion NPLs of CCB and RMB 140.0 billion NPLs of BOC were written off;
2004	RMB 128.9 billion NPLs of CCB and RMB 149.8 billion NPLs of BOC were transferred to AMCs;
2005	RMB 705.0 billion NPLs of ICBC were transferred to AMCs;
	CCB listed on the Hong Kong Stock Exchange;
2006	BOC listed on both the Hong Kong and Shanghai Stock Exchanges;
	ICBC listed on both the Hong Kong and Shanghai Stock Exchanges;
2007	CITIC bank listed on both the Hong Kong and Shanghai Stock Exchanges;
	Beijing, Ningbo and Ningbo City Commercial Banks listed on the Shanghai Stock Exchange;
2008	Approval of ABC shareholding restructuring plan and the state injection of RMB 130 billion to the bank.

Source: Berger et al. 2009; Yao et al. 2007; Official website of CCB, www.ccb.com; BOC, http://www.boc.cn/; ABC, www.abchina.com; and ICBC, http://www.icbc.com.cn/icbc/.

2.4 US Credit Crunch and Its Influence to the Chinese Banking Sector

Triggered by the US housing crisis, the year 2008 saw a sequence of adverse financial news around the world. Some of the largest US financial institutions, including Fannie Mae, Freddie Mac, Merrill Lynch, Lehman Brothers and AIG, were either put up for sales, bought by the US government or became bankrupt. Meanwhile, the prices of Chinese banking stocks also plummeted because of the collapse of the Chinese stock market and the world financial turmoil. Within 12 months to September 2008, the share prices of three biggest SOBs lost more than 60% of their value (Figure 2.3). In particular, share price of BOC dropped from RMB 7.31 per share to just RMB 2.92 per share, a level which was 25% lower than its IPO price.

Nevertheless, compared with those fragile Wall Street giants making huge losses due to the US credit crunch, the performance of the Chinese banks was encouraging. Banking stocks still dominated Chinese stock market and were traded most actively in 2008. With total trading volume of 81 billion, ICBC, CMINB and CCB accounted for more than 5% of the total trading volume of SSE in the year. Table 2.10 summarises the importance of banking sector stocks in terms of issued volume, market capitalization, tradable volume and tradable share capitalization in 2008. In each of the measurement, banking stocks took at least four positions among the top ten listed banks on the SSE.

Table 2.13 Importance of banking stocks in the overall stock market, 2008

(billion shares and billion RMB)

Issued Volume	ICBC	BOC	CITIC	BOCOM	Market weight Four banks	All banks
Number of shares	2510	178	27	26		
Weight (%)	16.4	11.6	1.74	1.7		
Rank	1	2	5	6	32.67	52.0
Market capitalization	ICBC	BOC	CMB	BOCOM		
Market value	888	528	146	123		
Weight (%)	9.17	5.45	1.51	1.27		
Rank	2	3	7	10	17.4	49.2
Tradable volume	CMINB	BOCOM	ICBC	CCB		
Tradable shares	18	16	15	9		
Weight (%)	3.7	3.3	3.12	1.88		
Rank	1	3	4	7	13.5	25.11
Tradable share capitalization	CMB	BOCOM	CMINB	PDB		
Tradable value	88	76	73	66		
Weight (%)	2.76	2.37	2.28	2.08		
Rank	4	6	7	9	11.31	25.85

Source: SSE year statistic, 2008, http://www.sse.com.cn/sseportal/ps/zhs/yjcb/tjnj/tjnj_2008.pdf;
Note: "All banks" represents the market weight of all top ten banks within each measurement; CMINB, with issued volume of 19 billion (1.23%), ranking 10th among banks with largest issued shares, BOCOM, with total market value of RMB 123 billion (1.27%), ranking 10th among banks with largest market capitalization and Industrial Bank, with tradable market value of RMB 58 billion (1.82%), ranking 10th among banks with largest tradable market capitalization were not listed but were included in the sum weight of "four banks"; Market value was derived from the number of issued shares and the current price per share, while the tradable value is the value of traded-only shares at current prices.

Starting from March 2009 after the state's implementation of a series of rescue schemes and the stabilization of world financial market, the stock market in China started to recover. Banking stocks rebounded rapidly. The share prices of CCB, BOC and ICBC had increased by 65%, 58% and 55% respectively from their lowest points between March and July 2009 (Figure 2.3). Thanks to their

risk-averse nature, the Chinese listed SOBs turned out to be the least affected

by the current financial crisis among all other big banks in the world,

outperforming their counterparts in the US and other major industrialized

countries. This leads to an important research question of whether the

performance of the Chinese commercial banks was improved via stock listing.

Figure 2.3 Share prices of CCB, BOC and ICBC, July 2007-July 09
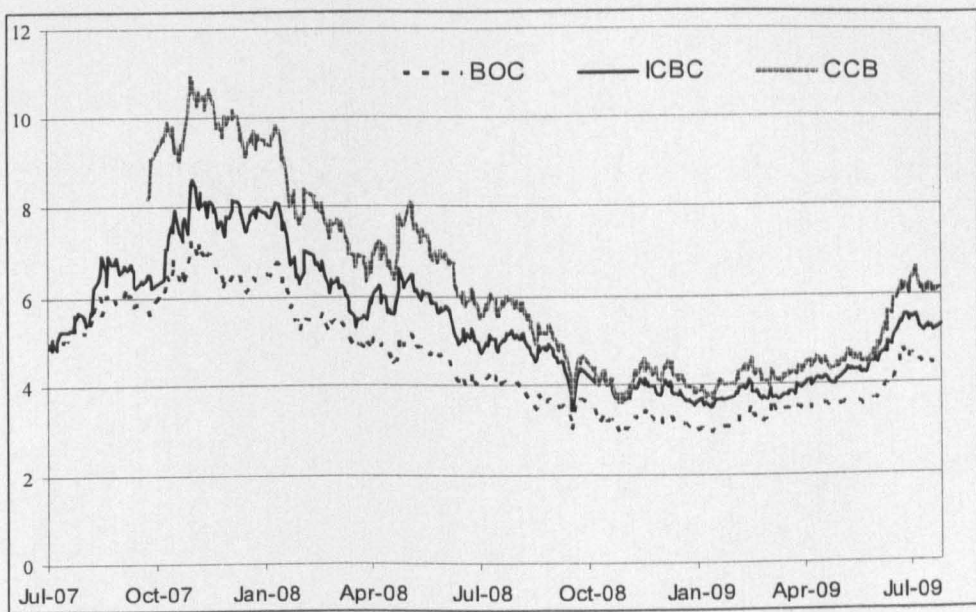
Source: Yahoo Finance, http://finance.yahoo.com.

Tough conditions in the housing market had imposed extra pressure on Chinese

banks operation and profitability. During the past five years, home mortgages

had grown to become an important revenue source for the banks. However, the

banks could no longer rely on expanding mortgage lending business to boost

profit in 2009. Worsened financial markets combined with a deteriorated

trading environment raised the serious concern of whether China could

decouple from the rest of the world and maintain its fast development pace and

whether the US housing crisis would be replicated in China in the near future.

2.5 Chapter Summary

Along with China's comprehensive economic reform from 1978, the Chinese banking system had experienced substantial transformation of the ownership structural and fundamental change in operations. It had evolved from a monopolistic state agent to one with more than a hundred commercial banks, urban cooperatives and financial institutions coexisting in the market. After a series of reforms, the profitability, asset quality and productivity of the banks had been enhanced significantly. In October 2005, the CCB was listed on HKSE successfully and it was followed by the BOC and ICBC in 2006. The market reacted positively to these IPOs, in particular from the second half of 2006. As stock listing has been widely argued as an effective tool to improve the corporate governance of the firms, the impact of IPO on Chinese banks' corporate governance practice will therefore be comprehensively analysed.

Nevertheless, triggered by the US credit crunch, both the Chinese stock and housing markets were hit badly. The prices of Chinese banking stocks plummeted, despite their profitability. Compared with the huge losses of the Wall Street giants, the Chinese listed SOBs turned out to be the least affected by the 2007-2009 world financial crisis. Therefore, it raised our research interest of assessing whether the efficiency of Chinese commercial banks had been improved via stock listing.

Chapter 3 Literature Review

The basic concept of "efficiency" could be explained as the ratio of the output (goods and services) to input resources under certain conditions. In the banking environment, the overall banking efficiency is usually divided into two components, scale and scope economies on one hand and cost efficiency on the other. And the latter could be further decomposed into technical and allocative efficiency. This section will review past bank efficiency literatures according to the type of efficiency been studied. In addition, I will also discuss the literature about Chinese stock and housing markets.

3.1 Scale and Scope Economies of the Banking Industry

Bank efficiency studies have grown since the late 1980s in parallel with the improved bank technologies and regulatory policies. Most of the early studies were focused on scale and scope economies (Yao et al, 2007). Economy of scale relates to firm size, and can be realized when the average costs decline as output rises. The bank can be said to have scale efficiency[6] when it operates in the range of constant returns to scale (CRS). Scope economy deals with joint production. It appears when two or more products or services are produced at a lower cost than when produced separately. These two types of economies were widely used by the banking industry to justify mergers and acquisitions (M&As) and product mix changes.

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[6] The term "scale efficiency" and "scale economy" can be used interchangeable.

3.1.1 Scale Economies

The earliest bank efficiency studies applied basic methods such as ratio and Tabular analysis to investigate the variations between bank costs and size (Alhadeff, 1954). They established the existence of scale economies in banking, but the choice of variables compromised the robustness of their conclusions (Benston, 1972). More comprehensive models, which took into account many factors that affected costs other than bank size, found that banks with larger accounts and lower cost per dollar were more efficient (Scheiger and McGee, 1961). However, the models simply related costs to dollars of output, which neglected the effect of differences in the number and activities of the deposit accounts.[7]

Later studies of Benston (1965) and Betl and Murphy (1968) also confirmed the positive relationship between scale economy and size of the bank. They applied multiple regression models to estimate the direct and indirect operating costs of individual banking services and concluded that a doubling in the size of a bank would lead to a 5-8% reduction in average costs, *ceteris paribus*. Unfortunately, their conclusions were challenged by four issues. First and for most, the assumption that banks would produce one output with the same inputs and technology was impractical because the products and services provided by the banks were quite diversified. Secondly, most of the early samples were composed primarily of small banks and thus underestimated the industry average. Thirdly, separated cost functions were applied for individual bank business and consequently neglected the effect of inter-product cost

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[7] Such treatment assumes that the wholesaler is more efficient than a retailer because his costs per dollar of sales are lower.

complementarities in assessing the scale economies of the multi-product banks (Adar et al., 1975; Osborne, 1982). Finally, no distinction between scale economy at the branch or the firm level led to misleading results. Later researches found that even though scale economies might exist at the branch level, these could disappear when the whole bank was under consideration (Benston et al., 1982; Beger et al., 1987; Beger and Humphery, 1991).

After addressing aforementioned issues, the recent literatures reached a relatively consensus view that in the US, the average cost curve of the banks was flat U-shape with medium-sized banks more efficient than either large or small banks (Humphrey, 1990). Only the small or medium banks were found to have the potential of benefiting from scale economies and their gain was quite small, less than 5% (Mester, 1987; Humphery, 1990; Berger et al, 1993). Studies of European banks reported similar results (Cavallo and Rossi, 2001; Zardkoohi and Kolaris, 1994).

Nevertheless, the identification of the scale-efficient point, the bottom of the U-curve, was difficult. For the US studies, when the sample was confined to banks with $100 million to $1 billion in assets, the cost minimisation point was identified somewhere between $75 and $300 million (Berger et al., 1993; Ferrier and Lovell, 1990). Whereas Berger and Humphrey (1991) argued that even when the banks of all size were included, the peak of the scale efficiency was likely to present at $100 million and decline monotonically thereafter for larger banks. Researches outside the US found mixed results. For the Spanish banks, the scale efficiency point was found to be $100 million while for the

French banks the threshold was $300 million in assets (Altunbas and Molyneux, 1996). However, all these findings needed to be interpreted with cautious because few big banks were included. With different product mix and more sophisticated technologies, the larger institutions might have different types of cost distribution, which might confuse the measurement of their scale economy (Berger et al., 1993).

Several researchers since the 1990 included large US banks in their studies (Elyasiani and Mehdian, 1990; Evanoff and Israilevich, 1990, Hunter et al., 1990; Noulas et al., 1990; Berger et al., 1993; Saunders and Walter, 1994; Hunter, 1995; Jagtiani et al., 1995; Jagtiani and Khanthavit 1996; Miller and Noulas, 1996; Rogers, 1998). They found that when the sample was restricted to banks with more than $1 billion in assets, scale efficiency could increase substantially to $2 to $10 billion. Some other cross-country studies were also published during the same period (Allen and Rai, 1996; Sheldon, 1999). A study of 1783 large European commercial and saving banks concluded that the optimal scale was in the range of $0.5 to $1.5 billion (Sheldon, 1999) and banks that provided a variety of financial products performed better than the banks offering selected financial services (Allen and Rai, 1996).

When banks of different size were considered in the model, results were different, which raised concerns that some limitations might exist in the estimated cost functions. McAllister and McManus (1993) suggested that the commonly used Translog cost function could be misspecified when the product mix is too complicated, and this was especially the case for large banks.

Moreover, the scale economy calculated based on all sample banks was also inappropriate because such estimation effectively mixed the scale diseconomies[8] and cost inefficiencies together. The scale economy should be applied on the technical efficient banks only.

Meanwhile, other studies argued that no matter what kind of estimation approaches were applied or whether the off-frontier banks were excluded, scale economies were more helpful to smaller banks (Mitchell and Onvural, 1996; McAllister and McManus, 1993; Berger and Humphrey, 1991; Bauer et al., 1993; Mester, 1993). Despite differences in the scale-efficient point, the fact that almost all these estimated points were well below the size of the largest US banks clearly indicated that no significant overall scale economies had been gained through continued bank M&As (Berger and Humphery, 1993). Over expansion led to scale diseconomies eventually.

McAllister and McManus (1993) defended their findings by including another factor, risk, into the calculation. As a financial intermediation, banks needed capital which was regarded as the most expensive source of funding to shield creditors from risks in banks' asset portfolio. The requirement for such input was affected by the degree of portfolio diversification. After accounting for financial return to scale, substantial scale inefficiencies were found for smaller banks. Full-scale efficiency was realized by banks with $500 million in assets, and approximately constant average cost thereafter up to $10 billion in assets, which was also the upper limit of their sample. Large banks that operated

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[8] The term "scale diseconomy" is opposite to "scale economy" and it can be caused by insufficient incentive, bureaucracy effects, spreading specialized resources too thin and conflict of interest (Besanko et al., 2000).

across wider geographical regions with diversified borrowers could fund with less financial capital input and were more likely to achieve scale economies.

Altering the path from assessing scale economy by calculating cost incurred, some studies were conducted from the revenue or the profit side (Pulley et al., 1993; Berger et al., 1993). They generally agreed the existence of scale economies but argued that such positive effect could disappear when the size of the bank was too big. Instead of cutting costs, it was easier for large banks to realize scale economy via increasing revenue.

3.1.2 Scope Economies

The scope economy comes from lower costs achieved through joint production. Berger et al. (1987) summarized the potential benefits of joint-production for commercial banks in three areas. Firstly, *"spreading fixed costs"*, as long as excess capacity exists, fixed costs like data processing, office construction and maintenance could be spread over the expanded product mix. Secondly, *"information economies"* which could also be illustrated as cost complementarities. For example, the payment flow information generated from deposit services could be used to assess the credibility of customers and monitor loans to the same customer. And finally, *"reducing risks and customer costs"*, joint production enables banks to realise asset diversification and thereby reduce their risk exposure. Through providing multi-services, such as deposits, loans and other financial services, to the customers jointly, costs due to transportation and inter-account transfers can then be saved.

However, empirical researches showed a complex picture. While studies of Gilligan et al. (1984), Gilligan and Smirlock (1984), Murray and White (1983) and Edirisuriya and Brien (2001) identified significant cost complementarities across the deposit, loan and investment activities of the banks, evidence from other studies were less clear (Lawrence and Shay, 1986; Kim, 1985; Mester, 1987; Altunbas and Molyneux, 1996). In the European banking market, scope economies were found to be realized by banks with different size in asset (Altunbas and Molyneux, 1996; Steinherr and Huveneers, 1992; Dietsch, 1993). For example, in Germany, economies of scope were found for large banks with more than $1 billion in asset whereas such positive effects for the French banks was found to exist with an asset range from as low as $100 million to $5 billion.

A later study of Berger et al. (1993) argued that such inconsistent measured scope economy was caused by model misspecification. It was hard to identify all the product complementarities of the banks and even if they were identified, the measurement of a simple Translog function might not be appropriate. In addition, similar to the scale economy studies, scope economy was also estimated based on the whole sample observations, rather than purely focusing on those cost efficient observations. Consequently, tested result was virtually a reflection of combined influence of scale and scope diseconomies and cost inefficiencies (Berger and Humphrey, 1991; Mester, 1993).

Some other studies assessed the scope economy of the banks from revenue generation or profitability (Pulley et al., 1993; Berger et al., 1993; Vander

Vennet, 1999; Bos and Kolari, 2005). Nevertheless, results were still mixed. Berger et al. (1993) proposed a new concept of "Optimal Scope Economies" in their US banks analysis and concluded that although joint production was better for most banks, circumstances under which specialization were optimal still existed. It seemed that in the whole industry, room for both large and small, and supermarket and boutique banks was coexistent.

3.2 Cost Efficiency Studies

3.2.1 Efficiency Concepts

While scale and scope efficiencies had been extensively studied, relatively little attention had been paid to what appears to be a much more important source of efficiency differences, cost efficiency. Cost efficiency, also known as economic or overall efficiency, refers to the deviations from the cost frontier, where the output bundle is produced at the minimum cost for given input prices. It is different from the previous two forms of economies because it takes the output package as given, whereas the scale and scope economies estimate the cost minimization scale and output mix, assuming that the firms are on the efficient frontier already.

The overall cost efficiency can be further divided into two components, technical efficiency (TE) and allocative efficiency (AE). The former one refers to the optimal utilization of all available resources either by producing maximum output for a given input mix or by using minimum inputs to produce a given output, while the latter one refers to the ability to achieve the optimal combination of inputs and outputs facing fixed prices (Lovell, 1993; Yao et al.,

2007). Therefore when input prices are given, a technically efficient unit is not necessarily cost efficient as the mix of inputs can be quite costly. Figure 3.1 depicts the relationships among the overall efficiency, the technical efficiency and the allocative efficiency.

Figure 3.1 Technical, allocative and overall efficiency
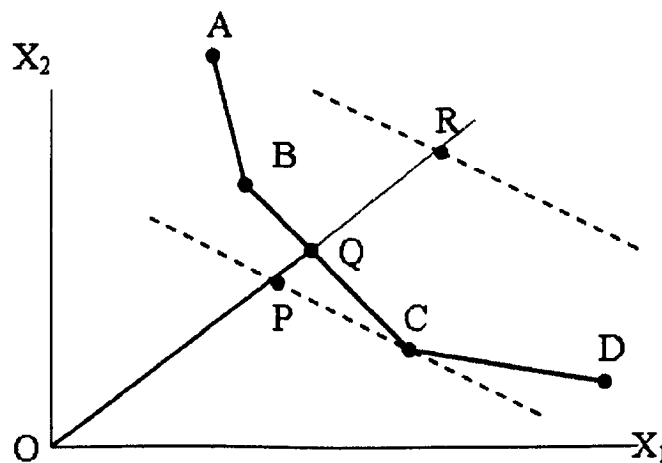
Source: Cooper et al., 2006.

Two inputs, X_1 and X_2, are used to produce a single output. The space above the piece-wise linear curve ABCD and its vertical and horizontal extensions contains all feasible levels of input mix to secure a unit of output. The curve ABCD is the locus of technical efficient input levels because on that curve lowering one input level would require the raising of the other. The cost line is labelled PC, tangential to ABCD at C. Thus the point C has the combination of input levels which can deliver a unit of output at the lowest aggregate cost feasible. If unit R were to become technically efficient, it would operate at Q. OQ/OR is therefore the technical input efficiency. As the aggregate cost of the inputs at Q can be lowered to P, the allocative efficiency of unit R is OP/OQ and the overall efficiency can then be calculated as OP/OR.

$$\frac{OP}{OQ}\frac{OQ}{OR} = \frac{OP}{OR} \qquad (E3.1)$$

However, the above equation is only appropriate when constant return to scale holds. Under various return to scale (VRS) assumption, technical efficiency can be further decomposed into pure technical efficiency (PTE) and scale efficiency (SE) and (E3.1) is then transformed into:

$$CE = AE * SE * TE \qquad (E3.2)$$

That is, cost efficiency (CE) or the overall efficiency is a product of allocative efficiency (AE), scale efficiency (SE) and pure technical efficiency (PTE).

3.2.2 Approaches of Cost Efficiency Measurement

Five approaches are widely used to study cost efficiency, stochastic frontier approach (SFA), distribution-free approach (DFA), thick frontier approach (TFA), data envelopment analysis (DEA) and free disposal hull (FDH). According to the different assumptions imposed on the sample data in areas like the functional form of the best-practice frontier, the treatment of the error terms, and the distributions assumed for inefficiency and random errors, the former three approaches are classified as parametric, while the latter two belongs to the non-parametric group. All these frontier methods are better than the ratio analysis because the estimated efficiency ratings and the ranking of the firms are more comprehensive and robust.

SFA, also referred to as the econometric frontier approach (EFA), was independently developed by Aigner et al. and Meeusen and Broeck in 1977. It pre-specifies a functional form for estimation and proposes a composed error

term, which comprises the random error and inefficiency. The random error is assumed to follow a standard normal distribution, whereas the inefficiency term follows an asymmetric distribution, usually half-normal, since it cannot to be negative (Ferrier and Lovell, 1990; Timme and Yang, 1991). However, such restrictions limited the inefficiency distribution and consequently inappropriately forced the estimated efficiency scores to cluster towards unity.

DFA has been introduced to relax the strong assumptions imposed on the distributions of inefficiencies. It assumes that the efficiency of each firm is stable over time and the mean random error tends to average out to zero over time. Such a measure makes it possible for the inefficiencies to follow almost any distribution, even the one that is fairly close to symmetric as long as it is non-negative. The third parametric approach, TFA, also predetermines a functional form for estimation. Nevertheless, it assumes that the random error is represented by the deviations from the predicted performance values within the highest and lowest performance quartiles of the observations, while the deviations in predicted performance between the highest and lowest quartiles represent inefficiencies. Instead of providing efficiency measurement for individual firms, TFA assesses the overall efficiency level of the whole sample.

Compared with the parametric approaches, the non-parametric methods have fewer restrictions on the frontier functional forms. The production frontier of DEA is created based on observations within the sample and it assumes that no random fluctuations exist. All the deviations from the estimated frontier are interpreted as inefficiencies (Rangan et al., 1988). The other method, FDH is

virtually a special case of DEA. It supposes that points on lines connecting the DEA vertices are not included in the frontier and thereby its production possibility set is only composed with the DEA vertices and points interior to them.

The debate over which approach offers a better efficiency measurement persists (Bauer at al. 1993; Hasan and Hunter, 1996; Beger and Mester, 1997; Resti, 1997; Eisenbeis et al., 1999; Weill, 2004). Unavoidable limitations are associated with whichever approach is chosen. On one hand, parametric approaches impose particular functional forms to pre-specify the shape of the frontier. However, when it has been misspecified, measured efficiency can be confounded with specification errors. On the other hand, non-parametric approaches allow the measured efficiencies to vary over time and have no prior assumptions on the functional forms. However, the exclusion of random error from estimation is inappropriate. If the errors do exist, the calculated efficiency scores would be mixed with these random effects. In addition, DEA suffers another serious drawback, self-identifiers and near-self-identifiers (Bauer et al., 1998). A firm can be recognised as fully efficient not because it dominates other firms in the sample, but simply because none of the other firms or their linear combinations is comparable.

Consistent with most of the prior literature, both SFA and DEA methods will be applied in this study.

3.2.3 Literatures of the Cost Efficiency Study

Despite the concept of cost efficiency dating from the 1960s (Leibenstein, 1966), it was not widely applied to analysis of financial institutions until the late 1980s. Instead of spending efforts to realize some optimal level of scale and scope economies, the study recognised banks could improve their cost efficiency more easily by simply reducing frontier inefficiencies (Berger and Humphrey, 1991). Later literatures supported this conclusion and confirmed that cost efficiency differences across banks were actually larger and dominated scale and scope economies. It accounted for about 20% of the banks costs, while the other two diseconomies only took a jointly 5% of the total costs (Berger and Humphrey, 1991; Hunter and Timme, 1986, 1991).

Summarizing the previous frontier efficiency studies, average efficiency scores of 88-94% for the US banks, about 85% for the developed economies, 76-82% for the EU banks and around 68% for the emerging markets were usually identified (Fu and Heffernan, 2007). In summary, these studies were focused on three aspects: the comparison of ownership structure (Weill, 2003; Kraft and Tirtiroglu, 1998; Taci and Zampieri, 1998; Opiela, 2000; Hasan and Marton, 2003); the effects of mergers and acquisitions (Berger and Humphrey, 1992; Rhoads, 1993; Shaffer, 1993), and the influence of financial liberalization and deregulation (Unite and Sullivan, 2003; Chen, 2001; Claessens et al, 2001; Hao et al., 2001).

For the ownership-performance of banks, privatization was considered to be an effective way to improve corporate governance, increase bank competition and

to realize an optimal allocation of scarce financial resources. One specific form of such private ownership, foreign participation was particularly welcomed because it had the merit of private ownership and other advantages, such as diffusion of their know-how in the host organization. In addition, it was hard for the local managers to build up any close relationship with foreign shareholders and thereby a healthy environment for corporate control could be constructed. However, findings from previous empirical studies were not fully in favour of private ownership and foreign control.

Researches focusing on transition countries had confirmed a positive relationship between private ownership and efficiency improvement in Poland, Czech Republic, Turkey, Greece and Hungarian (Taci and Zampieri, 1998; Opiela, 2000; Jackson and Fethi, 2000; Noulas; 2001; Isik and Hassan, 2002; Weill, 2003; Hasan and Marton, 2003). The majority of the foreign banks performed most efficiently, followed by domestic private-owned banks while SOBs were the least efficient (Fries and Taci, 2005). A higher percentage of foreign ownership was normally associated with higher efficiency (Hasan and Marton, 2003). However, when profit and cost efficiency were considered separately, the results were mixed. A study of 12 Central and Eastern Europe transition economies concluded that foreign banks were more cost efficient but less profit efficient than either domestic private or SOBs (Yildirim and Philippatos, 2007). A similar finding was reached for a study of Polish banks (Nikiel and Opiela, 2002). Another study employing 28 developing nations from various regions found that foreign banks were most profit efficient, followed by domestic private banks and SOBs, whereas in terms of cost

efficiency, private banks were among the best performers (Berger et al., 2004). Employing data for Pakistani banks, the study of Bonaccorsi di Patti and Hardy (2005) confirmed the dominated position of foreign banks in profit efficiency. Nevertheless, all banks in their sample were found to have similar cost efficiencies regardless of ownership structures.

Researches carried out using data for developed European countries and the US showed contrary results (Tulkens, 1993; DeYong and Nolle, 1996; Mahajan et al. 1996; Chang et al., 1998; Berger et al., 2000; Altunbas and Molyneux, 2001; Borovicka, 2007). Little evidence was found in favor of an efficiency difference for foreign ownership irrespective of which approach was applied and the kind of efficiency, either profit or cost efficiency that was measured. In a study of the Indian banking sector, though foreign banks were found to be somewhat more efficient than domestic banks held by private sector investors, but both of them were poorer performers compared with domestic banks held by the government (Bhattacharyya et al., 1997).

Inconsistent evidence in support of foreign ownership could be explained as the excessive cost incurred when foreign banks combined their own management pattern with local banks or due to their inability to integrate into the local markets. Distinguishing the efficiency of banks simply by their ownership structure was not appropriate (Grigorian and Manole, 2002; Bonin et al., 2005; Fries and Taci, 2005). Newly established banks were found to be more efficient than either old privatized banks or old state banks (Kraft and Tirtiroglu, 1998). Bonin et al. (2005) summarised the impact of ownership

structure more objectively in their study of 225 banks across 11 countries. They argued that privatization by itself was insufficient to enhance bank efficiency as SOBs were not necessarily less efficient than domestic private banks. Foreign strategic participation was the vital additive that helped the banks enhance their performance, confirmed in another study of 15 East European countries (Fries and Taci, 2005). In general, a higher percentage of foreign (domestic) ownership in privatized banks was associated with a better (worse) performance.

M&A is another route by which bank efficiency can be raised. The M&A wave among the US banks in 1980s and its subsequent effect of sweeping international mergers over the European and other continents was expected to eliminate duplicate investments and improve cost efficiency of the banks. Meanwhile, consolidation enabled the banks to expand their operation to other business areas and geographical regions to generate more revenues.

Focusing on the US banks, earlier studies based on the 1980s data identified little improvement, around 5% after consolidation (Berger and Humphrey, 1992; Peristiani, 1997; Rhoades, 1993) while later studies employing 1990s data showed a more positive effect, greater than 10% (Akhavein, et al., 1997; Berger and Mester, 1999). When the mergers happened among relatively large institutions with substantial market overlap, objectives such as cost cutting could be realized fairly quickly (Rhoades, 1998). However, if the banks in a merger deal had roughly equal size, same efficiency gains were more difficult to be achieved due to policy intransigence or capacity limitations (DeYoung,

1997). Instead of assessing the effects of M&A that had happened in the past,

Shaffer (1993) estimated the efficiency variation after M&A from the pairing

of 210 banks randomly. Their results showed that the potential efficiency gains

or losses could be considerable. When the banks in the most efficient quartile

acquired other banks, the predicted cost savings could be as high as 21%, while

if banks in the least efficient quartile spread their inefficiencies to other banks

through mergers, the efficiency losses could also reach 21%. Therefore, the

management should examine the performance of the acquiring banks carefully

before merger.

Results outside the US were mixed. Efficiency outcomes could be heavily

influenced by the characteristics of the merged banks and the economic

environment of the country during examination period (Vander Vennet, 1996;

Lin, 2005; Resti, 1998; Avkiran, 1999; Drake and Hall, 2003). For example,

Avkiran (1999) study of the Australian banks during the period 1986 to 1995

observed that only the mergers accomplished before 1991 presented positive

effects whereas serious bad debt problem deteriorated the post-merger

performance of the banks afterwards. A more recent study of Drake and Hall

(2003) also cast strong doubts on the commercial logic of the M&As among

Japanese banks. Their analysis suggested that large banks in Japan were

already too big to realize and further efficiency gains through M&A. For the

smaller banks, despite clear evidence of improvement in scale economy, cost

efficiency tended to be damaged as soon as the size reached the threshold of

medium level (about JPY 8291 billion). Hence, mergers needed to be planned

and managed cautiously to ensure that any cost savings from scale economy

were not counteracted by worsened cost efficiency.

Efficiency studies of financial liberalization and deregulation generally confirmed obvious positive effects, as high as 25% in Canhoto and Dermine's study of Portugal banks during the deregulation period of 1990 to 1995 (Berg et al., 1992; Zaim, 1995; Chen, 2001; Canhoto and Dermine, 2003; Girardone et al., 2004; Sturm and Williams, 2004). It was consistent with the expectations that a more competitive system would lead to efficiency improvement as banks strived to cut costs and increase profitability. Large banks and smaller banks respond differently to deregulation to achieve efficiency gains (Humphrey and Pulley, 1997). The former adjusted deposit and loan output prices and use of labor and capital inputs actively to minimize the negative impact of deregulation while the latter were more likely to rely on an improved business environment.

From 2002, European banking system had experienced a fundamental restructuring process. Extensive integration and EU legislative harmonization were expected to bring in more competitions among banks and consequently force them to improve performance. However, the effects were less clear (Grifell and Lovell 1996; Lozano-Vivas, 1998; Casu and Philip, 2003; Caus and Girardone, 2004). Casu and Philip examined five major EU developed nations over the period 1993 to 1997, immediately following the completion of the Single Market Programme in 1992. With the exception of Italy, only slightly efficiency improvement of sample banking systems had been identified and country-specific factors were found to be more important in determining

the efficiency levels. The later study of Caus and Girardone (2004) argued that even such little improvement was not caused by EU deregulation but mainly attributed to technological progresses.

Recently, some researchers began to compare the efficiency among different nations or to test the consistency among different frontier methods (Allen and Rai, 1996; Pastor et al., 1997; Bos and Kolari, 2005; Berg et al., 1993; Ferrier and Lovell, 1990; Ferrier et al., 1993; Bauer et al., 1998; Weill, 2004). Berg et al. (1993) earlier study of three Nordic countries, Finland, Norway and Sweden found that Sweden had the most efficient banking system while Finland had the worst. Other studies compared the efficiency of the US and European banks. Pastor et al. (1997) found that banking system of France, Spain and Belgium appeared to function better than their UK, Australia, German and US counterparts. When banks of Japan were included, US banks were still among those least efficient quantile (Allen and Rai, 1996). Whereas Bos and Kolari (2005) argued that on average, multibillion European banks had lower cost and profit efficiency than large US banks measured by either profit or cost model.

For the studies testing the consistency among different efficiency measurements, earlier works generally identified higher efficiency scores generated by DEA as it neglected the allocative inefficiencies while later studies addressed the issue by using cost-based DEA model (Allen and Rai, 1996; Ferrier and Lovell, 1990; Ferrier et al., 1993). The non-parametric approach, DEA, was originally designed in particular for estimating the technical efficiency of public and non-for-profit sector, where price

information might not be readily accessible or reliable. It did not consider allocative inefficiency and thereby granted higher efficiency scores to the observations. So in practice, only after the price information were taken into account, results estimated by DEA and other parametric approaches were not directly comparable.

Studies testing the consistency issue among different parametric approaches generally confirmed comparable efficiency scores and ranking of the observations estimated (Bauer at al. 1993; Hasan and Hunter, 1996; Beger and Mester, 1997). More dissimilarity was found when efficiencies between non-parametric and parametric approaches were studied (Ferrier and Lovell, 1990; Eisenbeis et al., 1999; Bauer et al., 1998). The DEA technique was found to grant lower efficiency ratings to the observations with higher variance. This might result from the "self-identification" problem and the confusion of random errors with inefficiencies of DEA. For ranking consistency, results from the literatures were contradictory. Very high rank-order correlations between DEA and SFA of 0.73 to 0.89 were found by Resti (1997) whilst Eisenbeis et al. (1999) also identified fairly high rank correlations ranging between 0.44 and 0.59. However, Ferrier and Lovell (1990) concluded that rank-order correlation in their study was only 0.02, which was not significantly different from zero.

Using four frontier approaches, DEA, SFA, TFA and DFA, Bauer et al. (1998) study of 683 US banks confirmed that the distributional characteristics of the efficiency scores were quite similar across parametric approaches with

relatively comparable values for means and standard deviations, while the DEA

ratings had lower mean and larger standard deviation. Efficiency rating

discrepancy between non-parametric and parametric approaches was as high as

0.5. For the rank-order correlation, it was high and positive across parametric

approaches but negative between DEA and parametric approaches. The

identification of best and worst banks again led to very weak correspondence

between DEA and parametric measurements. In addition, they found that the

parametric approaches were more consistent with the standard performance

indictors such as ROA and ROE.

A more recent study (Weill, 2004) using five European country data

summarized similar findings. The efficiency scores were positively correlated

between parametric approaches for all countries, while no statistically

significant relationship between any parametric approach and DEA was

identified. Moreover, he argued that no consistent conclusion could be drawn

in favour of one group of approaches when compared with traditional

performance indictors. The DEA efficiencies had clearly advantages in

correlation with the total cost/ total asset and ROE ratios whereas the

parametric methods were better representations of total cost/ total income and

ROA ratios. All approaches were proved to be related to the traditional

performance measures to some extent.

Other studies comparing parametric approaches noticeably included Drake and

Weyman-Jones (1996) on British building societies and Dietsch and Weill

(2000) on US and European banks. In summary, comparable mean values

among parametric approaches had been concluded whereas differences between parametric and non-parametric methods were substantial. Unlike the US studies, European evidence tended to show higher rank correlations between SFA and DEA estimations.

3.3 Efficiency Studies of the Chinese Banking Sector

Studies of banks in emerging economies, especially China, have become more common in recent years. These studies mainly focused on analysing the history of banking reform and its consequences (Shirai, 2001; Lin, 2001; Podpiera, 2006), the relationships between banks' performance and foreign banks participation and determinants and timing of foreign banks entry to China (Leung, 1997; Leung et al. 2003a, b). For the literatures on China comparing bank performance, early studies usually adopted ratio analysis. Measured by ROA and ROE, Chinese banks were found to generate lower returns with higher financial risks than their Western counterparts (Li et al., 2001). However, ratio analysis could only evaluate performance of banks from a particular aspect, such as profitability and liquidity, but was unable to generate one single comprehensive indictor that differentiates "good" entities from the whole population. It does not control for outputs, input prices, and exogenous factors associated with an individual bank and hence may generate misleading results.

Studies using frontier methods to analyse overall efficiency level of Chinese commercial banks are quite limited. This may be caused by the scarcity and poor quality of data, which are not widely accessible and generally doubted in areas of NPLs and profitability. For instance, the official website of CBRC

shows that by the end of 2003, NPL ratio of the Chinese banking sector was 17.8%, while the S&P estimate was around 45% (Asia Pacific Banking Outlook, 2004, cited in Jia, 2009). The limited number of publicly accessible literatures in general found that the overall efficiency of the Chinese commercial banks had been enhanced substantially after a series of reforms and the JECBs were more efficient than their state-owned counterparts (Chen et al. 2005b; Fu and Heffernan, 2007; Jiang et al., 2009; Ariff and Can, 2008; Lin and Zhang, 2009, Berger et al., 2009).

Using frontier measurements, most of the studies identified that the Chinese commercial banks were technically inefficient, though the efficiency level had improved over the years. The technical efficiency of the JECBs were 10-20% higher than that of the SOBs (Wei and Wang, 2000; Zheng and Zhang, 2004; Li and He; 2005; Zhao et al., 2002; Zhang, 2003; Li et al., 2005). However, Chen et al. (2005b) argued that large SOBs and smaller banks were more efficient than medium-sized banks. Laurenceson and Zhao (2008) found that differences in efficiency levels between the two groups were small. The inefficiency of the JECBs stemmed mainly from their failing to realize scale efficiency, while for the SOBs, pure technical inefficiency accounted for a bigger percentage (Kumbhakar and Wang, 2005; Wang and Wei, 2000). Unlike the US banks, which had a flat U-shape average cost curve, the large- and small-sized banks in China appeared to be more efficient than the medium ones.

For the effects of deregulation and banking reform, the studies also had mixed implications. Chen et al. (2005b) found that the financial deregulation of the mid-1990s improved cost efficiency levels including both technical and allocative efficiency significantly. Dividing this sample into two sub-periods, the deregulatory period (1993-1998), and the post-deregulatory period (1999-2002), Kumbhakar and Wang (2005) failed to find evidence to support the effectiveness of deregulation as a means to improve banks efficiency, a conclusion consistent with Fu and Heffernan (2007). Both the JECBs and SOBs experienced a decline in technical efficiency between the first (1985-1992) and second stages (1993-2002) of bank reform. WTO accession was found to be associated with a decline in overall, pure technical and scale efficiencies (Hu et al., 2008). Berger et al. (2009) tested the efficiency effects from reforms that reduced state ownership of Chinese commercial banks and increased the role of foreign participation. They concluded that by bringing in foreign investors, both profit and cost efficiencies of SOBs and JECBs could be improved. When the foreign bank acted as a strategic investor, its positive effect on bank performance was more obvious than compared with purely financial investors (Garcia-Herrero and Santabarbara, 2008).

Previous studies had also explored the relationship between the efficiency of the banks, profitability, risks and ownership structure (Yao et al., 2004; Yao et al., 2007; Zhang, 2003; Qian, 2003; Zheng and Cao, 2005; Wang and Tan, 2007; Laurencenson and Qin, 2008). Banks that were more profitable, with higher ROA and ROE, appeared to be more efficient, whereas banks with poor cost control, with higher ratios of cost-to-income or total cost to total assets, were less efficient (Yao et al., 2004). Banks with higher credit risks, evidenced

by higher ratio of NPLs to total loans or loan loss reserves to total loans, were less efficient (Yao et al, 2007; Chang and Chiu, 2006). Results on the correlation between bank efficiency and capital risk were mixed. Interpreted in conjunction with the budget constraint theory, banks with higher equity to asset (E/A) ratio were more efficient (Jiang et al., 2009). Ariff and Can (2008) to the contrary found that E/A ratio were negatively related to bank efficiency because of the high transaction cost of share issuing. Despite more than a decade of reform focusing on the SOBs, they remained disadvantaged because of their heavy burden imposed by the toxic assets and various political interferences. However, one study proposed that reason for the JECBs and CCBs outperforming the SOBs was also the result of their geographical location (Ferri, 2009). Rather than spreading all over the country, like the SOBs, they were more concentrated in the prosperous provinces. Moreover, external factors, such as the Asian financial crisis, WTO accession and GDP growth were also found to influence the bank efficiency significantly (Yao et al., 2004; Hu et al., 2008; Jiang et al., 2009; Ariff and Can, 2008).

In addition to assess the cost efficiency of the Chinese banks, Matthews et al. (2007) introduced the concept of rent-seeking inefficiency. They assumed that a protected banking market, like China, would not only encourage technical inefficiency, but also lead to moral hazard and bureaucratic rent seeking. Employing data for four SOBs and 11 JECBs between 1997 and 2004, they observed that under the pressure of opening up the banking system imposed by WTO agreement, the cost inefficiency of Chinese banks was reduced

significantly. By the end of 2004, it had virtually declined to zero. All the leftovers in the overall inefficiency were caused by the cumbersome bureaucratic management system. Further transformation of management structure to improve corporate governance was demanding for the future development of Chinese banking sector.

Chinese government reformed the SOBs by partially privatizing through minority foreign ownership and subsequent IPO. Stock listing was expected to improve the accuracy and transparency of the banks' financial records, and also to bring additional market discipline. However, whether such mechanism is effective still remains doubtful as only few studies have been conducted recently. Liu and Song's (2004) observed that within those JECBs, listed banks, such as CMB and PDB, had a higher than average efficiency score. However, due to data constraints, they were unable to track the efficiency changes of a particular bank before and after listing, which impeded effort to prove the effectiveness of IPO in banks efficiency improvement. A recent study identified that banks which had listed recorded better pre-event performance than those which had not (Lin and Zhang, 2009). Nevertheless, after the IPO, no significant efficiency changes were found in either the short or long term. As most of the Chinese commercial banks were listed on the stock exchanges in 2006 and 2007, data of post-IPO period were limited. Insufficient empirical work made it hard to evaluate the effectiveness of stock listing on banks efficiency improvement, a gap this study aims to fill.

In accordance with the revitalization of Chinese stock market, the real-estate market in China had been heated up again since the end of 2005 (Shi, 2007a). To assess the role of bank lending in house price rise, some studies investigated capital support offered by the banks. As an important revenue generation component, banks expanded their personal loan business, in particular mortgage lending rapidly. These studies tried to estimate the risks associated with such fast expansion and proposed several suggestions of bad debt control and credit risk management (Han, 2002; Wang and Wang, 2007; Shi, 2007a; Hu, 2007). In 2008, the US housing crisis destabilised the world financial market, which raised an important question for our study of assessing the extent of the risk exposure of Chinese commercial banks.

3.4 Chapter Summary and Hypothesis of the Research

Despite the increase in studies of the Chinese banking sector and financial system in recent years, these analyse inadequately the restructuring of SOBs and the effect of IPO on banks corporate governance and efficiency improvements. In the following Chapter 4, using CCB as an example, a case study will be conducted to get a detailed understanding of the role of stock listing on banks' corporate governance improvement. Then in Chapter 6, employing panel data for 14 listed Chinese banks over the period 1999-2008, two econometric methods, DEA and SFA will be used to examine the relationship between stock listing and efficiency enhancement quantitatively.

Moreover, in the process of continued globalisation, the influence of the US credit crunch to the Chinese banks and its financial market will also be

addressed in Chapter 7. To what extent is the Chinese banking sector exposed to the US sub-prime mortgage market? Might such an exposure spillover into China's financial sector? With rapid growth in domestic mortgage market, is it possible for China to experience a similar housing crisis in the future?

In summary, focusing on the Chinese financial system, in particular its banking and stock market, this thesis will test the following research hypothesis:

- IPO is an effective tool to improve corporate governance practice of Chinese listed banks, in particular if the bank choose dual-listing to show their commitment to fulfilling higher level of regulatory requirement;

- The overall efficiency of Chinese commercial banks has been improved after more than decades banking reform. The efficiency gap between the SOBs and private-owned commercial banks have been reduced;

- Stock listing is an effective way to improve efficiency of the Chinese commercial banks;

- Efficiency estimations generated by two frontier techniques, the non-parametric approach, DEA, and the parametric approach, SFA, are comparable;

- Given the specific nature of Chinese economy and culture, the US credit crunch is unlikely to be replicated in China. However, some negative impacts on Chinese commercial banks operation and the overall economy are hardly to be avoided.

Chapter 4 The Effect of Stock Listing on Corporate Governance Improvement

As it has been widely believed that IPO could improve the corporate governance of listed firms, a case study approach will be applied in this chapter to get a detailed understanding of in what aspects had the corporate governance of the listed banks been enhanced? As the first listed state-owned commercial bank, CCB will be chosen for the case study because information before and after its IPO covers a relatively long period, which eases our comparison and analysis. The *OECD Principles of Corporate Governance* of 2004 is employed as the analytical prism to examine the bank's degree of compliance and its strengths and weaknesses in corporate governance practices.

4.1 Stock Listing, Corporate Governance and Performance Improvement

Corporate governance can be interpreted as the set of processes, customs, policies, laws, and institutions that affect the way a company is directed, administered or controlled. It also includes the relationships among various stakeholders and the goals for which the corporate is governed. Debate over which constitute a good corporate governance can be dated back to the late 1970's, when the needs and desires of shareholders to exercises their rights of corporate ownership and to increase the value of their shareholding increased. Since the late 1990s', the collapses of Thailand, Indonesia and Malaysia financial markets during the East Asian Financial Crisis and the massive bankruptcies of a number of high-profile US corporations, such as Enron and

WorldCom renewed interest in the corporate governance practises of modern corporations. In response, the US federal government passed the Sarbanes-Oxley Act in 2002, intending to restore public confidence in corporate governance (Delucia, 2004).

Corporate governance is a multi-faceted subject and it was initially proposed to address the problem of conflict of interest between widely-spread shareholders and powerful managers (the principal-agent problem). Later it started to incorporate other issues, such as shareholders' welfare and corporate social responsibilities. The principles and codes of corporate governance had evolved over years and one of the most influential guidelines was the 1999 *OECD Principles of Corporate Governance*. It was further revised in 2002 and finalised in April 2004.

According to the *2004 OECD Principles of Corporate Governance (p.2)*:

> *"The principles are intended to assist OECD and non-OECD governments in their efforts to evaluate and improve the legal, institutional and regulatory framework for corporate governance in their countries and to provide guidance and suggestions for stock exchanges, investors, corporations, and other parties that have a role in the process of developing good corporate governance."*

Good corporate governance is supposed to be able to provide effective incentives for the board and management to pursue objectives that are in the interest of the company and its shareholders and should facilitate effective monitoring. The presence of an effective corporate governance system, either

within a particular company or across an economy as a whole, should help to provide a degree of confidence that the market is functioning properly. This in turn reduces the cost of capital, encourages the efficient resource usage of the companies and thereby underpins growth.

Extensive studies in the past literatures had documented the positive effect of good corporate governance and the improvement of firm performance (Agrawal and Knoeber; 1996; Maug, 1998; Emmons and Schmid, 1999; Dockery et al., 2000; Gompers st al., 2003; Brown and Caylor, 2004; Fan et al., 2007; Sapovadia and Rehman, 2007; Li at al., 2008). Through careful designed monitoring and incentive system, managerial performance and overall corporate performance can be aligned and thereby mitigating the problem of divergence of interests between owner and management (Maug, 1998; Dockery et al., 2000). Moreover, by appointing independent directors sitting on board, they could not only monitor the management of the company more effectively, but more importantly, they are expected to share they professional expertise in problem solving and project management (Cai, 2007). Last but not least, the establishment of three independent subcommittees under the board could introduce more effective control and improve communications among various parties related to the firm.

Compared with corporate governance study on general firms, researches focusing on banks are relatively late. It was the serious problems occurred in three fourths of IMF member banks during 1980 to 1997 and the following Asian Financial Crisis in 1997 that induced people's attention to the self

corporate governance of commercial banks (Ding and Hu, 2008). In September 1999, Basel Committee issued the guidance of *"Enhancing Corporate Governance for Banks"*, emphasising the importance of corporate governance in the bank management and finance supervision and consequently prorogued the study on the banking sector (Ding et al., 2005; Sun and Tobin, 2005; Vernikov, 2007; Ding and Hu, 2008; Lo and NG, 2009).

Among various mechanisms aiming at achieving good corporate governance, diversifying the ownership structure and listing the companies on the stock exchanges with higher disclosure standards were considered to be one of the most effective ones. Historically, the main direct contribution of exchanges to corporate governance had been exercised through the issuance of listing, ongoing disclosure, maintenance and de-listing requirements. Since the promulgation of the *OECD Principles of Corporate Governance*, stock exchanges have often enlarged their regulatory role to embrace a wider palette of corporate governance concerns. Although the enforcing power of the exchanges can be mitigated as some requirements for the listed companies are based on legislation or regulatory rules rather than the stock exchange standards, by bringing the case to the attention of the public and securities regulators, the exchanges have the capacity to prevent fraud and other abusive practises effectively. In essence, by raising transparency and discouraging illegal or irregular practices, exchanges help the listed companies build up their "reputational capital", which in turn increase the value of the companies (Christiansen and Koldertsova, 2008). The market would rewards companies with better corporate governance and punishes those without automatically,

especially in countries where legal and cultural constraints on corporate behaviour are weak (Black, 2001; Cai, 2007).

According to an investigation of McKinsey (2002) on global investors, about 80% of the respondents in all surveyed countries would pay a premium for firms with effective corporate governance. The premiums range from 12 to 14% in North America and Western Europe, 20-25% in Asia and Latin America, and over 30% in Eastern Europe and Africa (Lo and Ng, 2009). It is apparent that investors perceive effective corporate governance as a particular important factor in regions with inadequate regulatory underpinnings (Black, 2001). This is also the case for the Chinese firms as the formal regulatory and legal framework are relatively weak and a large number of CEOs of China listed SOEs are government bureaucrats (Bai et al., 2004; Fan et al., 2007). As stated by the Chinese government, the main purpose for the establishment of stock market is to help listed companies to raise funds and improve corporate governance (Ding et al., 2005). It is possible that even when the state remains the controlling owner of a privatized firm, the stock market could still play a monitoring role and improve performance of the firm (Fan et al., 2007). Obtaining stock listing, especially cross-listing in overseas market, shows the firms' determination of voluntarily subject to higher disclosure standards and more stringent legal liability and therefore ensures the investors of their commitment to follow good corporate governance practise (Sun and Tobin, 2005; Cai, 2007). In the flowing part, a case study of China Construction Bank (CCB) will be conducted to compare the improvement of its corporate governance practises since the bank obtained stock listing in October 2005.

According to 2004 *OECD Principles of Corporate Governance* and *Code of Corporate Governance for Listed Companies in China*, a listed company should ensure: (1) the basis for an effective corporate governance framework exist, (2) the right of shareholders, (3) the equitable treatment of shareholders, (4) the role of stakeholders in corporate governance, (5) disclosure and transparency are adequate, and (6) the responsibilities of the board are fulfilled (OECD, 2004). Although China is not a member of OECD, these principles were designed to offer general guidance to all companies worldwide to improve their corporate governance practices. In particular, since CCB was initially listed on HKSE, it makes the OECD principles more appropriate for reviewing its corporate governance practice. The international listing itself was aimed at ensuring the principles from one to three, which do not convey much requirement at individual company level for radical improvement after qualifying the listing requirements. Therefore, in this case study, only the remaining three principles will be compared and analysed in detail.

4.2 Corporate Governance Practice of CCB

4.2.1 Improvement in Disclosures and Transparency

The main objective of the Disclosure and Transparency Principle is to "*ensure that timely and accurate disclosure is made on all material matters regarding the corporation, including the financial situation, performance, ownership, and governance of the company*" (OECD, 2004: pp.11). This goal affects a wide range of corporate areas including financial and operating results of the company, company objectives, major share ownership and voting rights, remuneration policy for members of the board and key executives, information

about the board members and their independency, related party transactions, foreseeable risk factors, issues regarding employees and other stakeholders and governance structures and policies which the company is required or voluntarily adheres to. In the case of CCB, the comprehensiveness of the information it disclosed had improved significantly over the period 1999 to 2008. This is most directly signified by the increased pages of its annual report. From 1999 to 2003, annual reports of CCB were about 70 pages and then increased to about 150 pages in 2004. Since its IPO in 2005, page number of its annual reports almost doubled to about 300 pages. However, apart from the major areas of the business, we could find that other facts of the organisation were still relatively vague.

Firstly, regarding the financial and operating results of CCB, before its IPO in 2005, no clear definition had ever been given about what specific accounting standard had been adopted by the bank to prepare its financial statements. Although CCB mentioned that the "*accounting policies adopted by the bank are based on the Accounting Standards for Business Enterprises*" in its 2004 report (CCB Annual Report, 2004), the abbreviation of "*PRC GAPP*"[9] was first introduced in 2005. In addition, before stock listing, the section, "financial statements", was about 10-15% of the whole report but it increased significantly to more than 50% of the overall length since 2005. Besides the general required three statements, the balance sheet, the income and cash flow

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[9] According to the definition of "PRC GAAP", the consolidated financial statements prepared need to be in accordance with the *Accounting Standards for Business Enterprises*, the *Accounting Regulations for Financial Enterprises* (2001) and othe relevant regulations issues by the Ministry of Finance of the PRC (the "MOF"). On 15 February 2006, MOF updated the *Accounting Standards for Business Enterprises*, so the financial statements of CCB in 2007 and 2008 were prepared under the 2006 new constitution.

statements, the CCB added more explanations to its financial statement to help the investors get a better understanding of the bank's operation, the prospect and the risks involved. With more accurate interpretation of the financial information, investment decisions made by the investors are expected to be more rational. Last but not least, we also saw an improvement in CCB's choice of auditors. Two audit companies, Zhongtianyin (originally named as Zhongyin) and KPMG, were employed during the sample period 1999 to 2008. The first one is a mainland audit company based in Beijing and it was responsible for the auditing work during the period 1999 to 2004. However, as the audit firm was directly founded by the People's Bank of China in 1993, its independence was questionable. To enhance the public confidence about the audited financial statements, CCB started to employ KPMG Huazhen as the domestic auditors and KPMG as the international auditors (in 2004, only the KPMG Huazhen was appointed) since 2005, right after its IPO in HKSE. Such arrangement signified the banks' determination of becoming the world's leading banking giant, subjecting to stricter scrutinises and integrating more closely with the international standards.

A major drawback of the CCB disclosure regime is that it only uses RMB as its reporting currency in the financial statements. Since the CCB was listed on both HKSE and SSE and its operations were extended worldwide, the use of a single currency might confuse the investors when they compare the absolute figures in certain business. For example, the CCB disclosed its holding of the US sub-prime mortgage loan backed securities in the 2008 annual report. However, all these figures were based on US dollars. So if an investor wants to

evaluate the influence of the sub-prime backed securities to the profitability of the bank, the choice of appropriate exchange rate would make such analyses process painful. On the other hand, if foreign investors want to invest into H-share of the bank, lack of comparable report denominated in HK dollar would also incur extra costs and trouble to the investors and may finally cause them to forgo such investment opportunities. Therefore, to increase transparency and comparability, the CCB could use multiple currencies in its annual report, facilitating invertors' review of the financial statements and consequently encouraging their investments. Such mode had already been adopted by some internationally listed Chinese companies, such as China Mobile and it had proved to be welcomed by the investors (Madera and Sun, 2005). In summary, the financial reporting of CCB has some limitations, but it is generally consistent with the disclosure requirements set out in the OCED Principles.

For the remuneration disclosure requirement, the Principle clearly specified that all the information related to the remuneration for the directors needed to be disclosed on a personal basis (including termination and retirement provisions). Therefore, the investors could assess the costs and benefits of the remunerations plans and the contribution of incentive schemes, such as stock option schemes, to the performance of the company. However, despite such requirement had been laid down since the first draft of the OECD Principles in 1999, the CCB did not disclose these information until it obtained the stock listing. In the 2005 annual report, the bank published all the information about the emoluments to its directors, supervisors and highest paid individuals for the

first time. Consistent with other big international companies, the remuneration

package of the directors is comprised of basic salary, annual bonus and other

long-term incentive and subsidies to provide sufficient disciplines and

incentives.

In terms of the overall impact of the directors' remuneration on the net profit of

the bank, the ratio had increase significantly since 2004 from 0.006% to the

highest of 0.03% in 2006 and then remained relatively stable at 0.02% in 2007

and 2008 (CCB Annual Report, 2004-2008). This figure was similar to the

other SOBs in China, such as ICBC, which paid about 0.02% of its net profit to

the directors in 2008 (ICBC Annual Report, 2008). Nevertheless, this payment

ratio is still quite low compared to other Asian listed companies (CLSA, 2004).

For example, the ratio of remuneration to net profit of China mobile was about

0.05% in 2004 (Madera and Sun, 2005). As most of the directors of China

SOBs are directly appointed by the central government, apart from the basic

salary and performance related payment, other kind of indirect benefits, such as

housing subsidies, childcare, various duty-related reimbursements, are hard to

be precisely measured. Not to say some of these payments are deliberately

covered up to serve personal interests. Therefore, stricter rules to force

compliance and enhance transparency would be necessary in future.

Besides detailed disclosure of the remuneration package, personal information

of individual board members and the selection process if changes have been

made are also required by the Principle to enable the investors to evaluate their

experience and qualifications and to assess any potential conflicts of interest

that might affect their judgements. Earlier annual reports before IPO had already incorporated some general information, such as age and gender of the directors. However, detailed information about the qualification, past work experiences and holding of membership in other organisations of the directors, supervisors and seniors managements had only been disclosed since 2005. It is quite important to disclose membership of other boards not only because it is an indication of experience and possible time pressures facing a member of the board, but also because it is a crucial measurement of independency and may reveal potential conflicts of interest.

Concerning changes of directorships, the selection process, background of the new the director and his connection with the bank, these information had been clearly stated since 2002. However, whether the new nominated director could be classified as executive or non-executive and, if non-executive, whether he could be considered as independent or not were only started to be disclosed since 2004. We found that the number of board of directors increased yearly from 13 in 2004 to 17 in 2007[10] and seven out of 13 members in 2004 were still serving on the board in 2008. Meanwhile, the number of independent non-executive director (NED) had doubled to six in 2007. Such increased weight of independent NED (from 23% in 2004 to 38% in 2008) could be regarded as movement towards good corporate governance as they are expected to be less influenced by the management and thereby overseeing the management and bank's operation from an independent stand.

Regarding the share ownership structure and voting rights, the substantial state

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[10] in 2008, the number of board of director dropped by one to 16.

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ownership simplified such issue. Since the bank obtained stock listing in 2005, China SAFE Investments Limited (Huijin) together with its wholly controlled subsidiary, Jianyin, had owned about 60% of the total shares. Therefore, share ownership for parties other than the holding company was not material. However, such over-concentration of share ownership might impair the effectiveness of corporate governance as apart from shareholder's benefits, interference from other beneficial groups would also need to be addressed. International experience of establishing sound corporate governance suggests that as the share composition has an inherent influence on boards of directors in discharging their strategic responsibilities, the share split structure should be carefully designed (Wei and Geng, 2008). Institutional investors and banks should be encouraged to take a majority ownership while government-related agencies or state-owned investment groups should invest less. Otherwise, the board of directors would very often to serve as a mere "rubber stamp" for those state-controlled shareholders (Tong et al., 2009).

In the Chinese SOEs, most of the shares are owned by the government and there is lack of "check and balances" from other interest groups, therefore introducing strategic foreign investors to optimising share structure has been widely chosen to improve the boards' performance (Tong et al., 2009). In 2005, two foreign strategic investors, Bank of America (BOA) and Asia Financial Holdings (AFH)[11] were brought in by the CCB to assist the bank in improving its corporate governance system in various aspects. Nonetheless, as BOA trimmed its share holding of CCB in early 2009, the bank needed to evaluate

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[11] Asia Financial Holdings (AFH) is a wholly-owned subsidiary of Temasek. On 4 July 2005, CCB had reached an agreement with the Singapore-headquartered Temasek Holdings (Private) Limited on entering into a strategic partnership. AFH holds about 6% of the stake of CCB.

the potential impact of such foreign divestment critically and be prepared for other potential changes in future.

Thirdly, the Principle requires the disclosure of Company Objectives. It specified that not only the commercial objectives of the companies, but also policies relating to business ethics, production safety, occupational health, protection of workers' lawful rights, the environment and other public commitments were encouraged to be incorporated because such information could be important for investors to evaluate the relationship between companies and the communities in which they operate as a whole (OECD, 2004). In China, consensus has not yet been reached regarding the understanding of social responsibilities, and firms are not giving sufficient priority to their social responsibilities. Nevertheless, in the case of CCB, it started to include a separate chapter on "*corporate social responsibility*" since 2005 and the term, "*corporate social responsibility*" was incorporated in its Chairman's statement in 2006 for the first time. Facing tough competition, in particular after the entrance of foreign banks, CCB had become increasingly aware of its corporate image and committed to fulfilling its social responsibilities as a good corporate citizen.

Furthermore, issues related to employees and other stakeholders in terms of legal proceedings and factors that will influence their involvement with the company have largely been considered immaterial and thereby not included in CCB's annual reports. To commitment towards good corporate governance, CCB incorporated one section called, "*major issues*" since 2007 to provide

more information about substantial litigations and arbitrations of the bank and changes of shares held or controlled. In the area of foreseeable risk factors, the CCB has excelled in providing a robust list of risk factors to its business operation and updating the list when new factors emerge, as evidenced by its outline of the affects of US sub-prime related securities on its performance in 2007. Since 2001, the bank started to add an independent sub-section, *"internal audit"* under the chapter of *"risk management"* analysis. The department plays a key role in promoting the efficiency and effectiveness of bank's internal control as it is able to report to senior executive management free of influence.

In CCB's annual report, a separate chapter called, *"corporate governance"* was included since the beginning of our sample period 1999 with the only exception of 2001. Nonetheless, disclosure in early period was quite general, simply listing the bank's reorganisation of the importance of good corporate governance, organizational reforms and goals of the bank. In 2000, CCB set up the Supervisory Committee (board) to carry out the non-executive supervisory function of monitoring and inspecting the performance of the bank.

The most significant changes on CCB's corporate governance practice happened since its stock listing in 2005. The bank first publicly documented its corporate governance policies in the 2005 annual report and has continued to outline specific changes and initiatives engaged by the bank to foster improved corporate governance. The CCB adopted the *"Code on Corporate Governance Practices (Codes)"* set out in Appendix 14 of the *Rules Governing the Listing of Securities on the Stock Exchange of Hong Kong Limited* and also committed

to comply with both domestic and international corporate governance best practices. In addition, according to the requirement of *Code*, the CCB also established five independent subcommittees and disclosed detailed information about the formulation, function, meetings of each of the five subcommittees. This should be considered as a very good start for the bank. Although the CCB moved back to SSE in 2007, it still committed to comply with all the rules in HKSE, which was regarded to be stricter than the rules for the SSE.

4.2.2 Responsibilities and Composition of the Board

The OECD Principles provide clear guidance regarding the board of directors in various aspects under the *Responsibilities of The Board*. According to the guidelines, the CEO and the chairman of the board should not be the same person. Although CCB had separated both positions to enhance the independence of the board, members of the NEDs were dominated by high-ranking state bureaucrats and seasoned members of the Chinese Communist Party (CCP) and therefore may not fulfil their expected role of "watchdog". Meanwhile, as the major shareholder of CCB, the state typically appoint leaders of the bank directly rather than leaving the authority to the board. These appointed executives are either seasoned financial technocrats in the banking industry or state bureaucrats and their performance are heavily influenced by the government, consequently weakening the corporate governance practise of the bank.

In terms of the composition of the board, one of the sub-principle states that it is the duty of the company to appoint sufficient number of independent,

non-executive directors sitting on the board. In particular, the NYSE requires a

majority of independent directors while HKSE specified that an issuer should

assign at least *one-third* independent NEDs on the board (Appendix 14, p5.).

Having a balanced composition of executive and non-executive directors is

regarded as beneficial to the company as it helps align the interests of different

parties, forcing the board of directors to act in the best interests of the

shareholders and bringing an objective view to the evaluation of the

performance of the board of management. Table 4.1 summarises the

composition of the board of CCB during 2004 to 2008.

Table 4.1 Composition of the board of CCB, 2004-2008

	2004	2005	2006	2007	2008
Total number of directors	13	15	16	17	16
Number of NED	6	7	7	7	7
Number of independent NED	3	4	5	6	6
Independent NED/Total directors (%)	23%	27%	31%	35%	38%

Source: CCB Annual Report, various issues.
Note: NED: non-executive director; Annual reports before 2004 had no separation on the
dependency of the directors and therefore information from 1999 to 2003 was not
included.

It is not surprise that there was no distinction of dependency among directors in

early sample period as the CCB was a fully state-owned enterprise. The

ownership structure of the bank did not require it to have any pre-existing

outside investors prior to listing. For example, in 2001, its president and chief

executive officer, Enzhao Zhang, was also in charge of the Human Resources

Management Department, the Audit Department and other major departments.

Meanwhile, he was also the chairman of several large Chinese corporations and

the Deputy President of the China Banks Association. Such oversaturation of

power and lack of effective supervision facilitated him to pursue unending

personal interests and finally led him to be sentenced in prison for 15 years for

accepting more than $500,000 in gifts and bribes.

To impose effective control over the senior management and to bring in foreign

expertises to assist the bank with its final stock listing, CCB introduced two

foreign strategic investors, BOA and AFH in mid-2005. Holding about 9% of

the stake of CCB and committed to spend another $500 million to maintain its

share after the IPO of CCB in the second half of 2005, BOA had agreed to

assist CCB in various areas, including risk management, corporate governance,

credit cards, treasury services and consumer banking. In addition, BOA had

also appointed one of its members as the non-executive director of CCB since

August 2005. Up to 2008, foreign people sitting on board had increased from

one in 2004 to four, clearly indicating the bank's awareness of absorbing

foreign expertises to enhance its own performance.

For the percentage of independent NEDs, CCB is improving continuously and

has satisfied the requirement of HKSE since 2006. The ratio reached its highest

level of 38% in 2008. However, compared with the higher requirement set up

by NYSE, CCB still has a long way to go. Within these six independent NEDs

in 2008, one of them used to be a partner of KPMG. Although retired in March

2003, the independency of the director was questionable as he could still use

his personal relationships to influence the audit result as KPMG had become

the auditor of the CCB since 2004. If taking account of only unchallenged

independence, the percentage of independent NEDs of the bank in 2008 would

fall to just above 30%. The low representation of independent directors on the board would be a critical flaw in CCB's corporate governance practices.

Worse more, as a SOB, CCB was originally funded by the Chinese government, and therefore there was no need for directors to represent the interest of minority shareholders. However, after IPO, how to protect the interests of minority shareholders, increase transparency and communication and improve the efficient and prudent usage of asset had imposed serious problems for the directors. In such situation, the need for experienced non-executives to take a leading role in educating other board members on best practises has become prominently important. Nonetheless, acknowledging the need for independent NEDs and employing the right candidates are two separate issues. Especially in China, hiring appropriate NEDs to sit on board is even more difficult as the pool of qualified people is quite small. This situation has been improved continuously in recent years as more Asian firms attain listings overseas. The CCB should keep on recruiting high-quality independent directors to address the current imbalanced board, trying to achieve better corporate governance.

The importance of independent NEDs is also represented by their ability to fulfilling other corporate governance requirements set out in the Principles. In particular, the Principles recommended that three board subcommittees should be formulated, namely, the audit committee, the remuneration committee and the nominations committee. The audit committee is expected to serve as a link between board of directors and the external auditors and to mediate potential conflicts or disputes between the management and auditors, thus enabling

auditors to perform their job more independently (Ding et al., 2005). While the objective of the latter two subcommittees is to design the most appropriate policies to recruit and retain the right candidates. Directors sitting on these subcommittees are supposed to be all NEDs and the chairman should be an independent NED to ensure that they could monitor the bank's critical issues on behalf of the shareholders effectively.

In the case of CCB, the term, "*Board Committees*" was first appeared in its 2004 annual report. The board set up five specialised committees to "*ensure the efficiencies of the policies agreed on at the Shareholders' General Meetings*" (CCB annual report, 2004, p. 27). However, the classification of these subcommittees was not consistent with the Principles and no other information apart from the definition of the committees had been incorporated.

It was in CCB's 2005 annual report that the bank first disclosed comprehensive information about its corporate governance framework. Five subcommittees were established under the board, namely, strategy development committee, risk management committee, audit committee, nomination and compensation committee and related party transactions committee. People who composed these committees, their dependency status, responsibilities of the committees, meetings during the year, issues discussed and the attendance rate of the directors had all been clearly stated in the report. Moreover, conform to the recommendation of the Principles, chairmen of the latter three subcommittees are all independent NEDs to enhance transparency and effectiveness. However, again, the relatively small number of non-executive board members at CCB

made it hard to formulate all the critical subcommittees with NEDs. Not to mention that the effectiveness of these committees might have already been hampered by requiring each director to sit on several committees and spread their limited time and knowledge amongst various demanding projects simultaneously. For example, two independent NEDs, Song Fengming and Tse Hau Yin Aloysius were found to sit on four of the five subcommittees in 2008. Therefore, despite attending all the meetings during the year, the amount of time they could devoted to each of the project and their ability to fulfil all the functions specified for board members were really questionable.

Finally, concerning the effective mechanism to align the interest of board of directors and senior management with the shareholders, the principles of professionalism and ethics would offer some help but this is generally not enough to drive the director to make controversial statements in support of minority shareholders. The best way to ensure that sufficient motivation has been granted to the directors to act on behalf of the interests of shareholders whom they represent is to make them minority shareholders themselves. Such recommendation has also been suggested by the OECD Principle. However, until 2008, annual report of CCB stated clearly that *"there were no internal staff shares"* and *"none of the directors, supervisors or senior management holds any securities of the bank"* (CCB annual report, 2008, p. 111). "Other benefits" been awarded to the board of directors of CCB mainly include the bank's contributions to medical fund, housing fund and other social insurances but not stock options. Such remuneration arrangement for the directors is not popular among large listed corporations as it makes the board members with

little personal wealth at stake and therefore reluctant to align their own interests with those of the shareholders. The CCB should learn from the experience of other companies, being aware of the potential problem of over-issuance of options, and introduce its own "Stock Ownership Plan" in the near future.

4.3 Chapter Summary

Corporate governance is a reflection of quality of management and it has become increasingly valued by the investors in recent years. In comparison to the firms in other developed nations, listed companies in China facing added challenges, such as the need to educate executive and non-executive board members and the frequent multi-level agency problems associated with the controlling shareholder who is also the government. Moreover, as the standard of corporate governance required by local stock markets in China are generally lower than that of the capital markets in other western countries, many Chinese companies choose dual-listing to show their commitment to fulfilling higher level of governance requirements. Such strategy was also adopted by China Construction Bank.

From the discussion above, we could see that CCB has strived to comply with good principles of corporate governance since its IPO in 2005. Compared with the annual reports of past few years, changes made since the 2005 report were quite profound and comprehensive. In all major areas required by the Principles, the bank had displayed a very high level of compliance. For instance, in the area of Disclosure and Transparency, the CCB clearly outlined the operating and regulatory structures and risks to its investors and had good

tracking records of communications. The requirements of OECD Principles on equitable treatment of shareholders, rights of shareholders and the provision of a framework for effective corporate governance had all been well followed by the bank.

However, despite outstanding improvements, flaws in some fundamental aspects of its corporate governance still existed. The highlighted responsibility of the independent non-executive directors was not fully reflected in its board composition. In most of the sample period even after stock listing, the percentage of independent NED of CCB was about 30%, just reaching the threshold of HKSE but far less than the higher requirement of NYSE. This level of independent director disabled board of CCB to exercise its function, such as monitoring complex transactions effectively. As more Chinese companies attained stock listing in recent years and the pool of qualified people been built up, CCB should try to attract more of these high-quality independent directors to address the current imbalanced board and consequently to achieve better corporate governance in future.

Chapter 5 Methodology

Apart from the qualitative method, case study we discussed earlier, the quantitative technique, frontier models for efficiency measurement will also be applied in the following chapter to estimate quantitatively the extend to which the efficiency of the banks can be improved after IPO. The case study technique emphasizes detailed contextual analysis of a limited number of events or conditions and their relationships, and therefore allows the researchers to look at the events in a systematic way, helping them to gain a sharpened understanding of why the instance happened as it did. While the econometric models estimate quantitatively how much the change is going to make. The use of two types of research methods allows us to get a more comprehensive understanding of the instance and therefore provides us a level of assurance that the findings are generalizable and reliable.

In this chapter, two methods, DEA and SFA, which will be used to estimate efficiency levels of listed banks, will be reviewed. Compared with traditional ratio analysis, frontier methods are better techniques as they could provide a comprehensive performance measurement whilst taking account of external environmental factors. In particular, the mathematical derivation, advantages and limitations of the non-parametric approach, DEA, and the parametric approach, SFA, will be compared and discussed in detail.

5.1 Non-Parametric Approach----DEA

Data envelopment analysis (DEA) is a non-parametric linear programming technique, which was developed by Charnes, Cooper and Rhodes in 1978.

They generalized Farrell's (1957) single input-output model into the multiple

input-output context and introduced the term "Decision Making Unit" (DMU).

At the beginning, DMU was used to differentiate non-for-profit business from

profit-oriented firms. Later it was extended to incorporate all producers and

organizations. In efficiency analysis, the observations (DMUs) in one sample

needed to be relatively homogeneous in terms of resources consumed,

operations undertaken and outputs produced. The efficiency of the DMU is

estimated by the ratio of the sum of weighted outputs to the sum of weighted

inputs. Under DEA estimation, the "efficiency frontier" is made up of the

DMUs that are more efficient than the other DMUs within the sample and the

efficiency scores of all other DMUs are assigned based on their radical distance

relative to the frontier. The efficient units, those making the best use of

resources, are rated as 100% or 1 while other inefficient DMUs receive lower

ratings. An efficiency score of less than one indicates that a linear combination

of other DMUs from the sample could produce the same vector of outputs but

use a smaller vector of inputs (Cooper et al., 2006).

DEA has several advantages over other efficiency measures. It does not impose

any restriction on either the form of the underlying production relationships or

the distribution of the data employed (Banker, 1984; Al-Faraj et al., 1993). The

DEA production possibility set is built by linear combination of a set of best

practice observations and thereby avoids the need of pre-specifying the relative

importance of different inputs or outputs. In addition, the choice of input and

output variables is quite flexible; DEA is able to process multiple inputs and

outputs without standardization. Not only the traditional indictors such as the

number of employees, working hours and stock value of the deposits can be used, but qualitative variables such as personality and motivation can also be incorporated. Therefore DEA gives the analysts more freedom in choosing variables according to managerial objectives or under complex situations. Finally, DEA could identify factors that contribute to the inefficiency of certain DMU and suggest reference DMUs to it for further improvement. With similar input and output mix, it would be easier to understand the nature of inefficiencies and set up targets accordingly. The major limitation of the DEA is that it assumes that there is no measurement error of the data and classifies all deviations from the frontier as inefficiency (Mester, 1996). This makes the DEA result particularly sensitive to data errors and outliers. Any random error could cause the reclassification of efficient DMUs and lead to the recalculation of efficiency scores of all inefficient DMUs. Another potential problem for DEA estimation is that the DMUs identified as fully efficient are only benchmarks within the sample, making it hard for cross sample comparisons.

One basic DEA model, the CCR model, could be illustrated as the following (Charnes et al., 1978). Assuming there is a set of $DMU_j, j = 0,1,...n$, and each of them consumes varying amount of $i = 1,...,m$ inputs to produce $r = 1,...,s$ outputs. For example, DMU_j uses amount x_{ij} of input i and produces amount y_{rj} of output r. We further assume that $x_{ij} \geq 0$, $y_{rj} \geq 0$ and at least one component of every input and output vector is positive. Farrell (1957) generalized the concept of "Pareto efficiency"[12] to a multiple input and output

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[12] Pareto efficiency is an important concept in economics. It refers to the situation if there is no way to rearrange things to make at least one person better off without making anyone worse off.

context and defined the term "efficiency" as the sum of weighted output

divided by the sum of weighted inputs. Accordingly, the efficiency of a

particular DMU, k, under constant return to scale can be obtained by

maximizing the equation below.

$$\max h = \sum_{r=1}^{s} \mu_r y_{rk} \bigg/ \sum_{i=1}^{m} \vartheta_i x_{ik} \tag{E5.1}$$

subject to

$$\sum_{r=1}^{s} \mu_r y_{rj} \bigg/ \sum_{i=1}^{m} \vartheta_i x_{ij} \leq 1 \, for \, j = 1, ..., n;$$

$$\mu_r, \vartheta_i \geq 0 \, for \, all \, i \, and \, r$$

where y_{rk} and x_{ik} are the *rth* output and the *ith* input of the *kth* DMU

respectively. μ_r and ϑ_i are coefficients of the *rth* output and the *ith* input

that maximize h.

(E5.1) aims to find the proper weights of inputs and outputs that maximize the

Farrell efficiency. Unlike other efficiency estimation techniques pre-specifying

weight of each input and output variable, DEA allows the optimal weights to

vary among different DMUs to maximize the ratio of virtual output/virtual

input (Cooper et al., 1999). By solving the above fractional program $(n+1)$

times, each time with a different DMU serving as the reference unit, the

efficient frontier could be constructed and the distance from it represents

inefficiencies of the DMUs.

The (E5.1) is nonlinear, which may lead to computational difficulties because it

could yield an infinite number of solutions. The original solution, (μ^*, ϑ^*), can

remain optimal when it is multiplied by any positive number. Charnes et al.

(1978) solved the problem by setting the denominator, $\sum_{i=1}^{m} \vartheta_i x_{ik}$, equal to 1 and

transformed the former fractional program into a linear programming problem

(LP). This ingenious transformation has long been regarded as the genesis of

the DEA method.

$$\text{(LP)} \qquad \max h = \sum_{r=1}^{s} \mu_r y_{rk} \qquad \text{(E5.2)}$$

subject to

$$\sum_{r=1}^{s} \mu_r y_{rj} - \sum_{i=1}^{m} \vartheta_i x_{ij} \leq 0$$

$$\sum_{i=1}^{m} \vartheta_i x_{ik} = 1$$

$$\mu_r, \vartheta_i \geq 0$$

(E5.2) is referred to as multiplier model (also called the *primal problem*). It has

proved to be equivalent to the envelopment model (also called the *dual*

problem), which is based on a production boundary (Thanassoulis, 2001).[13]

Instead of working out LP directly, solving its "dual" (DLP), the envelopment

model is easier because the constraints imposed on the DLP model, $(m + s)$, is

much smaller than that of the LP model, n. The efficiency of DMU$_k$, expressed

in the envelopment form is:

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[13] For detailed proof, see Cooper et al., 2006, appendix A.4. The "Duality Theorem" suggests that: "(i) In a primal-dual pair of linear programs, if either the primal or the dual has an optimal solution, then the other one does also, and the two optimal objective values are equal; (ii) If either the primal or the dual problem has an unbounded solution, then the other has no feasible solution; (iii) If either problem has no solution then the other problem either has no solution or its solution is unbounded."

$$(DLP) \qquad \qquad \min \ \theta \qquad \qquad \qquad (E5.3)$$

subject to

$$\sum_{j=1}^{n} x_{ij} \eta_j \leq \theta x_{ik} \quad i = 1,...,m;$$

$$\sum_{j=1}^{n} y_{rj} \eta_j \geq y_{rk} \quad r = 1,...,s;$$

$$\eta_j \geq 0 \quad j = 1,...n$$

where $\eta = (\eta_1,...,\eta_n)^T$ is a non-negative vector of variables. When $\theta = 1$, the

DLP has one feasible solution, $\theta = 1$, $\eta_k = 1, \eta_j = 0 \ (j \neq 0)$. Hence the

optimal θ, denoted by θ^*, is not greater than 1. Moreover, $\sum_{j=1}^{n} x_{ij} \eta_j \leq \theta x_{ik}$

ensures that θ must be greater than zero. On the other hand, as the data are

assumed to be non-negative, the constraint $\sum_{j=1}^{n} y_{rj} \eta_j \geq y_{rk}$ forces η to be

nonzero because $y_{rk} > 0$. Putting all these together, the optimal objective

value, θ^*, is bounded between $(0,1]$.

The above DLP is also referred to as the "Farrell model". The efficiency

estimated is regarded as "weak efficiency" because θ^* only reflects the

maximum possible radical contraction of a DMU's inputs within the production

possibility set while maintaining the output level constant (Zhu, 2003). Some

boundary points, which result from non-zero input and output slacks, are not

considered. To fully evaluate the inefficiencies, the maximum value of input

excesses, $s^- \in R^m$ and the output shortfalls, $s^+ \in R^s$ must be incorporated.

(E5.4) provides the complete solution.

$$\max \sum_{i=1}^{m} S_i^- + \sum_{r=1}^{s} S_r^+ \qquad \text{(E5.4)}$$

subject to

$$\sum_{j=1}^{n} x_{ij}\eta_j + S_i^- = \theta^* x_{ik}, \quad i = 1,...,m;$$

$$\sum_{j=1}^{n} y_{rj}\eta_j - S_r^+ = y_{rk}, \quad r = 1,...,s;$$

$$\eta_j, S_i^-, S_r^+ \geq 0$$

The aim of this second phase is to find a solution, (η^*, S^{-*}, S^{+*}), that

maximizes the sum of input excesses and output shortfalls while keeping $\theta = \theta^*$.

If the optimal solution $(\theta^*, \eta^*, S^{-*}, S^{+*})$ of (E4.3) and (E4.4) satisfies $\theta^* = 1$ and

has zero slacks $(S^{-*} = 0, S^{+*} = 0)$, then this DMU is called CCR-efficient or

Pareto-Koopmans efficient (Zhu, 2003). Otherwise, it is CCR-inefficient. The

first condition, $\theta^* = 1$, is referred to as "radical efficiency" or "technical

efficiency" because of a value of $\theta^* < 1$ means that all inputs can be

simultaneously reduced without altering the proportions in which they are

utilized.

For those inefficient DMUs, DEA could suggest reference sets to them for

further improvement. Assuming DMU_0 is inefficient with x_0 input and y_0

output. Its efficiency can be improved through reducing the input values

radically by θ^* and eliminating the input excesses, s^{-*} or through augmenting

the output shortfalls, s^{+*}. (E5.5) illustrates the formula for enhancement, which

is also called the *"CCR projection"* (Cooper et al., 2006). Δx_0 and Δy_0 are

the input and output improvements and $(\hat{x}_0, \hat{y}_0)$ represents the improved

activity that projects the DMU_0 onto the efficiency frontier.

$$\hat{x}_0 = x_0 - \Delta x_0 = \theta^* x_0 - S^{-*} \leq x_o \qquad (E5.5)$$

$$\hat{y}_0 = y_0 + \Delta y_0 = y_0 + S^{+*} \geq y_0$$

In previous discussions, we implicitly focus on the input technical efficiency. The input-oriented technical efficiency of a DMU refers to the extent to which the input resources can be reduced while producing at least the given level of output. However, in certain circumstance, we are more concern about how to raise output production of a DMU without using more than the observed amount of input. There comes the output-oriented model. The option of input minimization or output maximization is reflected in the choice of objective function in the DEA linear program. Table 5.1 presents the output-oriented DEA multiplier model (LP) and its dual (DLP).

Table 5.1 Output-oriented DEA model, CCR

(LP) $\quad \min q = \sum\limits_{i=1}^{m} \vartheta_i x_{ik}$	(DLP) $\quad \max \phi + \varepsilon(\sum\limits_{i=1}^{m} S_i^- + \sum\limits_{r=1}^{s} S_r^+)$
subject to	*subject to*
$\sum\limits_{i=1}^{m} \vartheta_i x_{ij} - \sum\limits_{r=1}^{s} \vartheta_r y_{rj} \geq 0$	$\sum\limits_{j=1}^{n} x_{ij} \eta_j + S_i^- = x_{ik}$;
$\sum\limits_{r=1}^{s} u_r y_{rk} = 1$	$\sum\limits_{j=1}^{n} y_{rj} \eta_j - S_r^+ = \phi y_{rk}$
$u_r, \vartheta_i \geq 0$	$\eta_j \geq 0 \ j = 1,...,n$

Source: Cooper et al., 2007.

If there is no input excess or output shortfalls, the optimal objective value ϕ^* represents the rate of output that can be radically enlarged to realize full efficiency.

These two kinds of CCR models generally estimate similar results and can be

easily transposed between each other. In empirical research, the type of model

chosen depends on the purpose of the research. For instance, the input-oriented

model is more appropriate when the company seeks to reduce costs and

downsize the branch network during a price cutting competition, whereas when

the firm tries to expend market share in an emerging market, an output-oriented

model suits better.

To evaluate the technical efficiency of the DMUs, the influences of scale

diseconomies should also be taken into account. Under similar operational

environment, some DMUs may operate at constant return to scale (CRS) whilst

others may experience various return to scale (VRS). CCR model is

constructed based on the assumption of CRS, which suggests that when the

input investment goes up, output level will increase proportionately and

therefore the efficiency of the firms will not be affected by their return to scale

characters. However, empirical studies show that most of the firms are

experiencing VRS that changing in inputs consumption will not result in a

proportional change in output production (Liu and Song, 2004; Zheng and Cao,

2005). In general, VRS takes two forms, either increased return to scale (IRS)

or decreased return to scale (DRS). A firm experiences IRS if a radical increase

in input consumption leads to a more than proportionate radial increase in

output levels, whereas if the radical increase in output production is less than

proportionate, the firm is operating under DRS.

In 1984, Banker, Charnes and Cooper introduced the VRS DEA model to

account for scale economies. Figure 5.1 compares the efficient frontier of the

BCC and the CCR model.

Figure 5.1 Efficient frontiers of CCR model and BCC model
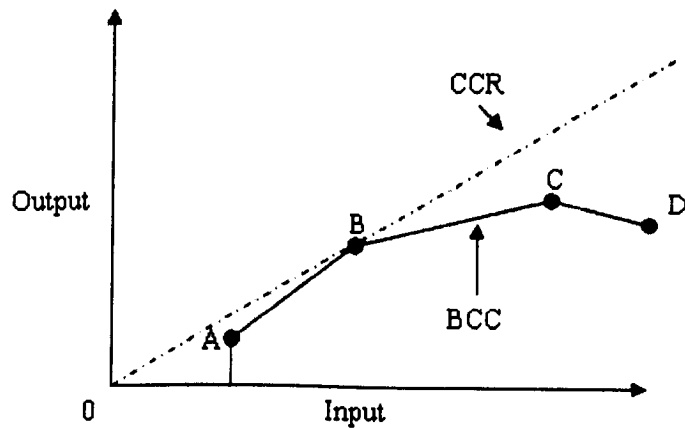
Source: Cooper et al. (2006).

The efficient frontier of the CCR model is the dotted line that passes through B from the origin while the frontier of the BCC model is nonlinear, connecting non-dominated units, A, B, C and D together. The use of VRS frontier enables the calculation of technical efficiency not to be influenced by scale diseconomies. To assess the input efficiency under VRS, one more constraint, $\sum_{j=1}^{n} \eta_j = 1$, needs to be added. Together with the condition, $\eta_j \geq 0$, this imposes a convexity condition on allowable ways in which the n DMUs can be combined. Table 5.2 summarizes the input-oriented BCC model.

Table 5.2 Input-oriented BCC Model

Multiplier form:	Envelopment form:
$$\max z = \sum_{r=1}^{s} u_r y_{rk}$$ subject to $$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} \vartheta_i x_{ij} \le 0$$ $$\sum_{r=0}^{s} u_r y_{rk} = 1;$$ $$\vartheta_i, u_r \ge 0$$	$$\min \theta - \varepsilon (\sum_{i=1}^{m} S_i^- + \sum_{r=1}^{s} S_r^+)$$ subject to $$\theta_k x_{ik} = \sum_{j=1}^{n} x_{ij} \eta_j + S_i^-$$ $$y_{rk} = \sum_{j=1}^{n} y_{rj} \eta_j - S_r^+$$ $$\sum_{j=1}^{n} \eta_j = 1$$ $$\eta_j, S_i^-, S_r^+ \ge 0$$

Source: Cooper et al., 2007.

Efficiency score generated under CRS assumption represents a combination of inefficiencies due to input/output configuration and return to scale character of the DMU, while VRS efficiency rating reflects PTE. CRS is appropriate when most of the DMUs in the sample are operating around optimal production size. When the variations in operation scale of the sample DMUs are large, CRS estimation needs to be complemented with scale efficiency analysis.

Previous studies suggest two ways of choosing between CCR, CRS, model and the BCC, VRS model. One is to examine the correlation between efficiency scores estimated under CRS assumption with the number of DMUs. When the relationship is strong, the VRS model is preferred. Alternatively, both of the CRS and the VRS models can be run for comparison. If the majority of DMUs emerge with the same efficiency scores under both assumptions, either of the two models can be adopted.

In addition to deciding the scale character and input-, output-orientation of the

model, when DEA has been applied to bank efficiency study, some other aspects, such as the choice of input and output variables, the treatment of subjective factors, need to be considered.

The operation of the banking industry is quite complicated because it provides various financial services, which sometimes are interrelated or not directly paid for. These "outputs" are difficult to be measured precisely as the form and price of these "outputs" can be influenced by the government regulations. In addition, despite complying with the general accounting framework, such as the Generally Accepted Accounting Principles (GAAP) adopted by the Chinese banks, banks could still manipulate their earnings by treating the transactions and defining accounting terms differently. This makes the comparison even harder, especially for cross-bank or cross-country studies. Therefore, it has been suggested to have the management involved right from the start to help with data interpretation and model construction (Cooper et al., 2006).

Another controversial issue of banking research is the choice of input and output variables. Unlike manufacturing firms producing physical goods, banks provide both intermediary services and a wide range of financial products, which make it difficult to distinguish between input resources and output products. In the past literatures, two approaches had been widely used, known as the production and intermediation approaches.

The production approach assumes that profit maximization is the key objective of banks. Therefore, the number and type of transactions and related documents

are the best output measure, while inputs are restricted to physical inputs including labour and capital (Yao et al, 2007). The intermediation approach pioneered by Sealey and Lindley (1977) considers banks as an intermediary between savers and borrowers. Accordingly, deposits are treated as an input because they are the source of loans and investments. Neither of the approaches is perfect as each only addresses one side of the role played by the banks and in practice, they can be used as complementarities.

In addition, the treatment of the variable, bad debt has also been well discussed. The emergence of NPLs is an output from imprudent operations. However, granting higher efficiency rating for the banks with large NPL is unreasonable. Some prior studies addressed the problem by leaving the bad debt in the output side but using its inverse value, while the others treated it as an input variable directly (Cooper et al., 2006). In a recent study, the ratio of NPLs to total loans was chosen as an input variable to reflect the asset quality of the banks (Yao et al., 2007). When the banks transferring deposits into interest-earning loans, NPLs were hardly avoidable and therefore it was classified as an input which was used to generate output, "loans".

Finally, like other econometric techniques, the robustness of the DEA result is also affected by the number and type of variables chosen. The sample size has to be big enough, at least two to three times the sum of its input and output variables, to ensure the discrimination power of the model (Cooper et al., 1999). Otherwise, many DMUs will be classified as efficient. An easy way to overcome this problem is to create more than one model with fewer variables

each or to run the model with few core input and output variables first and then

to examine the differences after including more variables. In addition, some

transformed DEA models, such as the "window analysis" and the "assurance

region" model could also be employed instead.

The "window analysis" is suitable when the observations of DMUs are

frequently available over multiple time periods and the research interest is to

indentify the efficiency changes of the DMU over time. This method is

particularly useful if the DMU is subject to structural changes that influence its

performance. Using a moving average analogue, the DEA model can be

performed over time by treating each DMU in different period as a "different"

observation (Färe and Grosskopf, 1996). For example, for a sample of 12 firms

covering six years, total observation of the sample is 72 (12*6=72). If we set

up the length of window as three years, then each firm will be assessed in four

windows (6-3+1=4). Each widow contains the efficiency ratings of three years

for one firm, making the total efficiency estimation within one window to be

36 (3*12=36). Such estimation effectively transforms the total observations of

the sample into 144 (36*4=144), much larger than the previous 72, which

solves the potential problem of "weak explanation power". In our study, data

for14 listed banks covering 1999 to 2008 will be employed. Total observation

of the sample is 139, while the number of input and output variables is five, so

the proposed "misspecification" problem should not exist. The window

analysis model can be run for comparison.

The other approach, the "assurance region", deals especially with

"non-discretionary" factors that exist exogenously fixed rather than controlled by the management, such as weather and soil characteristics. If these factors are not taken into account, estimated efficiency ratings can be misleading. Earlier studies address the issue by dividing the whole sample into several sub-categories and comparing each DMU only with DMUs that operate under similar or worse conditions. Other studies solve the problem by imposing constraints on the multipliers.

The usual assumption of the DEA model is that the dual multipliers assigned for the input and output variables may not account for any prior assumption. Golany (1988) extended the DEA to include ordinal relationships among multipliers to reflect the relative importance of input and output variables. Later Thompson et al., (1990) introduced the "assurance region" model to incorporate prior judgment and knowledge into the model specification. Through imposing restrictions about the range of multipliers with reference to management judgments, problem of assigning extremely low or high values to particular multiplier can be solved. The "cone-ratio" model, developed by Charnes et al. (1990), uses a similar approach.

Under DEA estimation, DMUs that are most efficient within the sample would receive the highest efficiency rating of 1. However, it is possible that a few DMUs of one particular firm can be ranked as fully efficient for several years and/or more than one DMU can achieve full efficiency in one particular year, making it hard for cross section or period comparison. Andersen and Petersen (1993) overcame this obstacle by proposing a super-efficiency model. It

enabled ranking among efficiency DMUs. Changing the reference set of the

original BCC model, the super-efficiency model provides the same efficiency

score for those inefficiency DMUs while generates larger than "1" scores for

those efficient DMUs (E5.6).

$$\min \theta - \varepsilon \left(\sum_{i=1}^{m} S_i^- + \sum_{r=1}^{s} S_r^+ \right) \qquad \text{(E5.6)}$$

subject to

$$\theta_k x_{ik} = \sum_{\substack{j=1 \\ j \neq k}}^{n} x_{ij} \eta_j + S_i^-$$

$$y_{rk} = \sum_{\substack{j=1 \\ j \neq k}}^{n} y_{rj} \eta_j - S_r^+$$

$$\sum_{j=1}^{n} \eta_j = 1 ; \quad \eta_j, S_i^-, S_r^+ \geq 0$$

(E5.6) is identical to the BCC model except that the DMU_k, which under

evaluation, is not included in the reference set. The theoretical rationality of the

super-efficiency model could also be illustrated by Figure 5.2.

Figure 5.2 Super-efficiency measurement of the DMU
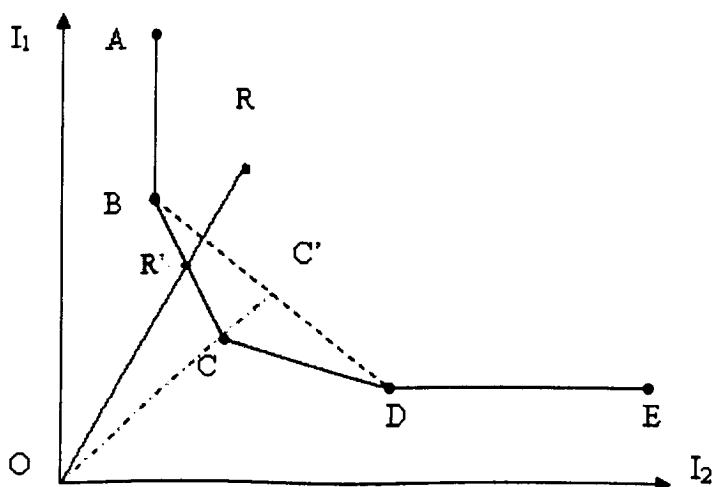
Source: Andersen and Petersen, 1993.

The solid line ABCDE is the efficiency frontier estimated by the BCC model and I_1 and I_2 are different inputs. R represents a technically inefficient DMU while C represents an efficient DMU under DEA-BCC estimation. When using the super-efficiency model to estimate the technical efficiency of an inefficient DMU, R, the original efficiency frontier, ABCDE, will still be chosen as the reference set and therefore gives the same TE score of DMU_R as the BCC model, $TE_R=OR'/OR<1$. Nevertheless, when the efficient DMU, C, is estimated by the super-efficiency model, C itself will be excluded by the reference set and its efficiency score is calculated by the ratio: $TE_C=OC'/OC \geq 1$. It means that the efficient DMU_c could expand its input by TEc but remain efficient in the whole sample. Therefore, the bigger the TEc score assessed by the super-efficiency model, the more efficient the DMU is. To differentiate performance among efficient DMUs and to enlarge estimated efficiency ratings, this study will also adopt the super-efficiency model after the DEA-CCR and DEA-BCC models.

5.2 Parametric Approach----SFA

The parametric efficiency measurement, SFA was first introduced by Aigner et al., Battese and Corra, and Meeusen and Van den Broek independently in 1977. It has been criticized for pre-specifying the functional form and inefficiency distribution. However, the model acknowledges the fact that output level can be influenced by random shocks, which are not controlled by the producers and the inclusion of which therefore improves the accuracy of estimation. Using a compound error term, the estimated technical inefficiency has been separated from the impact of variations in labour or machinery performance, weather

conditions and opportunistic luck, and so on. The stochastic production frontier, which incorporates producer-specific random shocks, can be specified as:

$$Y = f(\beta; x_1, x_2, ..., x_m) \cdot \exp(v) \cdot \exp(u) \qquad (E5.7)$$

where $[f(\beta, x_r) \cdot \exp(v)]$ is the production frontier which consists of two parts, a deterministic part, $f(\beta, x_r)$, universal to all producers and a producer-specific part, $\exp(v)$, capturing the effect of random shocks on each producer. $x_i, i = 1, ..., m$ are the input resources and β is the parameter vector, which describes the structure of the production frontier to be estimated. Y denotes the observed output level.

Assuming the stochastic production frontier takes the log-linear Cobb-Douglas form, (E5.7) can be re-written as:

$$\ln Y = \beta + \sum_m \beta_i \ln x_{mi} + v + u \qquad (E5.8)$$

The random error term v is normally distributed, $v \sim N(0, \sigma_v^2)$ and independent with the explanatory variables, and u represents nonnegative technical inefficiency. These two error terms are mutually independent and the compound error, $\varepsilon = v + u$, is asymmetric as $E(\varepsilon) = E(u) \geq 0$. In the Cobb-Douglas function, $\sum_{i=1,..,m} \beta_i = 1, i \neq 0$, u follows a half normal distribution.

However, such assumptions are relatively inflexible and lead many DMUs cluster near full efficiency (Fu and Heffernan, 2007). Two alternative distributional assumptions, the normal-exponential model, developed by (Aigner et al., 1977) and the truncated-normal model, proposed by Stevenson

(1980), have been employed instead. When the deterministic production frontier takes the Translog function, its inefficiency is assumed to follow the truncated-normal distribution. Most of the recent studies adopt the Translog function because it is able to deal with multiple input and output variables and imposes no restriction on scale economy (Liu and Song, 2004; Fiorentino et al., 2006; Yao et al., 2007). The maximum likelihood method (ML) can be used to estimate the parameters in (E5.8).

Consequently, the technical efficiency is defined as:

$$TE = \frac{Y}{f(\beta, x_i) \cdot \exp(v)} = \exp(-u) \qquad (E5.9)$$

The ratio of observed output to maximum feasible output under the condition characterized as $exp(v)$ represents the technical efficiency of the DUM. $TE \leq 1$ captures the output shortfall and provides the measurement of technical inefficiency. (E5.10) is the technical inefficiency model which is used to explain the differences in estimated inefficiencies by some firm-specific or macroeconomic characteristics.

$$u = \theta\alpha + \omega \qquad (E5.10)$$

α is a vector of explanatory variables that associated with efficiency levels of the firms and θ is the coefficients need to be estimated. ω denotes random disturbances.

Earlier efficiency studies employing SFA frequently adopted this two-stage procedure, estimating the technical efficiency of the DMUs first and later

running the regression to estimate the influence factors. However, this two-stage process suffers from serious econometric problems. The assumptions imposed on the independence of the inefficiency effects in two steps are inconsistent (Kumbhakar and Lovell, 2000). The estimation in the first step can be biased if the firm-specific characteristic, α, is correlated with input resources it consumed (Wang and Schmidt, 2002).

Being aware of the limitations, Battese and Coelli (1995) proposed the single-stage approach that specifies the stochastic frontier and the relationship between technical inefficiency and α simultaneously. In this thesis, we will also adopt this one-step approach, assuming the non-negative technical inefficiency is a function of firm-specific and environmental variables, and independently distributed as truncations of normal distribution with constant variance. The mean is represented by the linear function of the explanatory variables.

After obtaining the efficiency scores of both DEA and SFA, three consistency hypotheses will be examined to test the robustness of these two efficiency measures. The efficiency estimations generated by the different techniques were expected to be consistent in efficiency levels, ranking of DMUs and were related to traditional non-frontier financial indictors (Bauer et al., 1998). In this study, the correlation coefficients and the Spearman rank-order correlation coefficients will be estimated to test for consistency.

5.3 Chapter Summary

This chapter presents the detailed review of two widely employed efficiency

measurement approaches, DEA and SFA. In addition to their mathematical derivations, we also discussed issues that need to be considered when the method has been used for banking studies, such as selection of input and output variables and treatment of "non-discretionary" or "environmental" factors. DEA is a non-parametric approach, which was originally designed to assess efficiency ratings for those non-for-profit institutions while SFA belongs to the parametric group. Neither of the approach is perfect and both have limitations.

To enable comparison, both approaches will be applied in Chapter 6 to measure the effect of stock listing on banks efficiency improvement. The correlation test will be applied in the following part to examine the consistency of the two approaches, but more importantly, to ensure the correctness and usefulness of the derived policy implications.

Chapter 6 Efficiency Analysis of Listed Chinese Commercial Banks

In this chapter, we will apply both of the non-parametric approach, DEA, and the parametric approach, SFA, to assess the efficiency levels of 14 listed Chinese commercial banks. In particular we want to examine whether the stock listing is an effective way to improve the efficiency of the banks. In addition, we will employ the technical inefficiency effects model to test the factors that determine the efficiency ratings of the banks.

6.1 Data Description

Most of the data we employed are extracted from the monthly updated Thompson's BankScope database. The sample is composed of 14 listed Chinese commercial banks during the period 1999-2008 with 139 observations in total.[14] Other data sources we used include *Chinese Statistical Yearbook* (NBS, various issues), *Almanac of China's Finance and Banking* 1999-2008, websites of People's Bank of China (PBOC), statistical reports of China Banking Regulatory Commission (CBRC), and the annual financial statements of banks. As the quality of data in Chinese banking sector has been questioned, we cross checked the data from multiple sources to ensure consistency and to improve the reliability of research findings.

In determining the output and input variables of this study, we adopt the

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[14] Data of Ningbo Bank in 1999 are unavailable.

intermediation approach that treats bank deposits as an input. The output variables are (1) Total Loans and (2) Other Earning Assets (including Short-term Investments, Long-term Investments, Deposits with Central Banks, Other Investments, etc.). The input variables include (1) Number of Employees, (2) Fixed Assets and (3) Deposits. As data for the number of employees is not fully disclosed and other resources cannot be used as a substitute, missing values will be estimated in accordance with the change of total assets (Liu and Song, 2004; Wang and Tan, 2007).

Figure 6.1 and Figure 6.2 depict the changes of two outputs: total loans and other earning assets according to the ownership structure of the banks. Within ten years from 1999 to 2008, total loans had increased by 174% while the other earning assets had risen by 400%, suggesting that the banks had diversified their investment channels to broaden their income generation capacity significantly. Among all listed banks, it was the SOBs that expanded their outputs most obviously.

Figure 6.1 Total loans of Chinese listed commercial banks, 1999-08
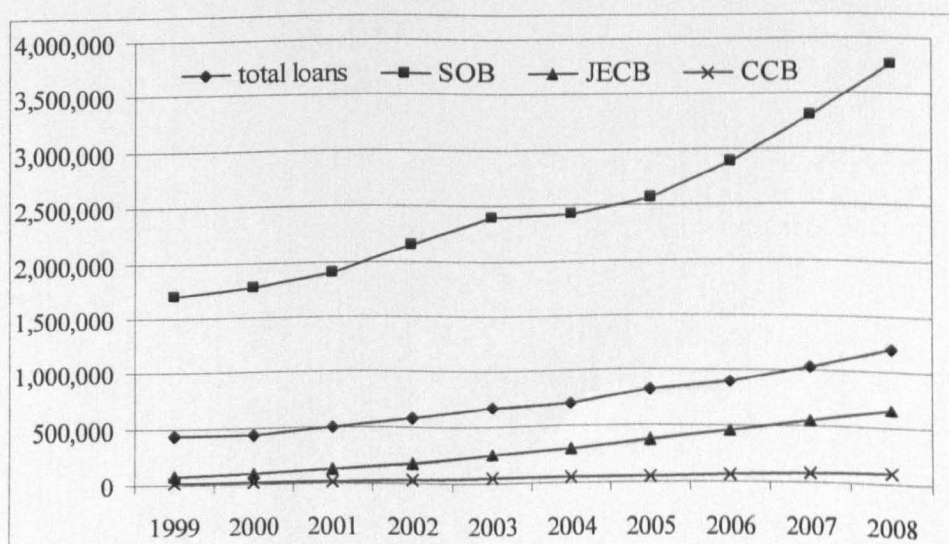
Source: BankScope, 1999-2008.

Figure 6.2 Other earning assets of Chinese listed commercial banks, 1999-08
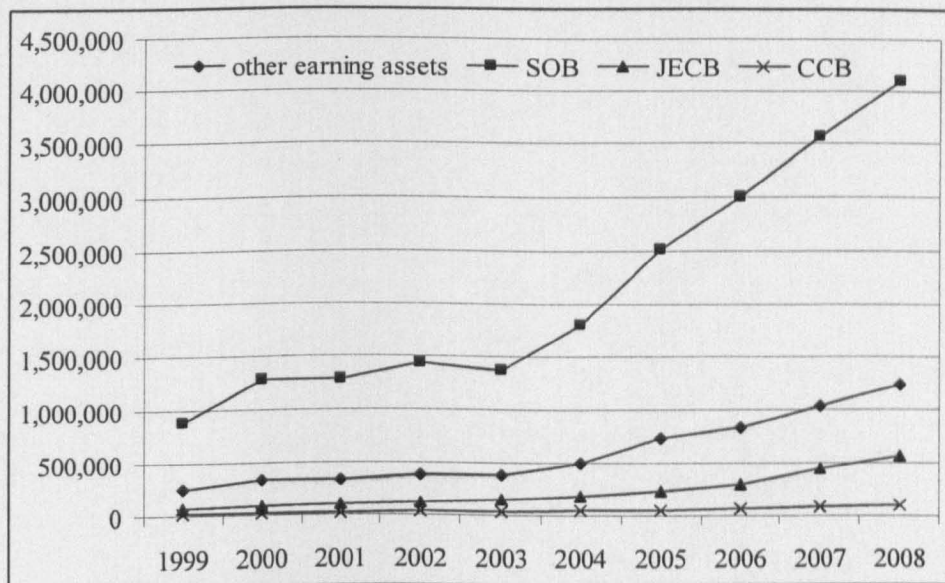
Source: BankScope, 1999-2008.

Figure 6.3, 6.4 and 6.5 presents the changes of three inputs: deposits, fixed assets and number of employees over the sample period 1999-2008. Despite producing more outputs, inputs of the banks were actually remain relatively stable except stock value of the deposits of the SOBs. It is worth noticing that employees of the SOBs were decreased by almost 20% over ten years, indicting a significant improvement of human capital usage by the SOBs.

Figure 6.3 Deposits of Chinese listed commercial banks, 1999-08
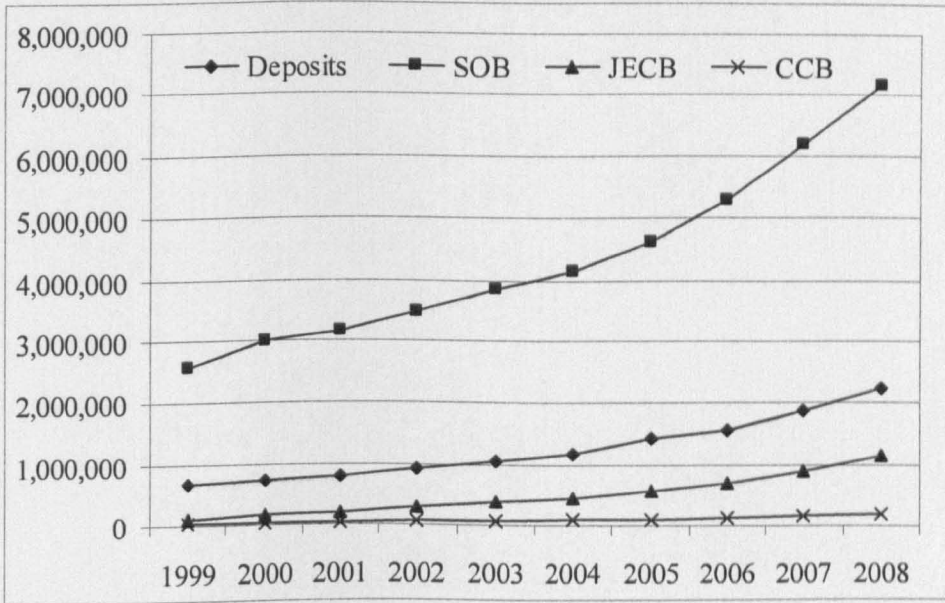
Source: BankScope, 1999-2008.

Figure 6.4 Fixed assets of Chinese listed commercial banks, 1999-08
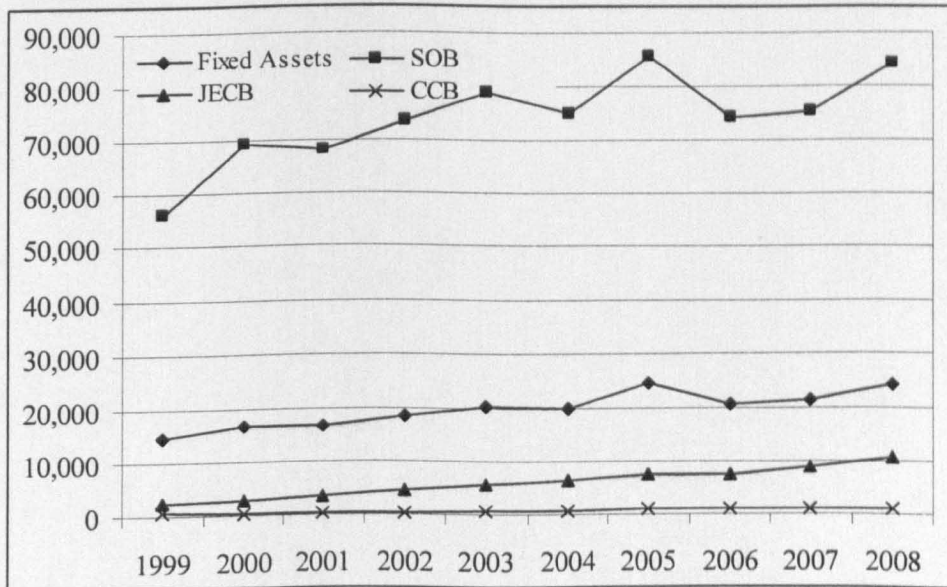
Source: BankScope, 1999-2008.

Figure 6.5 Number of employees of Chinese listed commercial banks, 1999-08
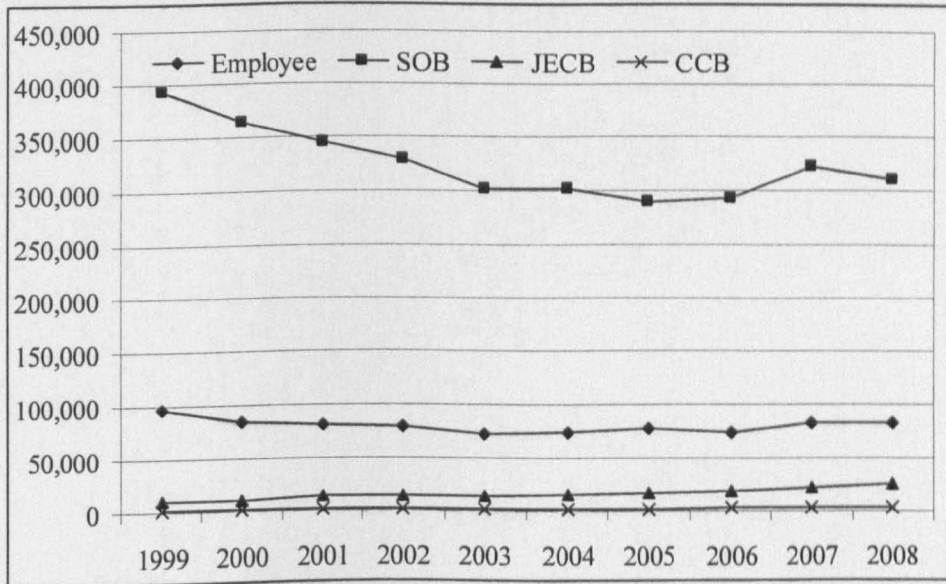
Source: BankScope, 1999-2008.

Although the above analysis of input consumption and output production can not be directly interpreted as an improvement of banks' efficiency, it clearly signified that performance of the banks had been enhanced. Such assertion could also be confirmed by the following Figure 6.6. The ratio of overall return on assets (ROA) of listed Chinese commercial banks had increased by 95% over 1999 to 2008, while this figure was as high as 270% for the SOBs. In 2008, average ROA of listed CCBs had reached a relatively high level of 1.7%.

Figure 6.6 Return on assets of the Chinese listed commercial banks, 1999-08
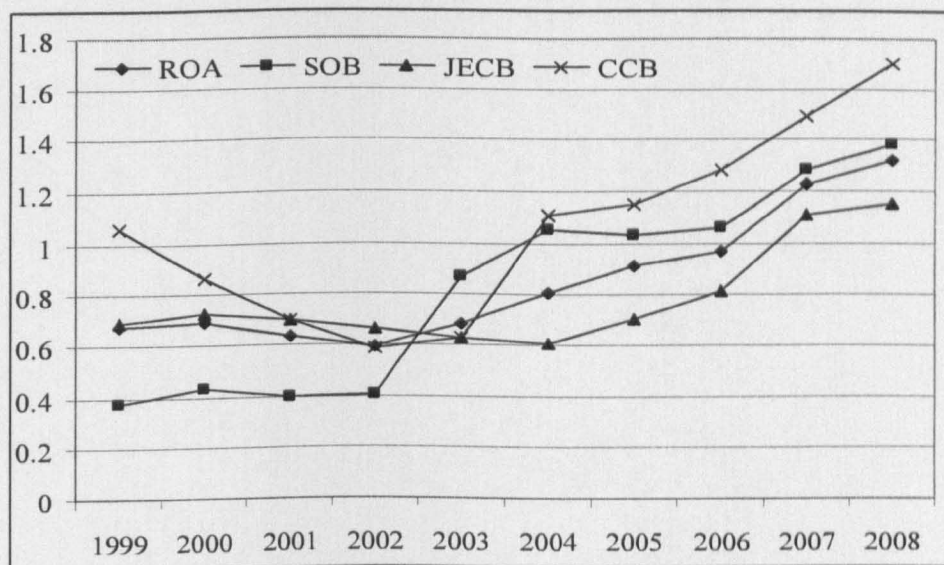
Source: BankScope, 1999-2008.

The following Table 6.1 summarized of related variables and ratios used in efficiency analysis.

Table 6.1 Mean value of sample banks by ownership structure, (RMB, billion)

	All listed banks	SOBs	JECBs	CCBs
Outputs and inputs				
Total loans	720.15	2414.73	302.82	44.89
Other earning assets	597.74	2061.59	224.79	48.75
Fixed assets	19.63	71.91	6.02	0.795
Employees (person)	79837	316095	15975	2303
Deposits	1234.02	4213.00	483.83	87.25
Other performance indictors (%)				
ROA	0.6483	0.6203	0.5798	0.8572
LLR/TLs	2.8248	3.6755	2.8495	1.8121
Equity/Assets (E/A)	4.3831	4.9655	3.7671	5.4810

Source: BankScope, 1999-2008.
Notes: ROA: return on assets; LLR: loan loss reserve; TL: total loans; SOBs: state-owned banks; JECBs: joint-equity commercial banks; CCBs: city commercial banks.

Compared with the SOBs, non-state-owned banks are much smaller. Both output and input of the JECBs are about 10% of that of the SOBs, except the

number of employees. The SOBs employ almost 19 times more staffs than the JECBs and this can be explained as a result of their relative longer history and past employment practices. Established about 10 years earlier than the JECBs, the SOBs employed a large number of people to fulfil its service requirement under the old labour-intensive system, typical of SOEs in China. When these people retired, the banks retain an obligation to provide pensions, housing and other benefits, imposing a heavy burden on the SOBs. If we look at the total number of employees of three listed SOBs, they are actually decreasing, suggesting an improved efficiency of human capital usage.

The profitability indictor, ROA, measures how much return has been generated by the assets employed. It increased steady from 0.45 in 1999 to 1.32 in 2008, with the improvement of SOBs more obvious from 0.37 to 1.38 during the same period. The CCBs surprisingly have the highest average ROA score and this may because only three of the most profitable CCBs are included. Both risk-taking indictors suggest that the SOBs are the most prudent banks, contrary to the general expectation. In particular, E/A controls for capital risk. A higher E/A ratio implies that banks use less debt finance and are exposed to lower capital risk. Facing high interest rate fluctuation or cash flow shortage, banks with high E/A ratio are less likely to experience bankruptcy risk. The ratio has also been used as an indictor of the risk management ability of the banks. Moreover, E/A ratio can be analysed in conjunction with the budget constraint argument.[15] A high proportion of equity finance suggests that banks

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[15] "Budget constraint" describes the consumption options available to an economic entity with limited resource to allocate among various goods. An entity faces hard budget constraint means that it must cover its cost of production with revenues generated or from other financial sources, such as capital support from the shareholders. On the contrary, soft budget constraint is used to

are subject to a hard budget constraint. Dependent on the capital of shareholders, they are more accountable, prudent and risk-adverse. The credit risk indictor, LLR/TLs, measures how much the banks provide for unanticipated losses from irrecoverable debts. It reflects the financial strength of the banks as the reserves provided can be used as a cushion against future loan default losses. Therefore, banks with higher LLR/TLs ratios have less exposure to credit risks and are expected to be more efficient. However, it has been argued that because the capital provided as reserves are effectively locked up and unavailable for investment, they actually forgo investment opportunities, which influence negatively their efficiency. Whether a higher provision of LLR influences the efficiency of the banks positively or negatively will be tested in the technical inefficiency effects model later.

In addition, the GDP growth rate is chosen to represent general macroeconomic environment in which banks operate. The dummy variable, ownership, captures the influence of the ownership structure on the efficiency of banks. A time trend variable, t, is incorporated to reflect common effects on efficiency, such as technical changes.

6.2 Application of DEA to Chinese Commercial Banks

6.2.1 DEA-CCR Model

Before applying the efficiency models, relations between specified input and output variables needs to be tested. Although the test itself can not directly prove the presence or absence of causality among input and output variables, it

characterize an entity that is likely to receive government support if it gets into financial difficulties.

helps identify critical factors that are most likely to fit the input-output correspondence being proposed (Thanassoulis, 2001). Table 6.2 shows that all three inputs are highly correlated to the output variables. The deposit is identified as the most important input resources with correlation coefficients to two output variables, total loans and other earning assets, as high as 0.99 and 0.92 respectively. Total employee is the weakest input, in particular in generating other earning assets. In addition, the relationship between the two types of outputs is found to be quite high at 0.941, reflecting the fact that banks that have a stronger finance position would not only grant more loans, but also invest more extensively in other interest-earning assets.

Table 6.2 Correlations between input and output variables

Correlate	Fixed assets	Employees	Deposits	Total loans	Other earning assets
Input variables					
Fixed assets	1.0000				
Employees	0.9063	1.0000			
Deposits	0.9190	0.8571	1.0000		
Output variables					
Total loans	0.9307	0.8927	0.9927	1.0000	
Other earning assets	0.8666	0.7555	0.9175	0.9408	1.0000

In our study, we choose the input-oriented DEA model because a reduction of input level is easier for management to control while the output quantity can be influenced by a range of external factors. Especially in a competitive market, it a bank will struggle to increase its output without raising inputs. Nevertheless, a bank can make efforts to minimise the inputs for given output levels and this rationale influences our selection of the input-oriented model.

The results of DEA-CCR model is summarised in Table 6.3. Consistent with

the prior studies, the mean efficiency of the Chinese commercial banks is about

0.86, with the JECBs the best performers (Li and He, 2005). On average,

efficiency scores of JECBs, SOBs and CCBs are 0.89, 0.79 and 0.87

respectively. Despite the latest reforms of SOBs, their performance remains

poorer than the other two types of banks (Figure 6.7). All three SOBs are

ranked bottom among 14 listed banks in terms of mean efficiency between

1999 and 2008. Within the 139 sample DMUs, 13 are fully efficient but none is

state-owned. The most efficient bank is CMINB, with an average efficiency

score of 0.94, while the least efficient bank is CCB whose mean efficiency is

just 0.73. Nine out of 14 banks average efficiency scores clustered around 0.85,

suggesting there is significant potential for further efficiency improvement

even among listed banks.

Table 6.3 Efficiency of Chinese listed banks before and after IPO--CCR

	Efficiency Level		
	One year before IPO	IPO year	One year after IPO
State-owned banks			
BOC	0.8923	0.9325	0.8989
CCB	0.7406	0.7829	0.8028
ICBC	0.7970	0.8480	0.8623
City Commercial banks			
Beijing	0.8597	0.9898	1.0000
Nanjing	0.8849	1.0000	0.9437
Ningbo	0.9421	0.9698	0.9113
Joint-Equity banks			
BOCOM	0.7804	0.8041	0.8145
CITIC	0.9567	0.9815	0.9140
CMB	0.8053	0.8405	0.8343
CMINB	0.8347	0.9040	0.8802
HXB	0.8063	0.8199	0.9347
Industrial	1.0000	1.0000	0.9291
PDB	--	0.8213	0.8355
SDB	--	--	--

Notes: CCR represents the DEA constant return to scale model; Full names of the banks are listed in the appendix; our data period covers the 10 years from 1999; the PDB was listed on the stock exchange on 10 November 1999, so data for 1998, before IPO, are not available; the SDB was listed in 1991, so its information is not included in this table.

My empirical results support the hypothesis that stock listing is an effective way to improve bank efficiency. The average efficiency rating of banks in the IPO year was about 6% higher than that before IPO. All 12 banks managed to achieve higher efficiency levels in their IPO year, except the Industrial Bank, which was already fully efficient before IPO. Under increased pressure of public scrutiny and foreign competition, Chinese banks were forced to improve their performance to satisfy current shareholders and to attract new investors. However, the efficiency scores of seven of the 13 banks declined immediately

after the IPO year. One possible explanation is that operational and managerial weakness may be covered up before the IPO to create favourable financial reports in order to be listed on the stock market, resulting in subsequent short-term gains. If the banks were unable to implement effective measures to overcome the weaknesses, these temporary gains were unsustainable in the long term. Another reason for the decline in the efficiency ratings after the IPO may reflect the timing of their listing: four of them were listed in 2007, so their performances were badly hurt by the poorer economic conditions in 2008. Although the expose of Chinese banks to the US sub-prime related securities was quite limited, the tightened credit policies and the slump in the stock markets impaired their performance significantly (Yao et al., 2009). Therefore, in order to evaluate more critically the effect of the IPO on the efficiency of banks, data for a few more years would be necessary to assess these external market fluctuations. Theses data we obviously do not have yet.

Figure 6.7 Efficiency of the Chinese commercial banks, 1999-08--CCR
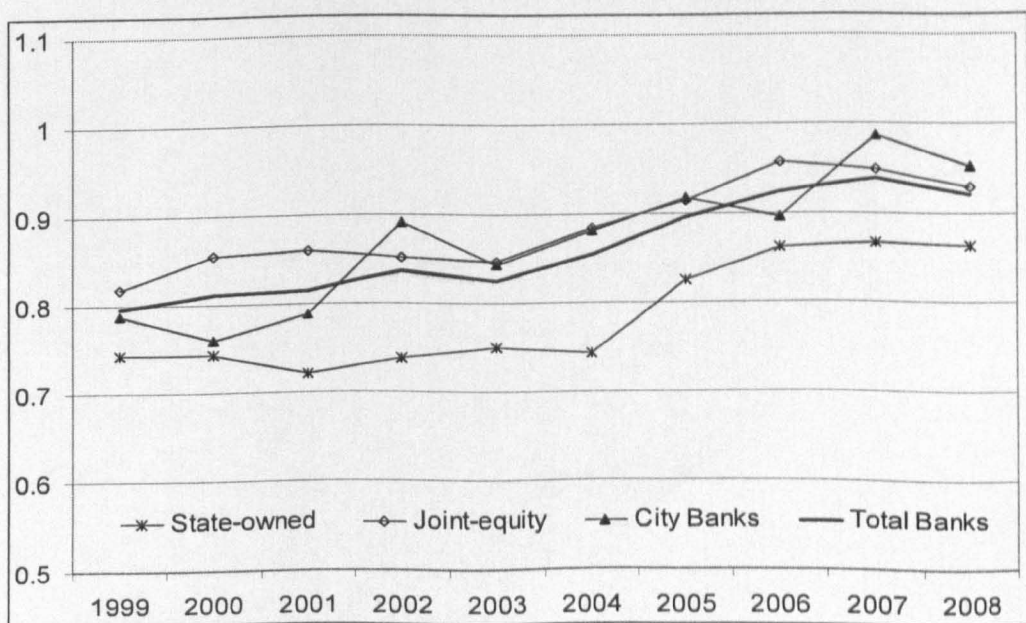
Note: CCR represents the DEA constant return to scale model.

As well as identifying the best practice in the banking sector, the DEA results also show the scope of possible improvement for the inefficient DMUs. With reference to the efficient observations within the sample, the DEA technique estimates the maximum possible radical contraction to the input levels of inefficient DMUs and the input slacks. The target efficiency improvement is then calculated as the sum of radical input contraction and slack deductions.

Take the lowest efficiency rating DMU, CCB01, as an example. CCB01 is scored 0.66, representing the maximum possible radial contraction to its input level while maintaining its output level constant. In addition, the DEA result shows that it has input slacks of 14505.16 on fixed assets and 29033.24 on employees respectively. These slacks need to be deducted to enable CCB01 realize full technical input efficiency. Table 6.4 presents the possible efficiency improvement of CCB01.

Table 6.4 Slacks and targets of CCB01

Input	Actual	Radial reduction	Slack	Target
Fixed assets (RMB million)	60,356	20,553	14,505	25,298
Employees (Persons)	419,157	142,731	29,033	247,393
Deposits (RMB million)	2,514,192	973,251	0	1,540,941

CCB01 needs to reduce its fixed assets, number of employees and deposits by 58%, 41% and 36% respectively to achieve full efficiency. These numbers are calculated by deducting the ratio of targeted input level to actual input level from unity. To improve efficiency, the CCB01 clearly needs more attention to be paid to fixed assets reduction rather than deposit cuts.

Apart from quantifying the amount of reduction, the DEA results also provide the referential efficient DMUs to the inefficient ones for further improvement. With similar input and output mixes, the reference set offers the inefficient DMU an easier way to develop an understanding of the nature of their inefficiencies and to re-allocate resources to catch up with their efficient counterparts more effectively. Again, we use CCB01 as the example. BOCOM99 was identified as its sole efficient peer. Multiply the variables of BOCOM99 by 5.326, as estimated by DEA technique, and compare the results with CCB01, we obtain the Table 6.5.

After expanded by 5.326, BOCOM01 offers the same output amount as CCB01 but consumes no more than 65.9% of the inputs of CCB01. This result is consistent with the efficiency rating of 0.659 for CCB01.

The reference set does not necessarily contain one efficient DMU only. When multiple efficient DMUs serve as the reference set, their combined results could also provide a fair approximation of the efficiency rating for inefficient DMU. For instance, CCB02 has two efficient DMUs in its reference set, BOCOM99 and HXB05. Data calculated in Table 6.6 indicate that CCB02 can reduce its input level by 67.3% to become technically efficient. This figure is consistent with its efficiency rating of 0.67275.

Table 6.5 Input-output comparison between CCB01 and BOCOM99

	Fixed asset (RMB million)	Employee (Persons)	Deposit (RMB million)	Loans (RMB million))	Other earning assets (RMB million)
① BOCOM99	4,750	46,453	311,335	283,888	219,380
② BOCOM99*5.326	25,299	247,409	1,658,170	1,511,987	1,168,418
③ CCB01	60,356	419,157	2,514,192	1,511,892	1,062,774
④ ②/③	0.419	0.590	0.659	1	1.099

Table 6.6 Input-output comparison between CCB02 and its reference set

	Fixed asset (RMB million)	Employee (Persons)	Deposit (RMB million)	Loans (RMB million))	Other earning assets (RMB million)
① BOCOM99	4,750	46,453	311,335	283,888	219,380
② BOCOM99*5.823	27,659	270,496	1,812,904	1,653,080	1,277,450
③ HXB05	3,724	7,761	273,971	228,491	119,963
④ HXB05*0.377	1,404	2,926	103,287	86,141	45,226
⑤ CCB02	64,935	406,411	2,848,248	1,739,199	1,190,062
⑥ (②+④) / ⑤	0.448	0.673	0.673	1	1.111

All the efficient DMUs can be chosen in the reference set. Those DMUs that appear in the reference set most often are the better role models for inefficient DMUs to learn from. Table 6.7 presents the frequencies of efficient DMUs' appearance in the reference set. Thirteen DMUs were scored as fully efficient by the DEA-CCR model but only four of them were frequently emulated by inefficient DMUs. Industrial07, BOCOM00, BOCOM99 and HXB05 were the most often adopted benchmarks before China's accession to the WTO whereas other banks, including some better-performed city banks, join the reference set in recent years. This might result from a more diversified scope of banks' operation. Different types of banks have their own strength and weakness and therefore been chosen jointly to provide a combined role model under current economic conditions.

Table 6.7 Frequencies of efficient DMUs used in reference set

DMU	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
BOCOM99	8	5	6	3	3	2	5	4	3	4	43
BOCOM00	6	8	10	8	9	8	3	5	6	3	66
HXB05	5	9	10	11	11	11	6	8	4	3	78
Industrial06	--	--	--	2	5	4	3	2	3	3	22
Industrial07	8	11	11	8	5	7	8	7	7	9	81
Nanjing02	4	3	1	--	1	1	5	4	3	4	26
Nanjing07	1	--	--	--	--	--	--	--	--	--	1
CMINB04	--	--	--	1	3	2	2	2	2	1	13
CMINB08	--	--	--	--	4	2	2	3	3	--	14
PDB06	--	--	--	--	--	--	2	1	2	--	5
PDB08	--	--	--	1	1	--	--	--	2	1	5
Beijing08	--	--	--	1	--	--	--	--	1	1	3
SDB08	--	--	--	1	1	--	--	--	1	--	3

For scale efficiency, the CCR model reported that all 30 DMUs of SOBs were operating at DRS, while for JECBs and CCBs, more than 60% of them present IRS, in line with earlier studies (Yao et al., 2008). Fourteen out of 139 DMUs were operating under CRS. To exclude the effect of scale economies on bank efficiency, the BCC-VRS model will be applied in the next part.

6.2.2 DEA-BCC Model

The DEA-BCC model estimates the pure technical efficiency (PTE) of banks without the influence of scale economies. Under input-oriented assumption, the scale efficiency can be calculated as:

$$SE_j = \frac{CRS_j}{VRS_j} \qquad (E6.1)$$

where SE_j is the scale input efficiency of DMU j. CRS_j and VRS_j represents the efficiency ratings of DMU$_j$ estimated by CCR and BCC models respectively. As VRS_j is always higher than CRS_j, scale economy score, SE_j, never exceeds unity. A higher SE score indicates that the technical efficiency of the DMU is less influenced by scale economies. Only those DMUs operating under CRS could obtain scale efficiency ratings equal to one.

After eliminating the negative impact of scale diseconomies, the overall efficiency of Chinese listed commercial banks increased to 0.92. The highest mean efficiency score over the 1999-2008 period was realised by ICBC of 0.98

while the lowest was Beijing Commercial bank of 0.87. Thirty DMUs realize

full efficiency, representing almost 22% of the sample. Eleven DMUs of the

SOBs were fully efficient, accounting for 37% of the total observations for the

SOBs. In particular, the efficiency ratings of all six SOBs' DMUs in 2007 and

2008 were "1", confirming the improved performance of the SOBs.

Under the VRS estimation, the average efficiency score of SOBs was 0.96,

which was an increase of 17% from the CCR model, while this ratio for the

JECBs and CCBs were just 2% and 6% respectively. The efficiency gap among

different banking groups was greatly reduced. Compared with the previous

10% efficiency deficit, the mean efficiency of SOBs was 3% higher than the

JECBs, implying that the main source of the inefficiency of the SOBs was their

diseconomy of scale. Despite continued improvement of their productivity and

profitability, the large overhead expenses due to overstaffing and an extensive

network of branches made the SOBs' overall efficiency far inferior to the

JECBs. For pure technical efficiency, however, SOBs had already

outperformed all other banks (Figure 6.8).

Figure 6.8 Efficiency of Chinese listed banks, 1999-08--BCC
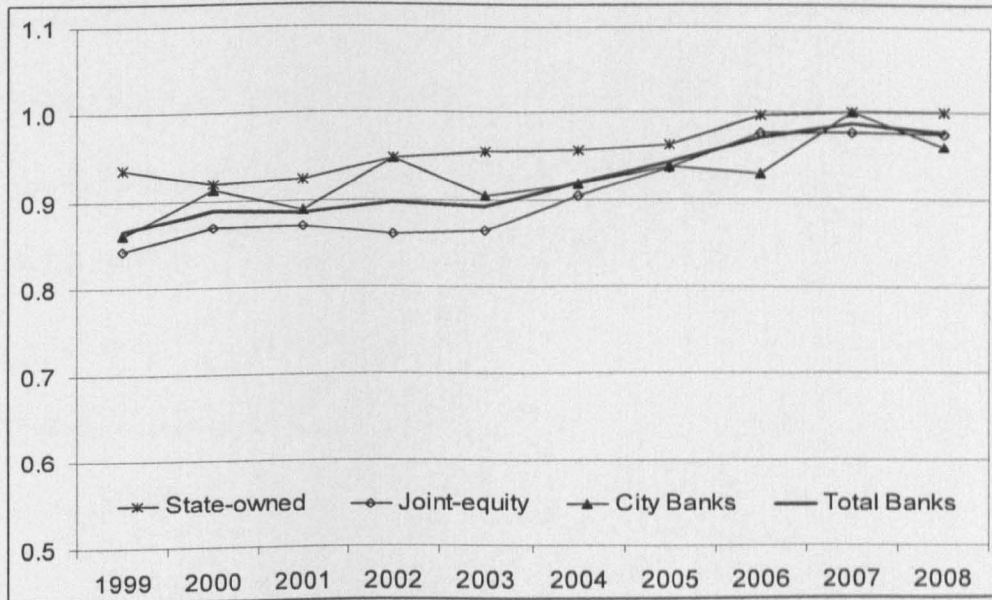
Note: BCC is the DEA various return to scale model.

Estimation of scale economy score confirms the above findings. The mean

scale economy rating for the listed banks was 0.93, indicating that about 7% of

the prior DEA-CCR inefficiencies were come from scale diseconomies. This

ratio for the SOBs, JECBs and CCBs were 18%, 3% and 6% respectively,

clearly suggested that SOBs were the most scale inefficient banks. Eleven

inefficient DMUs of the SOBs were purely caused by scale diseconomies. The

lowest scale efficiency rating, 0.67, was realized by Ningbo00. After

eliminating scale diseconomies, Ningbo00 was actually full technically

efficient. The finding suggests that it is very important for the Chinese

commercial banks to control their production size and to ensure the effective

allocation of resources.

Table 6.8 compares the VRS efficiency score before and after IPO. The results are similar to those obtained from the CCR model. Efficiencies of all sample banks were enhanced after stock listing, about 3% higher in average than the level before the IPO. However, as the highest possible efficiency score was one under DEA-BCC estimation, it was impossible to quantify any efficiency improvement of banks which were already fully efficient before IPO. To overcome this limitation, we apply the CRS and VRS super-efficiency models in the next section.

Table 6.8 Efficiency scores of Chinese listed banks before and after IPO—BCC

	Efficiency Level		
	One year before IPO	IPO year	One year after IPO
State-owned banks			
BOC	1.0000	1.0000	1.0000
CCB	0.9757	0.9816	1.0000
ICBC	0.9365	0.9901	1.0000
City Commercial banks			
Beijing	0.8636	0.9981	1.0000
Nanjing	0.9435	1.0000	0.9506
Ningbo	0.9841	1.0000	0.9271
Joint-Equity banks			
BOCOM	0.8794	0.8964	0.9160
CITIC	0.9836	1.0000	0.9972
CMB	0.8101	0.8424	0.8513
CMINB	0.8730	0.9349	0.8930
HXB	0.8154	0.8234	0.9372
Industrial	1.0000	1.0000	0.9689
PDB	--	0.8403	0.8493
SDB	--	--	--

Notes: BCC represents the DEA various return to scale model; Full names of the banks are listed in the appendix; our data period covers the 10 years from 1999; the PDB was listed on the stock exchange on 10 November 1999, so data for 1998, before IPO, are not available; the SDB was listed in 1991, so its information is not included in this table.

6.2.3 DEA Super-Efficiency Model

The super-efficiency model provides the same efficiency scores for those inefficient DMUs while generating higher than "1" efficiency scores for those efficient DMUs as estimated by the traditional DEA models. Such measurement enlarges the estimated efficiency differences and makes the efficiency comparison among DMUs more straightforward. Table 6.9 lists the super-efficiency scores under VRS assumption.

Table 6.9 Super-efficiency of listed banks before and after IPO--VRS

	Efficiency Level		
	One year before IPO	IPO year	One year after IPO
State-owned banks			
BOC	0.9739	1.0415	1.0058
CCB	0.9757	0.9816	1.0123
ICBC	0.9365	0.9901	1.0102
City Commercial banks			
Beijing	0.8636	0.9981	1.3152
Nanjing	0.9435	1.0459	0.9506
Ningbo	0.9841	1.0018	0.9271
Joint-Equity banks			
BOCOM	0.8794	0.8964	0.9160
CITIC	0.9836	1.0109	0.9972
CMB	0.8101	0.8424	0.8513
CMINB	0.8730	0.9349	0.8930
HXB	0.8154	0.8234	0.9372
Industrial	1.0371	1.1705	0.9689
PDB	--	0.8403	0.8493
SDB	--	--	--

Notes: Full names of the banks are listed in the appendix; our data period covers the 10 years from 1999; the PDB was listed on the stock exchange on 10 November 1999, so data for 1998, before IPO, are not available; the SDB was listed in 1991, so its information is not included in this table.

In average, the pure technical efficiency had been improved by 5.5% after listing with 4.2%, 8.5% and 4.7% increase for the SOBs, CCBs and JECBs respectively. Compared with super-efficiency scores generated under CRS estimation (Table 6.10) which took the effect of scale economies into account, it was found that stock listing could improve efficiency in two dimensions. PTE can be improved by imposing more pressure on a bank's operations, which helps the banks to realize scale economy by making public funding sources more readily accessible. For example, the efficiency rating of Ningbo bank increased by 2.8% assuming CRS, but was reduced to 1.7% under the VRS assumption, which implied that 1.1% of the gains were obtained from scale economy improvement.[16] Such dual positive effects have also been found in the other six banks, such as the CCB, Nanjing Bank, BOCOM and CMB. However, the results of the CRS model also suggested that despite the PTE of all listed banks having been enhanced, the scale economy of some banks, such as the BOC, CCB and Beijing bank, actually decreased. The PTE of the BOC, for example, improved by 6.8% after IPO under the VRS assumption, whereas under the CRS assumption, the efficiency score increased 4%, which indicated that there was a 2.1% loss of scale efficiency.[17] Such a

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[16] Improvement of scale economy for Ningbo bank could also be proved as: TE=PTE*SE, under CRS assumption, before IPO, SE=TE/PTE=0.9421/0.9841=0.9573; after IPO, SE'=TE'/PTE'=0.9698/1.0018=0.9681. Therefore, scale efficiency has been improved by 0.9681-0.9573=0.011 or 1.1%.

[17] Scale efficiency loss for BOC can be estimated as: TE=PTE*SE, under CRS assumption, before IPO, SE=TE/PTE=0.8923/0.9739=0.9162; after IPO, SE'=TE'/PTE'=0.9325/1.0415=0.8953. Therefore, scale efficiency has decreased by 0.9162-0.8953=0.021 or 2.1%.

negative impact of IPO on scale efficiency may arise from some Chinese

commercial banks, especially the SOBs, being already too big to realise

efficiency gains via further expansion. Stock listing enables banks to access

wider financial resources, enabling them to spread rapidly to emerging

business operations or to invest heavily to boost their capital base or branch

networks. Without careful plan and investigation, over-expansion leads to a

shortage of management ability and professional expertises, which drags down

the efficiency of the banks.

Table 6.10 Super-efficiency of listed banks before and after IPO --CRS

	Efficiency level		
	One year before IPO	IPO year	One year after IPO
State-owned banks			
BOC	0.8923	0.9325	0.8989
CCB	0.7406	0.7829	0.8028
ICBC	0.7970	0.8480	0.8623
City Commercial banks			
Beijing	0.8597	0.9898	1.3088
Nanjing	0.8849	1.0020	0.9437
Ningbo	0.9421	0.9698	0.9113
Joint-Equity banks			
BOCOM	0.7804	0.8041	0.8145
CITIC	0.9567	0.9815	0.9140
CMB	0.8053	0.8405	0.8343
CMINB	0.8347	0.9040	0.8802
HXB	0.8063	0.8199	0.9347
Industrial	1.0359	1.0667	0.9291
PDB	--	0.8213	0.8355
SDB	--	--	--

Notes: Full names of the banks are listed in the appendix; our data period covers the 10 years from 1999; the PDB was listed on the stock exchange on 10 November 1999, so data for 1998, before IPO, are not available; the SDB was listed in 1991, so its information is not included in this table.

We should note that the super-efficiency scores of Industrial Bank and Beijing Bank after IPO were as high as 1.17 and 1.32 respectively under VRS assumption. The results mean their inputs could expand up to 1.17 or 1.32 times and they would still operate on the efficient frontier. These two banks were also chosen more frequently as the reference set for inefficient DMUs in recent years.

The above empirical results show a positive effect of stock listing on bank efficiency. However, factors that influence such improvement have not been addressed yet. To identify those determinants, a regression analysis will be conducted in the next section.

6.2.4 Determinant of Banks Efficiency

Bank efficiency can be influenced by various factors, both internal and external. Seven variables are included in the following regression analysis, two dummy variables, ownership structure and stock listing indictor (IPO), return on asset (ROA), time trend (t), GDP growth and two risk indictors, ratio of loan loss reserves to total loans (LLR/TL) and equity to total asset (E/A). For ownership, "0" represents non-state owned banks and "1" represents SOBs and for IPO, "1" means that bank has already listed on the stock exchanges while "0" stands for the contrary. LLR/TL is used to control for credit risk and E/A for capital risk. The dependent variable is the efficiency ratings estimated by DEA-CCR

model. The scores are transformed by the natural logarithm to tighten the lower

tail of its bimodal distribution. As the efficiency score is restricted within (0,1],

the distribution is censored. With censored data, ordinary least square (OLS)

yields asymptotically biased estimators (Breen, 1996; Green, 1993).

Consequently, to analyze the determinants of efficiency, we adopt the Tobit

model and present the results in Table 6.9.

Table 6.11 Determinants of bank efficiency

Factors	Coefficient	Std. Error	t
Constant.	-0.57533***	0.21242	-2.71
Ownership	-0.01799*	0.01054	-1.71
IPO	0.04128**	0.01946	2.12
ROA	0.002713	0.05176	0.958
LLR/TL	-0.00517	0.003198	-1.62
Equity/Asset	0.03802*	0.022120	1.71
GDP growth	0.115679	0.09606	1.20
t	0.01150**	0.00502	2.29

Notes: *** means that the variable is significant at 1% level; ** means that the variable is significant at 5% level and * means that the variable is significant at 10% level; ROA, return on asset; LLR/TL, loan loss reserve to total loans.

Four variables, ownership, IPO, E/A and t, are found to have significant

impacts on efficiency. The negative sign of "ownership" means that on average,

non-state owned banks are 1.8% more efficient than the SOBs, lower than the

10% efficiency discrepancy estimated by the DEA-CCR model. This result

would not be welcomed by Chinese reformers in particular after the

government having devoted considerable efforts to reforming the banking

sector in recent years. However, as we discussed for the DEA-BCC model,

these inefficiencies are mainly caused by scale diseconomies, which are not fully controlled by the management. In order to realize the full effects of previous reforms and to be completely transformed into the benchmark of the banking industry, SOBs may need a few more years.

The sign and size of the coefficient on the IPO implies that stock listing can improve bank efficiency by 4%, *ceteris paribus*. This is consistent with prior DEA results that in general, banks are more efficient after they have been listed. Nevertheless, as the efficiency of more than 50% of sample banks deteriorated immediately after their IPO year, the positive effect of stock listing and efficiency improvement should be interpreted with cautious. Further research on Chinese commercial banks after they have acquired a longer post-IPO trading record is needed to reach a more convincing conclusion.

The profitability ratio, ROA, does not influence the efficiency of listed banks significantly. Banks that generate good profit may not necessarily be more efficient; for example, the SOBs devote more human resources to achieving their relatively high income. The negative sign of the risk indictor, LLR/TL, suggests that banks taking more credit risk were more efficient. However, it is not statistically significant. The positive coefficient of capital risk indictor, E/A, implies that banks with more equity capital were more efficient. One percentage point increase of the E/A ratio could increase banks' efficiency by

almost 4%. Banks that could manage their capital risk more effectively also displayed higher than average performance, in line with our expectation. Moreover, the result also confirms our assumption that banks subject to hard budget constraints were more efficient. Soft budget constraints cause inefficiency because of moral hazard problem. Therefore, if banks were subject to hard budget constraints, they need to attract shareholders with better performance.

The macroeconomic indictor, GDP growth, was found to have a positive impact on efficiency, but it was not statistically significant. A favourable economic condition does not guarantee a better performance of the banks. The time trend, t, was statistically significant and suggests that the efficiency of the banks was improving at about 1% per year.

Our discussion above relies on the non-parametric approach, DEA. To compare the efficiency rating generated by different measurements, a parametric approach, SFA, will be applied in the next section.

6.3 Application of SFA to Chinese Commercial Banks

6.3.1 Model Specification

In this part, we will adopt the distance function approach introduced by

Shephard (1953) to assess the efficiency of the Chinese listed commercial

banks. This technique has become increasingly popular recently because it

enables the consideration of multiple-outputs and -inputs production

technology without the need for price information or to make any behavioural

assumptions, such as cost-minimisation or profit-maximization (Cuesta and

Orea, 2002; Coelli and Perelman, 2000). When price information is unavailable

or inaccurately measured, or when behaviour assumptions are inappropriate,

traditional approach to resolve multi-outputs production technology is

inapplicable. So the distance function approach is an appropriate alternative.

A distance function can be expressed either in terms of input conservation or

output expansion. Consistent with the prior DEA estimation, we retain the

input-orientated model. An input distance function measures the maximum

amount of input that can be proportionally reduced with the output vector held

fixed. It can be defined on the input set, $L(y)$, which represents a list of

technologically feasible combinations of inputs and outputs, as:

$$D_I(x,y,t) = \max\{\sigma : (x/\sigma) \in L(y)\} \qquad \text{(E6.2)}$$

where x and y are the input and output vectors and t is the time trend, capturing

the technical changes. If the vector of M inputs is denoted by $x = (x_1, x_2, ... x_M)$ and the vector of K outputs is denoted by $y = (y_1, y_2, ... y_K)$, the input set $L(y)$ takes the form of (E6.3).

$$L(y) = \{x \in R_+^M : x \ can \ produce \ y\} \qquad (E6.3)$$

The input isoquant, expressed as $IsoqL(y) = \{x : D_I(y, x, t) = 1\}$, corresponds to the set of input vectors that have an input distance function value equal to one. Any further radical contraction of the input vector is incapable of producing the given output vector y. Figure 6.9 depicts the input distance function with two inputs, X_I and X_2; $L(y)^*$ is the input isoquant for producing output vector y.

Figure 6.9 Input distance function
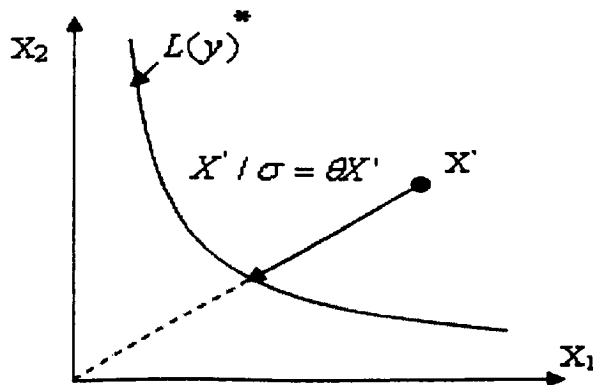
Note: X' is the actually usage of input X_1 and X_2 to produce output y.

The input distance function, $D_I(x, y, t)$, is non-decreasing and concave in x, but non-increasing and convex in y. It takes the value of unity if x is located on the input isoquant while otherwise it is greater than one. That is, $D_I(x, y, t) \geq 1$ if

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$x \in L(y)$.

The input distance function is closely related to the measurement of technical efficiency. $0 < TE(y, x, t) = \theta \leq 1$ represents the input-oriented technical efficiency while $D_I(x, y, t) = \sigma \geq 1$ measures the input distance function. Their relationships can be expressed by (E6.4) and shown graphically in Figure 6.3.

$$TE(x, y, t) = 1/D_I(x, y, t) \quad \text{or} \quad TE(x, y, t) * D_I(x, y, t) = 1 \qquad \text{(E6.4)}$$

Replacing TE with $\exp(-u)$, where non-negative values of u measures the input-oriented technical inefficiency, (E6.5) can be rewritten as

$$\ln D_I(x, y, t) + \ln TE(x, y, t) = \ln D_I(x, y, t) - u = 0 \qquad \text{(E6.5)}$$

The inefficiency u is calculated by taking the logarithm of the input distance function.

In this study, a Translog function is assumed to represent the input distance function which is given in (E6.6) for i banks consuming M inputs producing K outputs.

$$\ln D_I = \alpha_0 + \sum_{m=1}^{M} \alpha_m \ln x_m + \sum_{k=1}^{K} \beta_k \ln y_k + \frac{1}{2} \sum_{m=1}^{M} \sum_{n=1}^{M} \alpha_{mn} \ln x_m \ln x_n$$

$$+ \frac{1}{2} \sum_{k=1}^{K} \sum_{j=1}^{K} \beta_{kj} \ln y_k \ln y_j + \sum_{m=1}^{M} \sum_{k=1}^{K} \rho_{mk} \ln x_m \ln y_k$$

$$+ m_0 t + \frac{1}{2} m_{00} t^2 + \sum_{m=1}^{M} \gamma_{mt} t \ln x_m + \sum_{k=1}^{K} \xi_{kt} t \ln y_k \qquad \text{(E6.6)}$$

For notation ease, subscripts i and t representing the individual bank and time period are omitted. Since our sample covers a relatively long time period, 1999-2008, changes in both technology and efficiency are taken into account. The inclusion of t^2 term allows for a flexible temporal pattern of technology change as the technological changes do not have to be monotonic. The input distance function is required to satisfy certain restrictions, including homogeneity of degree one in inputs

$$\sum_{m=1}^{M} \alpha_m = 1 \text{ and } \sum_{m=1}^{M} \alpha_{mn} = \sum_{m=1}^{M} \rho_{mk} = \sum_{m=1}^{M} \gamma_{mt} = 0 \qquad \text{(E6.7)}$$

and restriction on symmetry

$$\alpha_{mn} = \alpha_{nm} \quad (m, n=1,2,\ldots M) \text{ and } \beta_{kj} = \beta_{jk} \quad (j, k=1,2,\ldots K) \qquad \text{(E6.8)}$$

According to Lovell et al. (1994), the homogeneity restriction can be imposed by normalizing the input distance function by one of the inputs. The homogeneity property suggests that $\frac{1}{\lambda} D_I(x,y,t) = D_I^*\left(\frac{x}{\lambda}, y, t\right)$ for any $\lambda > 0$ and therefore if the Mth input is chosen for normalization, (E6.6) becomes:

$$\ln(D_I / x_M) = \ln D_I - \ln x_M = \alpha_0 + \sum_{m=1}^{M-1} \alpha_m \ln(x_m / x_M) + \sum_{k=1}^{K} \beta_k \ln y_k$$

$$+ \frac{1}{2} \sum_{k=1}^{K} \sum_{j=1}^{K} \beta_{kj} \ln y_k \ln y_j + \sum_{m=1}^{M-1} \sum_{k=1}^{K} \rho_{mk} \ln(x_m / x_M) \ln y_k$$

$$+ \frac{1}{2} \sum_{m=1}^{M-1} \sum_{n=1}^{M-1} \alpha_{mn} \ln(x_m / x_M) \ln(x_n / x_M) + m_0 t + \frac{1}{2} m_{00} t^2$$

$$+ \sum_{m=1}^{M-1} \gamma_{m} t \ln(x_m / x_M) + \sum_{k=1}^{K} \xi_{k} t \ln y_k \qquad \text{(E6.9)}$$

Since $D_I(x, y, t) = u$, rearranging (E6.9) by moving the distance term " $\ln D_I$ "

to the right-hand-side, (E6.10) can then be transformed into the standard SFA

model with a noise, v, and inefficiency, u.

$$-\ln x_M = \alpha_0 + \sum_{m=1}^{M-1} \alpha_m \ln(x_m / x_M) + \sum_{k=1}^{K} \beta_k \ln y_k$$

$$+ \frac{1}{2} \sum_{k=1}^{K} \sum_{j=1}^{K} \beta_{kj} \ln y_k \ln y_j + \sum_{m=1}^{M-1} \sum_{k=1}^{K} \rho_{mk} \ln(x_m / x_M) \ln y_k$$

$$+ \frac{1}{2} \sum_{m=1}^{M-1} \sum_{n=1}^{M-1} \alpha_{mn} \ln(x_m / x_M) \ln(x_n / x_M) + m_0 t + \frac{1}{2} m_{00} t^2$$

$$+ \sum_{m=1}^{M-1} \gamma_{m} t \ln(x_m / x_M) + \sum_{k=1}^{K} \xi_{k} t \ln y_k + v - u \qquad \text{(E6.10)}$$

As discussed in the methodology section, we employ Battese and Coelli's

(1995) single-step technique to explore the factors that influence the technical

efficiency of the banks. Again, the same set of variables used in the DEA

analysis capturing the macroeconomic environment, the nature and risk taking

characteristics of the banks and time trend will be estimated using (E6.11).

$$u = \delta_0 + \delta_1 t + \delta_2 t^2 + \delta(IPO, ownership, Risk, \text{Pr}\, ofitability, GDP) + \varepsilon \quad (\text{E}6.11)$$

6.3.2 Result of SFA Estimation

Using computer programme Frontier 4.1, the maximum likelihood (ML)
estimation of stochastic frontier parameters was reported in Table 6.12. The
likelihood ratio (LR) test of one-side error was greater than 39, strongly
indicating the existence of a one-side error within the composite error term.
The coefficient of the time trend variable was positive but not statistically
significant, suggesting there was no obvious upward shifting of the production
frontier over sample period from 1999 to 2008. For the first-order coefficients
of input and output variables, only one in each group was found to influence
the efficiency level of the banks significantly and the signs were as expected.
The negative coefficient of the output variable, total loans, indicated that banks
generating more loans were less technically efficient. This can be interpreted in
the following way. The banks grant loans to the customers to generate interest
incomes. So the loan itself does not represent the ultimate output of the banks
but the interests it earned. If the banks expand the loan business too rapidly, it
may lead to mounting NPLs and consequently impairs the overall performance
of the banks.

Table 6.12 Results of the stochastic input distance function

Deposit (X_3)	Coefficient	Std. Error	t
Total loans (ln Y_1)	-0.237267	0.224693	-1.055963
Other earning assets (ln Y_2)	0.776363***	0.217672	3.566860
Fixed Assets (ln(X_1/X_3))	0.254097	0.264475	0.960761
Employees (ln(X_2/X_3))	-0.79308**	0.343533	2.308602
γ	0.279599*	0.157581	1.774323
σ^2	0.002125***	0.000431	4.924990
LR test of the one-side error		39.4833	
Mean Technical Efficiency		0.9543	
Explanation Variables			
Ownership	0.07735***	0.017907	4.319427
IPO	-0.058905***	0.018664	3.156007
t	-0.017291**	0.007784	-2.22137
ln(ROA)	-0.039596	0.623055	-0.63551
ln(LLR/TL)	0.0001717	0.007191	0.023881
ln(E/A)	-0.027993**	0.013653	-2.050347
ln(GDP Growth)	-0.183046	0.115686	-1.582263
constant	0.5745715**	0.242293	2.3713942

Notes: *** means that the variable is significant at 1% level; ** means that the variable is significant at 5% level and * means that the variable is significant at 10% level; ROA, return on asset; LLR/TL, loan loss reserve to total loans; E/A, equity to assets.

The average technical efficiency of the 14 listed banks over the 10 years sample period was 0.95, improving steadily from 0.88 in 1999 to over 0.99 in 2008. In particular, the efficiencies of the SOBs, JECBs and CCBs increased 16%, 8% and almost 20% respectively over the sample period. The most efficient bank was PDB with mean efficiency rating of 0.99 while Beijing bank was found to be the least technically efficient. Figure 6.10 depicts the efficiency ratings of the 14 listed banks in terms of their ownership structure

from 1999 to 2008.

Figure 6.10 Efficiency of Chinese listed commercial banks, 1999-08--SFA
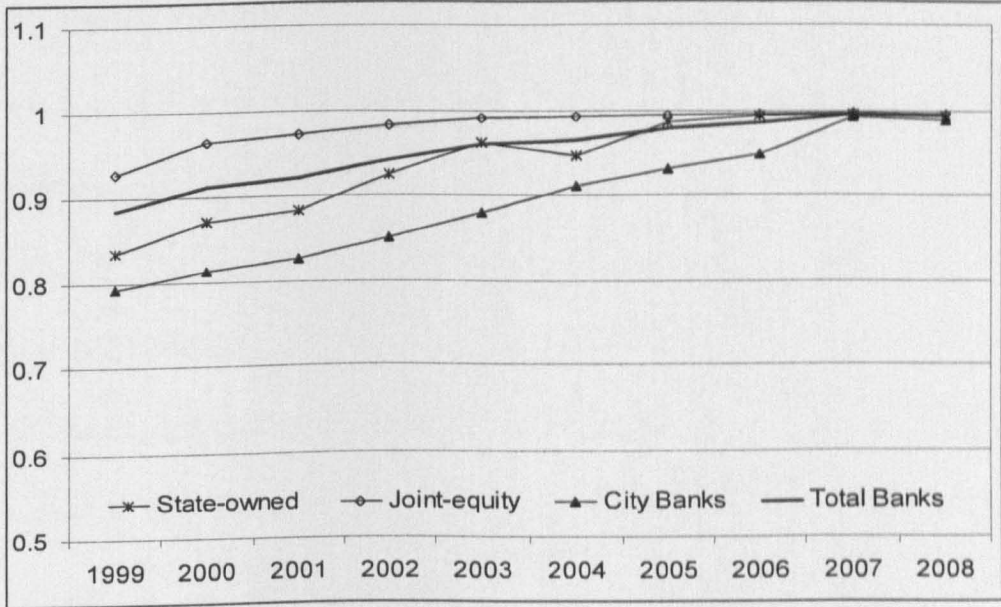
In the early years before 2003, the efficiency gaps among the different types of banks were substantial with the JECBs leading the overall banking industry. From 1999 to 2001, the JECBs in average were about 10% to 15% more efficient than the SOBs and CCBs. However after China's accession to the WTO and the completion of comprehensive banking reforms, the situation changed dramatically. Despite the JECBs performing better than the other types of banks, the SOBs and CCBs had caught up rapidly and reduced the mean efficiency ratings greatly to less than 1% in 2007 and 2008. This finding is consistent with the prior DEA conclusion.

For the effect of stock listing on efficiency improvement, Table 6.13 summarises the results. In line with the DEA estimations, the efficiency ratings of all 12 banks improved after stock listing. The difference in the mean efficiency level is about 2.5% between the pre-IPO and IPO year. The positive effect of stock listing was more obvious for the CCBs and JECBs as their efficiency in average was enhanced by 3.3% and 2.8% respectively while for the SOBs the improvement was just 1%. The small efficiency gain of the SOBs after listing might reflect the significant gains that had already been obtained through the recent banking reform that was mainly focused on them. After the unloading of their NPLs and substantial financial aid from the state, the efficiency of the SOBs had already been enhanced. The subsequent stock listing was just a way of consolidating the previous reform achievements and transforming the past management practices of the SOBs. Instead of serving as the lending mechanism of the government, the SOBs became responsible for their investment decisions after becoming public listed companies and were required to satisfy shareholders. On the other hand, as suggested by the results of DEA various return to scale model, the improved technical efficiency of the SOBs may be compromised by a deterioration in their scale economies, leading to a relatively small improvement of their overall efficiency.

Table 6.13 Efficiency levels of Chinese listed banks before and after

IPO—SFA

	Efficiency Level		
	One year before IPO	IPO year	One year after IPO
State-owned banks			
BOC	0.9840	0.9950	0.9963
CCB	0.9836	0.9937	0.9940
ICBC	0.9781	0.9933	0.9949
City Commercial banks			
Beijing	0.9224	0.9411	0.9902
Nanjing	0.9468	0.9926	0.9884
Ningbo	0.9576	0.9925	0.9903
Joint-Equity banks			
BOCOM	0.9892	0.9955	0.9962
CITIC	0.9936	0.9970	0.9968
CMB	0.9549	0.9913	0.9938
CMINB	0.9006	0.9880	0.9899
HXB	0.9628	0.9929	0.9957
Industrial	0.9961	0.9976	0.9969
PDB	--	0.9696	0.9821
SDB	--	--	--

Notes: Full names of the banks are listed in the appendix; our data period covers the 10 years from 1999; the PDB was listed on the stock exchange on 10 November 1999, so data for 1998, before IPO, are not available; the SDB was listed in 1991, so its information is not included in this table.

Moreover, similar to the DEA findings, the efficiencies of the four banks, Nanjing Bank, Ningbo Bank, CITIC and Industrial Bank, were found to have deteriorated immediately after the IPO year. As we discussed in the DEA part, this worsening performance may be due to "window-dressing" effects in their IPO year or it may be caused simply by the tough economic condition worldwide in 2008. The latter explanation in particular holds for the SFA result

as all these four banks were listed in 2007.

Table 6.12 also presents the result of the technical inefficiency effects model. Quite consistent with the Tobit estimation of the DEA efficiencies, the four variables—ownership, IPO, t, E/A and GDP growth—were found to influence significantly the efficiency of the banks. The positive sign of the ownership variable confirms the prior conclusion that in the sample period, the SOBs were 7% less efficient than the non-state-owned banks. The coefficients of the other three statistically significant variables were negative, indicting that they influence the efficiency level of the banks positively. In particular, the listed banks were almost 6% more efficient than the non-listed banks while a better asset quality and/or hard budget constraint could enhance bank efficiency by around 3%. The time trend, t, is significant at 5% level, implying that efficiency of the banks was improved by 1.7% year after year.

6.4 Comparison of SFA and DEA Results

The use of the two estimation techniques allows us to assess the robustness of tested efficiency ratings. In this section, we will apply the correlation test and paired t-test to analysis the relationships between the DEA and SFA results. Table 6.14 summarizes the descriptive statistics of the two methods. The mean technical efficiency estimated by SFA is about 10% higher than the DEA efficiency, consistent with the past research (Ferrier and Lovell, 1990; Bauer et

al., 1998). This difference stems from the different assumptions of the two

models. DEA assumes no specific production frontier and reports all noisy

factors as inefficiency whereas SFA pre-specifies the functional form and

allows for random error. In particular, if the measurement errors do exist in the

data, DEA estimation will mistakenly classify all of them into inefficiencies

and therefore grant lower efficiency scores to the DMUs. It is also noticeable

that the standard deviation of the DEA efficiency rating was twice as large as

that of the SFA. The dispersion of DEA efficiency was more than.0. 2 while the

same figure under SFA estimation was just 0.1. This might because the DEA

efficiency is a relative estimation and it is sensitive to "self-identifiers" or

"near-self-identifiers".[18] All these factors lead to the relatively low DEA

efficiency ratings and wider dispersions.

Table 6.14 Comparison of DEA-CCR and SFA efficiency estimations

Variable	N	Mean	Std. Dev.	Min	Max
SFA	14	0.9540164	0.0359535	0.8906471	0.9908708
DEA-CRS	14	0.8621343	0.0531057	0.7343848	0.9389356

Table 6.15 and 6.16 present the correlation test and paired-t test based on

DEA-CCR and SFA efficiency ratings. The correlation coefficient is 0.33 and

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[18] DEA identifies a DMU as either efficient or inefficient compared to other observations in its reference set, which is composed of efficient observations with the most similar configuration of inputs and outputs. The problem of "self-identification" will occur if there is no comparable observation of a particular DMU existing in the sample. This DMU will thereby choose itself as "reference" and obtain relatively high efficiency score.

not statistically significant, suggesting that the two sets of efficiency results are

not directly comparable. The weak correspondence between the two methods is

not a surprise and is consistent with earlier research (Ferrier and Lovell, 1990;

Bauer et al.,1998; Weill, 2004). A paired t-test further confirmed our

conclusion. The null hypothesis is that there is no difference between the two

observations. In the case of our sample, it can be rejected at 1% level as the

value of test statistic, t, is 6.42.

Table 6.15 Correlation test of DEA-CCR and SFA efficiency ratings

Efficiency scores	SFA	DEA-CCR
SFA	1.0000	
DEA-CCR	0.3272 (0.2535)	1.0000

Note: To reduce the effects of noise, the correlation coefficient are estimated based on the average efficiencies of 14 listed banks over 10 years' sample period. If use the efficiency ratings of different banks in separate years, the result is quite similar to the one reported

Table 6.16 Paired T-test of DEA-CCR and SFA efficiency ratings

Pair1 DEA-SFA diff.	Mean	Std. Dev.	Std. error mean	95% confidence interval		t	df	Sig.
				Lower	Upper			
	0.0919	0.0143	0.0535	0.0609	0.1228	6.42	13	.000

Note: To reduce the effects of noise, the correlation coefficient are estimated based on the average efficiencies of 14 listed banks over 10 years' sample period. If use the efficiency ratings of different banks in separate years, the result is quite similar to the one reported

In addition to testing the relationship of efficiency scores estimated by the two

approaches, we further examine the consistency by comparing the rank-order

correlations (Table 6.17). Although the parametric and non-parametric frontier

measurements generate different level of technical efficiencies, it is still possible that they similarly rank the same DMU. Identifying the rough ordering of which banks are more efficient than the others is important for regulatory policy decisions because it helps the government determine whether a particular reform is effective in improving efficiency rating of target banks (Bauer et al. 1998). The Spearman rank-order correlation of DEA and SFA estimation is 0.48 and significant at 10% level, indicating a fairly close rank correlation between the two methods. Despite increased efficiency ratings over years, the SOBs are all ranked in the bottom half of the sample banks, suggesting a clear necessity of further improvement.

Table 6.17 also reports the Spearman rank-order correlation among DEA, SFA efficiency and standard non-frontier performance indictors. It is expected that the efficiency orders should be positively correlated with traditional performance measurements to provide a certain assurance that the frontier techniques are not simply an artefact of the procedure but a measure of the performance and decision making. All the DEA, SFA efficiencies and financial ratios are averaged over time to reduce the influence of external random shocks.

Table 6.17 Spearman Rank-order correlation of DEA-CCR, SFA estimations

and traditional performance indictors

Efficiency Rankings	SFA	DEA-CRS
SFA	1.0000	--
DEA-CCR	0.4769*	1.0000
ROA	-0.5473**	-0.1956
LLR/TLs	0.2835	-0.1736
E/A	-0.6308**	-0.2584
Loan/ Deposit	0.8505***	0.4022

Note: To reduce the effects of noise, the rank-order correlations of the average efficiencies and financial ratios of the 14 listed banks over time are reported. If we use the efficiency ratings and financial ratios of different banks in separate years, the result is quite similar to the one reported. * represents that correlation is statistically significant at 10% level, ** is significant at 5% level and *** is significant at 1% level; DEA-CCR represents the DEA constant return to scale model; ROA, return on assets; LLR/TLs, loan loss reserve to total loans; E/A, equity to total assets.

Both frontier measures are related to traditional performance measures to some extent. Two risk taking indictors, LLR/TLs and Loan/Deposit are positively correlated with frontier efficiencies. The SFA efficiency rankings are more consistent with financial indictors while the DEA-based estimations are less so. This is consistent with prior literatures that the parametric techniques represent the traditional performance indictors better than the non-parametric approaches (Bauer et al. 1998). The profitability indictor, ROA, and the capital risk indictor, E/A is found to be negatively correlated with both DEA and SFA efficiency rankings. This might because of the Chinese banking data we employed. The Chinese financial institutions are well-known for operating under various state restrictions and are constantly subject to changing

government policies at various administrative levels. The bank management therefore can not fully control input investments and output productions, which leads to the discrepancy between frontier estimations and financial indictors. On the other hand, our DEA and SFA efficiency estimations are consistent with general expectations and prior studies, so it may suggest that the financial ratios employed for comparison are inaccurately measured. The allowance of choosing among different accounting policies leaves substantial potential for manipulating reported earnings, not to mention the manipulation by management of the financial figures to achieve desired outcomes. To improve the quality of published reports, financial regulation and supervision will need to be strengthened in future. For example, not only the listed banks, but all the commercial banks in China should be required to adopt International Accounting Standards (ISA) in preparing interim and annual reports. At present, only the listed banks follow the ISA. The banks will then have less opportunity to be "creative", making their financial statements more readily comparable.

6.5 Chapter Summary

In this chapter, we apply both the non-parametric approach, DEA, and the parametric approach, SFA, to analyse the efficiency of the 14 listed Chinese commercial banks. In particular, we sought to test the impact of listing on the efficiency level of the banks.

We first estimate the DEA-CCR, the constant return to scale model. Consistent with the prior studies, the mean efficiency of the Chinese commercial banks was about 0.86 and the JECBs were the best performers among all the banks. Despite the latest reforms of the SOBs, their performance was still poorer than the other two types of banks. Within the 139 sample DMUs, 13 were fully efficient but none was state-owned. Nine of the 14 banks had average efficiency scores clustered around 0.85, suggesting there was still significant potential for further efficiency improvement even among listed banks.

For scale efficiency, the CCR model reports that all the 30 DMUs of the SOBs were operating at DRS, while for the JECBs and CCBs, more than 60% of them displayed IRS. To eliminate the effect of scale diseconomies, we further apply the DEA-BCC, or the various return to scale model. The overall efficiency rating improved significantly to 0.92. The efficiency gap among different banking groups had been greatly reduced over years, implying that the main source of inefficiency of the SOBs came from scale diseconomies. Despite continued improvement of their productivity and profitability, the large overhead expenses stemming from overstaffing and an extensive branch network made the overall efficiency of the SOBs inferior to the JECBs. In terms of pure technical efficiency, however, the SOBs outperformed all other banks.

In the next part of the chapter, we employed the parametric approach, SFA. The average technical efficiency of the 14 listed banks over the 10 years sample period was 0.95, improving steadily from 0.88 in 1999 to over 0.99 in 2008. Similar to the DEA results, SFA also identified a converged movement of efficiency rating among different banking groups. Despite the JECBs out-performing than other banks, the SOBs and CCBs have caught up with them rapidly and reduced the mean efficiency ratings to less than one percentage point in 2007 and 2008.

All three models supported the hypothesis that stock listing would improve efficiency. Under DEA-CCR estimation, the average efficiency rating of the banks in the IPO year was about 6% higher than that before the IPO year while the figure under SFA model was 2.5%. However, we found that efficiencies of several banks deteriorated immediately after IPO. This worsening performance may be because of the "window-dressing" effects before their IPO year, which had already given the impression of significantly improved efficiency, or it may simply reflect the tough world economic condition in 2008. Therefore further research becomes necessary.

In addition to calculating efficiency ratings, we also employ the technical inefficiency model to test the determinants of bank efficiency. Both DEA and SFA results suggest that the four variables—ownership, IPO, t, E/A and GDP

growth—influenced the efficiency of the banks significantly. The SOBs were less efficient than the non-state owned banks over sample period and their IPO proved to be an effective way to improve their efficiency.

To examine the robustness of estimated efficiency ratings, we test the consistency conditions for DEA and SFA techniques in three aspects. Firstly we tested for the correlation between the DEA-CCR and SFA efficiency levels, compared their rank-order correlations, and finally compared the frontier results with traditional performance indictors. Our findings were consistent with prior literatures. Efficiency ratings estimated by the DEA-CCR and SFA techniques were not directly comparable whereas their rank orders were fairly well correlated. Both of the frontier measures were found to be related to financial indictors to some extent while the SFA was a better representation of traditional measures.

Chapter 7 Implication of the Financial Crisis on the Further Development of Chinese Banks[19]

The US sub-prime mortgage crisis which started from August 2007 has been transformed into a worldwide financial crisis. The slump in housing prices increased the default on mortgages, the negative effect further amplified by asset securitization. Not only were the US banks affected, nearly all financial institutions around the world suffered substantial losses from their investments in Mortgage Backed Securities (MBS). Investors lost confidence in the US financial market and its economy, causing the collapse of the stock market.

Turbulence of the US financial market also generated substantial negative impacts on the Chinese financial sector and its real economy. A report from Goldman Sachs disclosed that the BOC was widely exposed to the US sub-prime securities and might incur huge losses. SSE Composite Index plummeted through 2008 and there was a rapid increase in unemployment as export-dependent factories closed in late 2008, which subsequently promoted the Chinese government to announce a huge stimulus package. As China's financial sector becomes more integrated into the world market, there is increased interest in understanding the influence of the US housing crisis on

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[19] A part of this chapter will be published in: Yao, S. J., Luo, D. and Morgan, S. (2010), 'Impact of the US Credit Crunch and Housing Market Crisis on China', *Journal of Contemporary China*, 19 (65).

the Chinese banks and its wider economy. This chapter will address the above

issue in following aspects: to what extent is the Chinese banking sector

exposed to the US sub-prime mortgage market? Might such an exposure

spillover into China's financial sector? With rapid growth in domestic

mortgage market, is it possible for China to experience a similar housing crisis

in the future and what are the implications of the crisis?

7.1 US Credit Crunch and Its Threats to the Chinese Financial Market

7.1.1 Sub-Prime Lending and the Housing Crisis

MBS represents a debt obligation whose cash flows are backed by the principal

and interest payments of a pool of mortgage loans, most commonly on

residential property. It originated from the US in the 1970s and was regarded as

one of the most important financial innovations in the past three decades.

However, such a financial instrument based on risk management can make

lenders vulnerable to losses and liquidity stress during an economic downturn,

as exemplified by the current US sub-prime crisis from August 2007.

After many years' steady improvement, the US economy was badly hit by the

"*dotcom bubble*"[20] in 2001. The real GDP grew by 1.2% in 2001, compared to

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[20] Also is referred as "I.T bubble". It was a speculative bubble starting roughly from 1995 and peaked in 2000. During this period, the value of the stock markets in Western nations increased rapidly because of the growth in the new Internet sector. Many companies dismissed standard business models, purely focusing on increasing market share at the expense of the bottom line.

4.1% one year earlier (Country Profile, USA, 2002). To revive the economy,

the Federal Reserves cut the interest rate 11 times continuously from 5.5% in

January 2001 to 1% in June 2003. During the same period, mortgage interest

rate dropped by more than 20 % from 7.01 % in the first quarter of 2001 to just

5.52 % in the second quarter of 2003 (PD&R, 2004). Reduced interest rate

directly relieved the mortgage payment and led to a renewed prosperity in the

housing market. The US housing price index more than doubled between 2000

and July 2006, reaching its highest level of 206.52 (January 2000=100). In

particular, the US house prices increased faster than its GDP growth from

December 2001 to 2005 (Figure 7.1).

Figure 7.1 US real home prices vs. real GDP
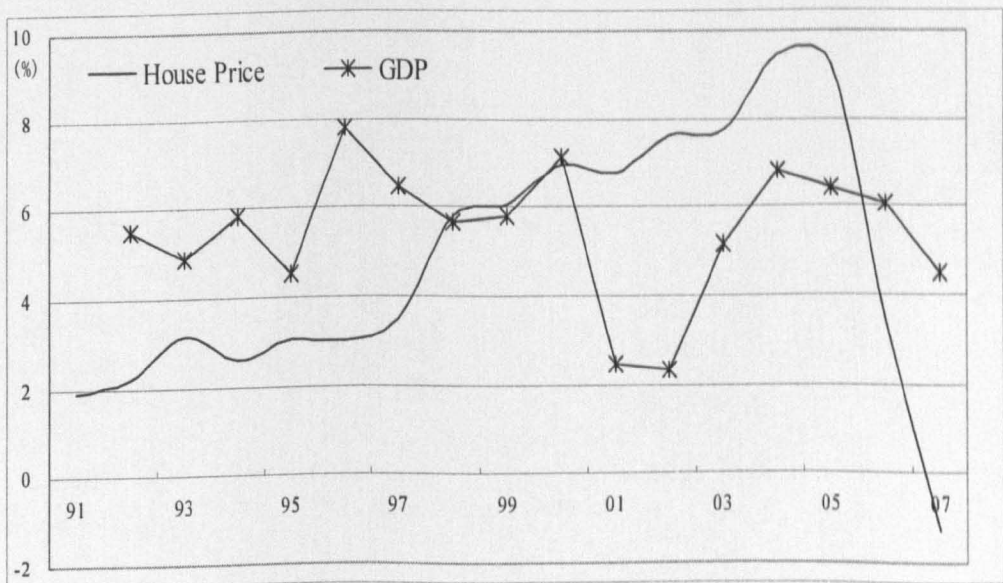

Source: Country Profile, United States, 1996-2008.

When the bubble burst, many dotcoms ran out of capital and were acquired or liquidated, representing the beginning of a period of mild recession in the developed world.

Meanwhile, various personal mortgage products[21] were offered to people with

poor or impaired credit history and consequently, triggering the rapid growth of

sub-prime lending (Figure 7.2). From 2004 to 2006, about 21% of the newly

issued mortgages were sub-prime, up from 9% during 1996 to 2004 period

(Waggoner, 3 September 2007). Till the end of 2006, sub-prime mortgages

totalled $665 billion, accounting for 23% of the US home loan market

(Bernanke, 14 March 2008).

Figure 7.2 Sub-prime mortgage growth and its share in total mortgage market
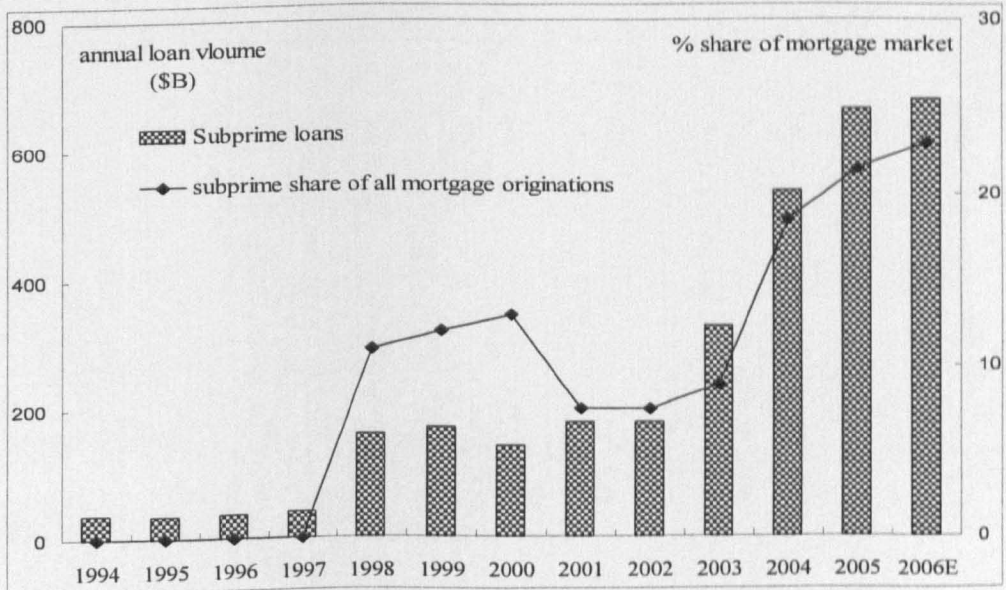
Source: Schloemer, et al. (2006).

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[21] These mortgages include Adjustable rate mortgage (ARM), interest-only ARM and negative amortization loans, etc. ARM is a mortgage loan which adjusts the interest rate on the note periodically based on a variety of indices, such as 1-year constant-maturity Treasury (CMT) securities and London Interbank Offered Rate (LIBOR). An interest-only ARM is a loan in which for a set term the borrower pays only the interest on the principal balance, leaving the principal balance unchanged. At the end of the term, the borrowers may choose to enter an interest-only mortgage, pay the principal, or convert the loan to a principal and interest payment loan at their own option. The negative amortization loan means that based on some pro-agreed terms, the loan payment for a period can be less than the interest charge over that period and this shorted amount is then added to the total amount owned to the lender. From an international perspective, all these three mortgage types belong to *Variable Rate Mortgage* or *Floating Rate Mortgage* whose interest rate fluctuates to reflect market conditions.

To cool down the overheated economy, the Federal Reserves raised the interest

rate 17 times consecutively to 5.25% by 29 June 2006. Increased mortgage

payment pressure led to foreclosures and a sharp drop in house price. This

problem worsened after the second half of 2007 when most of the

adjustable-rate or interest-only mortgages entered their resetting period (Figure

7.3). In 2007, about 1.3 million US housing properties were subject to

foreclosure activities (Irvine, 29 January 2008). After the first two years' low

initial offering rate period expired, the revised interest rate increased as much

as 30-50%. Accompanied by the banks' tightened lending activities, housing

demand was further reduced, which caused more price drops and defaults.

During the previous downturn in the early 1990s, the US average house price

fell by 2.8 % according to the S&P/Case-Shiller Home Price Index (Corkery

and Hagerty, 14 July 2008). However, the price slide this time was

substantially steeper and has lasted much longer. By July 2008, average US

house prices had dropped 19.2%, resulting in the value of some houses even

significantly less than the outstanding mortgages.

Figure 7.3 First reset date as percentage of Sub-prime outstanding
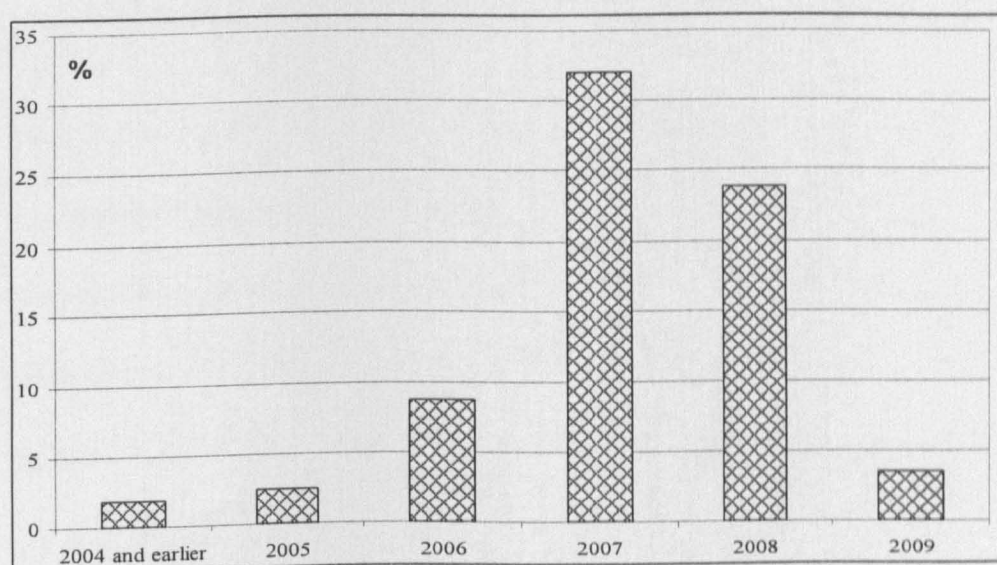
Source: FitchRatings, Loan Performance, http://www.fitchrating.com.

Soon after the broke of housing crisis, two credit rating agencies, Moody and Standard & Poor's, downgraded the ratings of 399 and 612 sub-prime related MBS respectively (England, 2007). Heightened levels of fear in the credit market soon transformed the original residential mortgage default problem into a financial turmoil. Investors lost confidence in the US housing market and its economy, causing the collapse of its stock market. The US S&P 500 Index slumped to 682 on 5 March 2009, a level much lower than its previous drop in 2002. Bearing the risk of higher inflation, the US Federal Reserves slashed interest rate nine times consecutively to 2% by April 2008 to stimulate consumption and generate relief to borrowers. However, it also accelerated the speed of the US dollar depreciation. Huge amount of foreign investments was withdrawn from the US market, making capital financing more difficult. Meanwhile, these "hot money" imposed greater pressure on the Euro and other

currencies, generating turbulences in the worldwide financial markets.

Both the US Reserve and the European Central Bank (ECB) acted swiftly and unprecedentedly to rescue the market, but could do little to stop the global economy from deteriorating. All the Wall Street giants suffered. Between June 2007 and March 2008, more than $430 billion was wiped off the combined market value of the top ten US investment banks, while the losses for the mortgage lenders was about $162 billion (Stamp, 3 August 2008). Some of the US biggest names, including Fannie Mae, Freddie Mac, Merrill Lynch, Lehman Brothers and AIG, were either put up for sales, bought by the US government or became bankrupt. Worsening problems in the financial sector cascade through to impact negatively on the real economy. During 2008, the International Monetary Fund (IMF) began to issue increasingly worse forecasts for world GDP growth in 2009. The US economy is expected to contract by 3.3% and the UK by 4% in 2009 (Anonymous, EIU, 4 May 2009).

As the turmoil unfolded in 2008, reports emerged that one of the biggest Chinese commercial banks, BOC, had also invested heavily into the US sub-prime market and may face substantial losses. BOC's exposure indicated China's financial sector was more integrated into the world economy than previously imagined, which raised questions about the influence of the US housing crisis on the Chinese banks and its economy. To what extent has the

Chinese commercial banks been exposed to the US sub-prime mortgage sector?

Will the US housing crisis be replicated in China? These are two important

questions that need to be addressed to understand better the current Chinese

housing and stock markets.

7.1.2 Influence of The Financial Crisis to the Chinese Banking Sector

The *Capital Weekly*, a Chinese journal, reported that Chinese financial

institutions had invested $107.5 billion into the US sub-prime sector in the year

ending 30 June 2006 (Zhong, 13 August 2007). This was almost double the

amount of the previous year. It further estimated the possible losses of six listed

Chinese commercial banks based on 2006 data and information released by the

US Treasury.

Table 7.1 Chinese banks exposure to US sub-prime mortgage securities

(Million RMB)

Bank	US Securities Investment	ABS (%)	SPL Lending (%)	Value of SPL	Estimated Loss of SPL	Compared with PBT of 2007 (%)
BOC	590,766	37.4	0.51	29,641	3,853	4.5
CCB	306,685	10.8	0.07	4,433	576	0.7
ICBC	199,870	3.5	0.01	930	120	0.1
BCOM	27,583	52.5	0.1	1,941	252	1.2
CMB	34,272	17.3	0.07	794	103	0.7
CITIC	24,052	4.8	0.02	154	19	0.2

Source: *Capital Weekly*, 11 August 2007, http://focus.jrj.com.cn.

Notes: ABS: Asset Backed Securities; SPL: Sub-prime Loans; PBT: Profit before Tax; Full name of the banks are listed in Appendix; PBT in 2007 is estimated.

The disclosure of these losses generated huge turmoil in the Chinese financial market. BOC clarified immediately that their exposure was not as large as reported. CCB and ICBC confirmed that they only had small holding of US sub-prime related investments, while the joint-equity banks, CITIC and BCOM, simply denied any exposure. CMB announced that all its sub-prime securities had already been settled in August 2006 in a favourable condition.

On 25 March 2008, the BOC 2007 annual report showed net profit of the group was up 31% to RMB 56.2 billion, which was far inferior to the other commercial banks, such as ICBC, whose net profit rose 65% (Leow, 7 April 2008). BOC disclosed information related to its sub-prime mortgage investment, including that by the end of 2007, the bank had settled most of its MBS and its entire Collateralized Debt Obligations (CDO).[22] It retained $4.99 billion (RMB 36.4 billion) MBS and $2.47 billion (RMB 18.04 billion) Alt-A,[23] accounting for 2.13% and 1.1% of the group's total securities investment. BOC disclosed that it had made loss provision of $1.3 billion (RMB 9.5 billion) and $0.3 billion (RMB 2.1 billion) for its MBS and Alt-A

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[22] A CDO is an unregulated asset-back security and structured credit product, which is an important funding vehicle for fixed-income assets. It is constructed from a portfolio of fixed-income assets, which are divided by the ratings firms that assess their value into different trenches. On 30 June 2007, the balances of BOC's MBS and CDO were USD 8.965 and 0.682 billion. On 31 March 2008, the balances of BOC's MBS and Alt-A were $4.43 billion and $2.21 billion respectively.

[23] An Alt-A mortgage is a type of US mortgage which is risker than "prime" but safer than "sub-prime" mortgage. Its interest rate is therefore between those of prime and sub-prime house loans.

obligations respectively in 2007 (Hou, 2008). However, Moody estimated that

the actual losses for the MBS alone could reach $2.1 billion (RMB 14 billion)

after reassessing the associated risks. If the value of BOC's US security

investment dropped by 5% on average, the total loss could be as high as RMB

19.8 billion in 2008, wiping off 18.7% of the group's expected profit.

Compared with ICBC and CCB, BOC's 2008 performance was indeed heavily

impaired.

The US credit crunch has played out in the Chinese housing market. The house

price movements in China, the US and the UK have moved synchronically,[24]

with the Chinese market lagging a bit behind the two developed countries. The

market condition of China at the start of 2008 was similar to the US market

during the first half of 2007, when the house prices began to drop.

The "Chinese Housing Prosperity Index" (CHPI) which is designed to reflect

the development and the prosperity of the Chinese real-estate market fall 15

months in a row to 94.74 points in March 2009. Another indictor, "House Price

Index of 70 Large- and Medium-sized Cities in China", showed a similar

picture (Figure 7.4). The Chinese house price index went up by 0.2%

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[24] We tested the correlation coefficient among the UK, the US and China house price indices. The correlation coefficient between UK and China, US and China and UK and US was 0.59, -0.86 and -0.39 respectively. We next ran the following regression using house indices of the three countries, China = α + β_1US+ β_2UK. We found that both of β_1 and β_2 were highly significant at 1% with an R^2=0.81, which further supports the view that China's house price index is influenced by the movements of the indices of UK and US markets.

year-on-year in March 2009. However, compared with the previous month, it had actually decreased slightly.

Figure 7.4 House price indexes: China, the US and the UK, (July 2005-Mar 09)
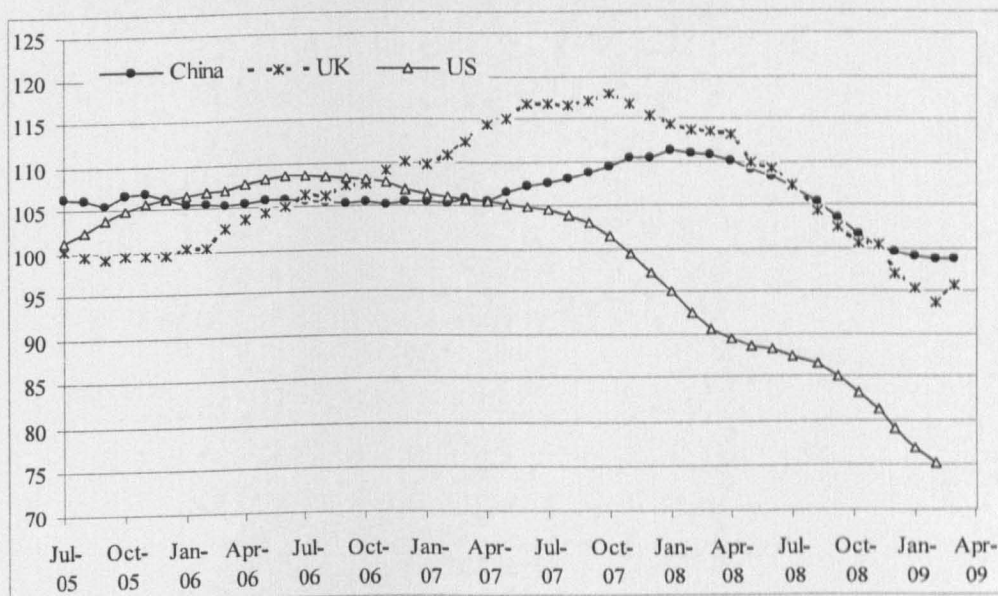
Source: US Composite-20 SPCS20R, Standard & Poor's, http://www2.standardandpoors.com/portal/site/sp/en/us/page.topic/indices_csmahp/0,0,0,0,0,0, 0,0,0,1,1,0,0,0,0,0.html;   UK   Nationwide   House   prices, http://www.nationwide.co.uk/hpi/historical.htm, China 70 large- and Medium-cities house price index, National Development and Reform Commission, monthly statistic, 2005-09.
Notes: July 2005=100.

The slowdown in the Chinese house market has imposed substantial pressure on bank operation and profitability. During the six years 2003-08, the proportion of home mortgages to total loans rose from 9.2% to about 15%, increasing the importance of mortgages for bank revenue (Figure 7.5). However, banks could no longer rely on expanding mortgage-lending business to boost profit in 2008. All the major SOBs acted prudently towards the approval of new personal housing loans, ensuring limited exposure of risk. For instance, mortgage lending to total loans of CCB has contracted by 6.1% in

2008. Nonetheless, the default rate and prepayment risk increased substantially.

For example, the Guangdong branch of CMB reported that in the first quarter

of 2008, RBM 600 million personal loans were repaid to the bank,[25] of which

more than 80% were mortgage prepayment (Shihua Financial Report, 14 May

2008).

Figure 7.5 Percentage of housing mortgage to total loans, 2003-08
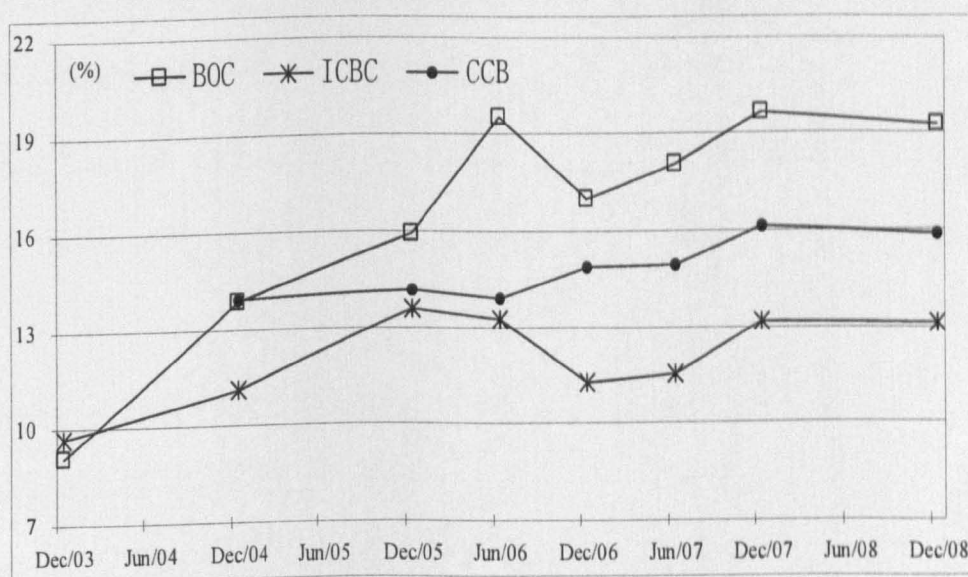
Source: Bankscope.

Meanwhile, Chinese banking stocks slumped. BOC's share price for the 12

months to October 2008 fell from RMB 7.48 to RMB 3.06, which was below

its IPO price. Poor performance of banking stocks has brought down the entire

stock market in China. The SSE Composite Index declined more than 70% to

1706 by November 2008. Yao and Chen (2008) argue that such a sharp

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[25] Personal loans includes: personal residential mortgage loans, credit card loans and other loans, in which personal residential mortgage loans account for around 80% of the total personal loans.

downturn might have been associated with the US credit crunch, but a more recent study by Yao and Luo (2009) attributes the Chinese stock market crash to specific psychological factors of Chinese investors.

Moreover, the weakened US dollar and the contraction in US consumer spending hit China's exports hard. Export to the US has slowed significantly since the beginning of 2007 (Anderlini, 16 November 2007). According to the National Bureau of Statistic, the trading surplus of China in 2008 had increase just 13% year-on-year, compared with a rise of 84% one year earlier. Worse more, rather than reflecting improved or sustained exports, the increase was mainly due to the sharp decline of China's imports, many of which were intermediate inputs for the export manufacturing sector. For instance, the $62 billion trade surplus in the first quarter of 2009 was realized by a decrease of 25% of export and a more radical contraction of 31% in imports. As exports accounts for more than a third of China's economic growth, and the US is the second largest recipient of all Chinese exports, a depressed US economy might derail China's rapid economic growth (Anderlini, 16 November 2007). China's central bank estimates that if the US's GDP growth declines by one-percentage point, Chinese exports to the US will drop by 6%, which would cut about two-percentage points from the Chinese GDP growth (Wang and Fan, 2008). Clearly, China is unable to decouple itself completely from the slow down of the rest of the world and it will also need to cope with increased pressure from

"foreign investment" betting on RMB's further appreciation.

7.2 Threat to the Chinese Financial Market

7.2.1 Housing Boom

House prices in China increased sharply and even doubled during the past two years in some fast developed cities. The Chinese National Development and Reform Commission showed that the "House Price Index of 70 Large- and Medium-sized Cities in China" rose 6.5% in 2008, 1.1% lower than the previous year. Figure 7.6 presents the house price indexes of China's four major cities, Beijing, Shanghai, Shenzhen and Guangzhou from January 2006 to March 2009 (July 2005=100).

Figure 7.6 Housing price index of four major cities: Jan 2006--March 09
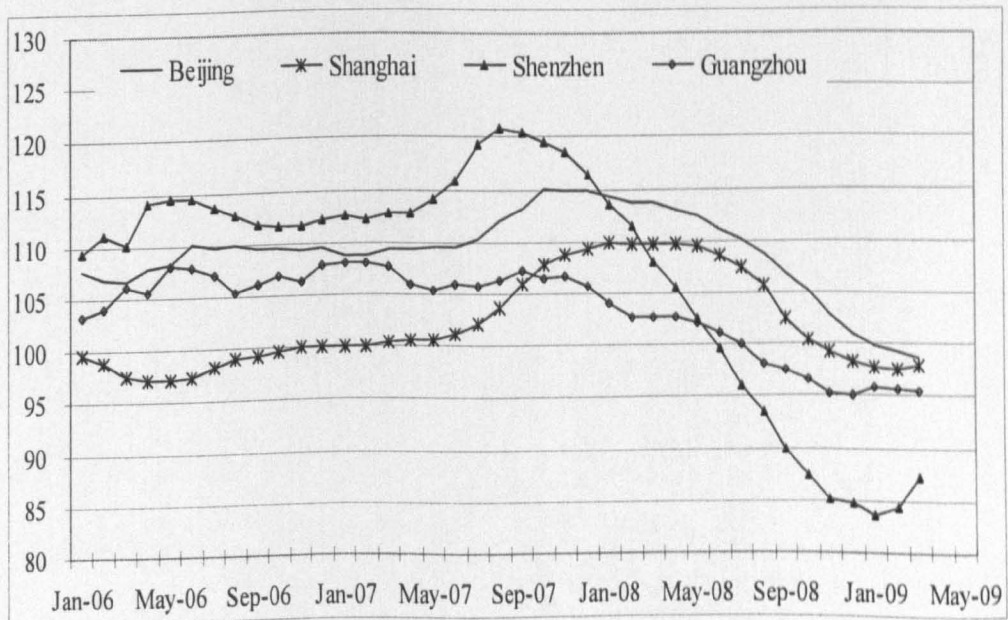
Source: National Development and Reform Commission Monthly Statistic 06-09.

The prosperous Chinese housing market had already started to drop down since the second half of 2007. Cities with a steeper past house price upswing, such as Shenzhen and Guangzhou, were the biggest causalities in the market downturn. Within a year to 2009, the average sale price of houses in Shenzhen was down more than 30%. While the downward movement flattened in early 2009, there were few signs of recovery in the overall house price index. In response, most Chinese banks have tightened their lending policies, asked new home buyers for larger deposits and restricted lending to multi-home buyers. A big concern of the Chinese government is that the house market downturn following on the heels of a stock market crash may unleash a domestic financial crisis.

7.2.2 Irresponsible Lending Activities of the Banks

If the sub-prime crisis in the US was due to irresponsible lending activities of banking and non-banking mortgage originators, then Chinese banks have made similar mistakes too. Rising house prices made mortgage lending lucrative and attractive to Chinese banks. On one hand, loans secured on residential property are classified as high quality assets when the house market is booming, normally with a bad debt ratio of less than 1%. On the other hand, the "Basel Accord II" specified that the risk weight of such assets is only 35%, much lower than some other assets (Basel Committee on Banking Supervision, 2006; Li and Lin, 2007). Therefore, banks have strong incentives to reduce their loan application requirements to attract more and more borrowers. Table 7.2

summarizes the investment of Chinese banks in the housing market. The total

loans committed to the housing market increased from RMB 7.36 trillion in

December 2006 to RMB 9.6 trillion in December 2007. Over the same period,

commercial housing loans rose by 30.8%, mortgage loans 33.6% and

real-estate development loans 25.7%.

Table 7.2 Bank loans in the housing market 2006-07 (RMB trillion)

Category		Dec-06	Dec-07
Commercial Housing Loan	Balance	3.7	4.8
	Growth (%)	22.1	30.8
Personal Mortgage Loan	Balance	2.3	3.0
	Growth (%)	19.0	33.6
Real-estate Development Loan	Balance	1.4	1.8
	Growth (%)	22.1	25.7

Source: China Banking Regulatory Commission, Statistic Yearbook 2006-07.
Notes: Growth rate = annual growth from the previous year, Commercial housing loan=
Personal mortgage loan + Real-estate development loan

Rapid growth in mortgage and real estate development loans fuelled the

already overheated housing market in China. Although Chinese banks were

unable to offer deals to their borrowers with zero down payments like their US

counterparts, loose loan granting requirements and numerous faked documents

provided by borrowers rendered the banks exposed to unpredictable risks. This

problem was exacerbated in China because of the undeveloped system for

monitoring the personal credit history of a borrower. Frequently borrowers can

obtain evidence of income from some private companies that can be 10-times

higher than their salary, which is used to support the application for a mortgage

(Guo, 2007). When the market is good, this was not an issue as banks could recover their lending by selling the collateralized estate had the customer defaulted. However, even before the market deteriorated, the complexity of disposing of mortgaged assets made such an approach somewhat unrealistic or even cavalier.

Commercial banks in China are more fragile because of the underdeveloped financial market, rather than the converse. US banks could spread their high risks related to sub-prime mortgage through asset securitization. Thereby, if the borrower defaults, the bank was not the sole entity that bore the loss. Such mortgage-related financial instruments originated in the US from the 1970s, but appeared in the Chinese market only in 2005 when the CCB launched the country's first mortgage-backed securities, the "Jianyuan 2005-1 MBS". As a result, if the housing market in China lost value, commercial banks providers of mortgages will be the only losers to carry the cost of irresponsible borrowers. At least in the first instance – the large state banks have ready recourse to government assistance.

7.2.3 Interest Rate Cycle

Interest rate adjustment is widely used as a monetary instrument by most central banks to manage their national economies. From January 2001 to 2003, the US Federal Reserves cut the interest rate from 6.5% to 1% to boost the

economy (Figure 7.7). Cheap credit overheated the US housing market quickly.

Consequently, the Federal Reserve raised interest rates to cool the market. This

U-turn in interest rate policy was the catalyst for the crash in the house market

that accelerated from 2006 onwards.

The UK interest rates moved similarly to the US pattern, but with less volatility.

The UK house market had enjoyed more than a decade of rising prices to the

end of 2007, but started to decline steeply in 2008. Both the US and UK have

cut their interest rates to historical low levels to restore market stability and

cushion the slide into recession.

Figure 7.7 Interest rate movements of US, UK and China: Jan 1999- Jan 09
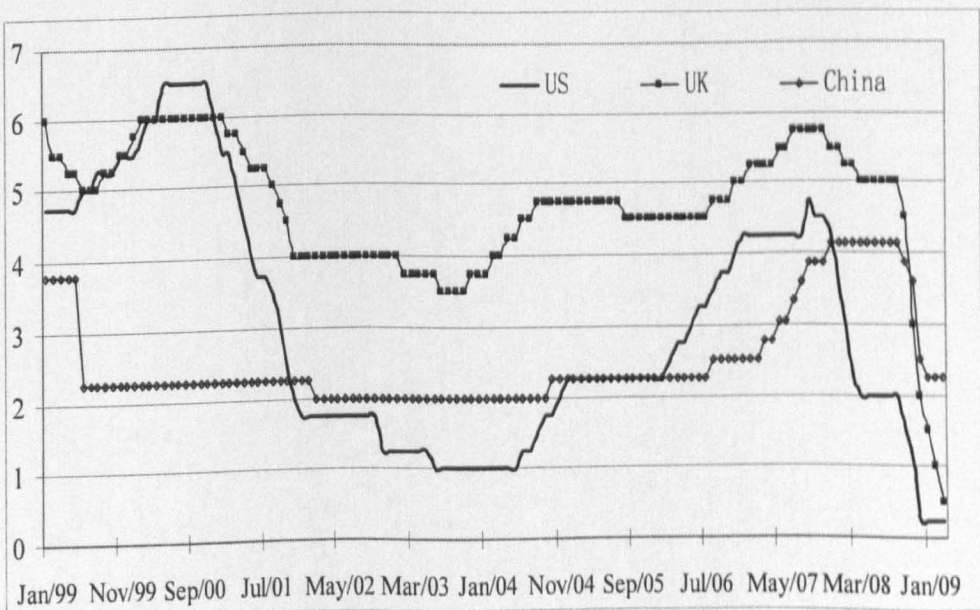
Source: US Federal Reserve, Bank of England and People's Bank of China, Statistic data.

In China, the interest rate was maintained at a relatively low level before 2006,

but as the housing market heated up, the rate was raised. Mortgage borrowers

began to feel the pinch more acutely from January 2008, when the one-year

loan interest rate had up swung by almost 1 percentage point to 7.26%. On

average, the monthly payments had increased by hundreds or even thousands

of RMB, causing many homeowners to default on their mortgage payments.

However, as China's Consumer Price Index (CPI) was rising and the real

interest rate of savings was negative, there was pressure on the Central Bank to

raise the interest rate further. High interest rates, declining house prices and

defaults on mortgage payments can run into a vicious circle, which have

potential to induce the Chinese housing market to collapse. However, despite a

sharp drop in a few big cities, the overall Chinese housing market is unlikely to

crash in the same way as in the US due to a number of social, economic and

cultural differences.

7.3 Competitive Strength of China

7.3.1 Fast Development of China's Economy

Different from the US, the prosperity of the Chinese real-estate market was not

triggered by low interest rate or by attractive mortgage products, but has grown

along with the fast expanding Chinese economy. Table 7.3 compares the GDP

growth rates of China, the US, the UK, Japan and Germany.

Table 7.3 GDP growth in China, the UK, the US, Japan and Germany (%)

Year	UK	US	Japan	Germany	China
2001	2.46	0.75	0.18	1.15	8.30
2002	2.10	1.60	0.26	0.01	9.10
2003	2.82	2.51	1.41	-0.23	10.0
2004	2.76	3.64	2.74	1.18	10.1
2005	2.06	2.94	1.93	0.75	10.4
2006	2.84	2.78	2.42	2.98	11.6
2007	3.03	2.03	2.08	2.51	11.9
2008	0.70	1.13	-0.58	-0.4	9.13

Sources: International Monetary Fund (IMF), http://www.imf.org/external/data.htm;
http://www.tradingeconomics.com/.

China achieved much higher economic growth than the four largest industrialized economies in the world, especially after its accession to the WTO in December 2001. By the end of 2008, China's trading volume reached $2.6 trillion, generating a surplus of $297 billion, a rise of 18% and 14% respectively from the previous year. In addition, a large and increasing amount of foreign capital flowed into China during recent years. Therefore, it was not surprising that the stock and the housing markets soared. Although the house price index for large- and medium-sized cities in China increased by 6.5% in 2008, it was slower than the GDP growth rate and seemingly reasonable. Meanwhile, the fast expending economy spurred on income growth. The real incomes of China's urban and rural residents grew by 7.5% and 11% respectively in the year to September 2008, which was faster than the growth of house prices. As a result, the demand for housing increased, which prolonged prosperity in the real-estate market.

It is no doubt that the favourable trade condition of China had been seriously deteriorated from the second half of 2008 due to contracted demand from the western world. China still managed to keep its GDP growth rate at 9% in 2008 (National Bureau of Statistic, 2001-08). Although the figures are not high compared with recent achievements, they are the envy of the rest of the world under the current financial situation. In November 2008, China stunned the world by unveiling a massive fiscal stimulus package worth RMB 4 trillion ($586 billion). The plan put substantial emphasis on upgrading China's infrastructure and improving the living standards of disadvantaged groups through the building of social security and social welfare systems (Dollar, 12 November 2008). Amounting to 16% of China's GDP in 2007, the stimulus plan is large by any measure and showed China's determination to stem the domestic impact of the global financial crisis and prepare for sustainable long-term growth in the future (Batson, 10 November 2008).

7.3.2 China's Specific Social and Cultural Characteristics

China's huge population, diversified housing requirements, and people's savings and consumption habit are distinctly different from the other countries. From the demand side, the US has only one-fourth of China's population, although the territorial areas are almost the same. There is no doubt that US physical housing needs are far less than those of China. On the other hand, China's urbanization process was another factor pushing up house prices.

Many rural people have migrated to cities in recent year, but the urban areas

available for real estate development are limited (Zhao and Lv, 2007). As a

result, the cost of land has increased rapidly in China over the past 15 years. In

the US and other western countries, such social transformation process is

relatively moderate and bidirectional.

Chinese consumption and savings habits are also more conservative than the

westerners'. Table 7.4 shows the house buying intention of different income

classes in "China seven biggest cities" in the first quarter of 2008 and

compared with three months earlier.[26]

Table 7.4 Potential buyers of different income classes (Q4 2007 & Q1 2008, %)

Monthly Income per head (RMB)	<500	500-1000	1000-2000	2000-5000	5000-10000	10000-20000	20000-50000	>50000
Q42007	9.3	9.9	12.7	15.5	18.7	21.8	28.4	33.1
Q12008	8.8	8.8	10.9	14.2	17.8	19.5	26.3	29.9
Change (+-)	-0.5	-1.1	-1.8	-1.3	-0.9	-2.3	-2.1	-3.2

Source: Chinese real-estate information statistic, http://www.crci.cn/.

More than 80% of potential home buyers are those with a monthly income of

RMB 10,000 or more. For these people, mortgage payment accounts for a

rather small proportion of their incomes. Therefore, different from the US

where banks lent to those who were less able to service a mortgage, especially

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[26] The survey was carried out by the People's Banks of China in Beijing, Shanghai, Chongqing, Xi'an, Tianjin, Wuhan and Guangzhou.

the low income households, most of the home loans are concentrated on the well-off urban middle and high income households in China. As a result, a house market meltdown would impact on relatively few Chinese.

Chinese house buyers are also rather risk-averse. Owning a house is an important savings instrument and Chinese people have a much higher propensity to save than their western counterparts. This saving and investment behaviour combined with fast growing incomes is a key factor that has sustained recent China's housing boom. Comparing the figures in the first quarter of 2008 with those in the last quarter of 2007, only among high-income households was there a marked declined in expressed intension to buy a house (Table 7.4). However, except in a few fast developed cities, the house price fall was not as big as has been in the US or the UK.

7.3.3 Different Nature of Chinese Commercial Banks Operation

First of all, Chinese banks require higher buyer deposits from borrowers than the US banks. In order to reduce the operational risk to a controllable level, the CBRC requires at least 30% of the total value of the property as deposit, while 100% mortgages were available in the US and the UK. Under the pressure of recent housing boom, CBRC and the People's Bank of China further request that multi-home buyers have to stake a minimum 40% down payment from 27 September 2007. Such a policy sought to provide the banks more protection.

As long as house prices do not fall more than 30%, banks are unlikely to incur huge losses from liquidating properties repossessed.

Secondly, the proportion of "Personal Loans" of Chinese banks was much smaller than their US counterparts. Although these have increased during recent years, in total personal loans only account for around 20% of the bank lending in China while this ratio in the US was between 30% and 50%. Residential mortgages account for the largest share of personal loans, typically 70-80%. However, multiplied by the ratio of personal loans to total loans, even among the state-owned banks, home mortgages only accounts for 15% of total lending. Therefore, the impact of a house market downturn on Chinese banks will be limited provided the rest of the economy does not deteriorate at the same time.

Finally, the improved asset quality of Chinese commercial banks gives them more flexibility to deal with unexpected risks. Both the impaired loan ratio and composition of bed debts look quite healthy recently. Figure 7.8 sketches the bad debt ratio and the percentage of sub-prime debt to total bad debt of all the Chinese commercial banks from 2004 to 2009 and figure 7.9 concentrates on the three state-owned banks.

Figure 7.8 Bad debt and sub-prime debt of Chinese commercial banks: 2004-09
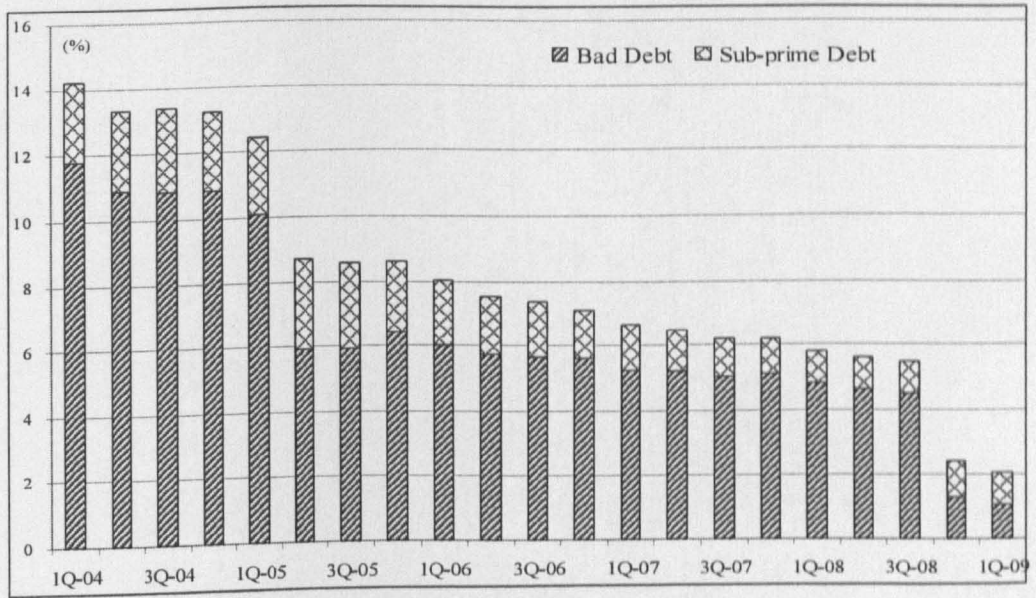
Source: China Banking Regulatory Commission, Statistic yearbook 2004, 2009.

Notes: Total bad debt of the Chinese banks equals to Bad debt plus sub-prime debt.

Figure 7.9 Bad debt and sub-prime debt of BOC, ICBC and CCB: 2002-08
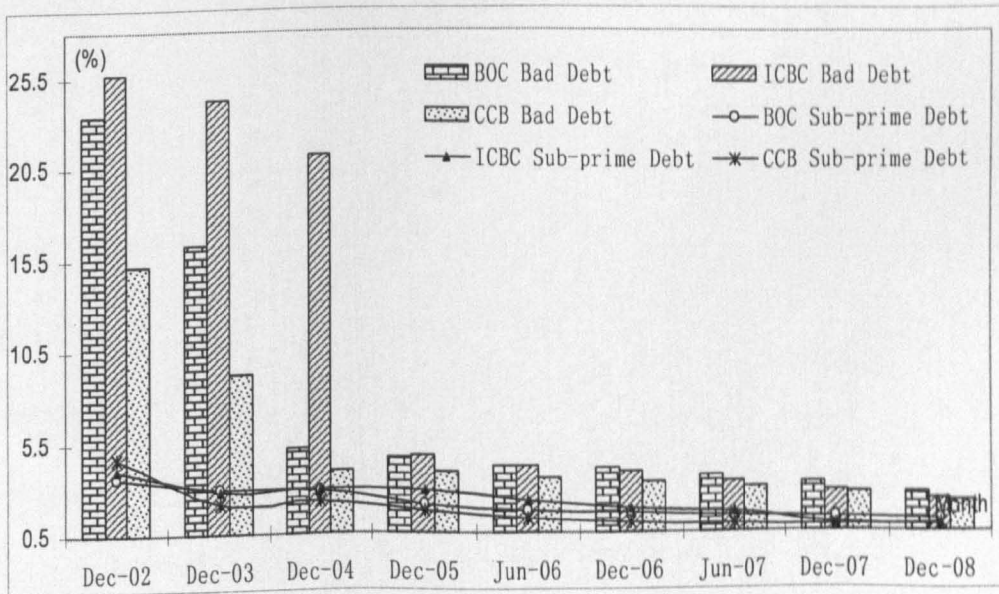
Source: Bankscope.

After a series of bank reforms, the problems related to state-owned banks'

non-performing loans (bad debts) have been solved by and large. The bad debts

and sub-prime loans have been small and have decreased over the years. In

particular, on 21 October 2008, the state had approved the reform plan of the

last troubled state bank, the ABC, and injected $19 billion to strengthen its

balance sheet, bringing down the overall bad debt ratio of Chinese commercial

banks to just 2.42% by the end of 2008. In the first quarter of 2009, the ratio

fell further to 2.04%, of which 0.95% represents sub-prime debt (CBRC, 2009).

Moreover, as the securitization market in China is in its infancy, the negative

effect of sub-prime loan defaults can hardly spread to the whole financial

system.

These three points discussed above lead us to believe that the gloomy

atmosphere in the US and the rest of the industrialized world may not seriously

affect the stability of Chinese banking system and financial market. The

conservative nature of the banks operation and the risk-averse attitude of the

Chinese people enable the Chinese commercial banks to survive the turmoil of

the financial crisis. Despite losses in its US sub-prime related investment, BOC

managed to realize a net profit of RMB 64 billion in 2008, up 14.4%

year-on-year, while the other two state banks, CCB and ICBC, were up 34%

and 35% respectively. Meanwhile, the collapse of the share price of many

banking giants has enabled the three biggest Chinese SOBs in early 2009 to

supplant their American and European competitors as the world's largest

commercial banks measured by market capitalization (Table 7.5). Not only is

the ICBC the world's most profitable bank and largest bank in market

capitalization, it has become the biggest deposit holder as well (Anderlini and

Guerrera, 14 April 2009). By the end of March 2009, customer deposits of

ICBC reached RMB 8,900 billion ($1,302 billion), overtaking JPMorgan Chase

and Japan's Mitsubishi UF J Financial Group, which held about $1,000 billion

and $1,290 billion in deposit respectively (Anderlini and Guerrera, 14 April

2009). This latest symbolic milestone again supports our argument that Chinese

banks have emerged relatively unscathed from the global crisis and also

highlights the growing affluence of Chinese citizens, who have historically

saved a large portion of their incomes rather than relying on credit.

Table 7.5 Share prices, market values and profits of selected world banking

giants

		Dec-98	Dec-01	Dec-05	Dec-07	Dec-08	Mar-09
BOC	Share price				0.90	0.43	0.51
	Market cap.				229.69	110.30	129.59
	profit before tax	1.03	1.88	7.54	13.51	12.76	
ICBC	Share price				1.11	0.52	0.58
	Market cap.				371.76	173.01	192.52
	profit before tax		1.83	8.96	17.75	21.27	
CCB	Share price				1.35	0.56	0.63
	Market cap.				315.12	130.96	147.68
	profit before tax	0.25	1.31	7.77	15.49	17.52	
RBS (UK)	Share price	5.21	7.91	9.80	8.57	0.72	0.35
	Market cap.	4.52	21.84	31.21	99.55	11.85	5.80
	profit before tax	1.67	6.23	13.65	19.47	-59.37	
HSBC (Hong Kong)	Share price	8.11	11.70	16.04	16.89	9.51	5.50
	Market cap.	65.40	108.06	177.10	194.99	112.32	94.68
	profit before tax	6.57	8.00	20.97	24.21	9.31	
Citigroup (US)	Share price	23.19	47.10	48.53	29.44	6.71	2.53
	Market cap.			265.80	147.06	38.89	13.94
	profit before tax			28.56	0.78	-53.06	
BoA (US)	Share price	30.06	31.48	46.15	41.26	14.08	6.82
	Market cap.	51.82	49.08	156.91	183.11	70.64	43.68
	profit before tax	8.05	10.46	24.48	20.92	4.43	

Sources: share prices: http://www.google.com/finance, http://finance.yahoo.com/ and
http://www.sse.com.cn/sseportal/webapp/datapresent/queryindexcnp?indexCode=000001&inde
xName=; profit and number of shares: official websites of the banks, e.g. RBS:
http://www.rbs.com/, Citigroup: http://www.citigroup.com/.

Notes: When the share price data of 31 December 1998 do not exist, we use the earliest 1999
January figure instead; Share price: $; Market cap: $ billion; Profit before tax: $ billion; the
market cap. is calculated by: Market cap.=No of shares * share price; the exchange rate we use
are from: http://finance.yahoo.com/currency-converter?u#from=GBP;to=USD;amt=1;

	Dec-98	Dec-01	Dec-05	Dec-07	Dec-08	Mar-09
RMB:$				7.3046	6.8346	6.8359
£:$	1.664	1.4562	1.72	1.98	1.46	1.43
HKD:$	7.7459	7.8003	7.7536	7.7979	7.7506	7.7504

7.4 Policy Implications of the Financial Crisis to the Further Reform of Chinese Banking Sector

The US sub-prime mortgage crisis has wrecked havoc in the worldwide economy and invokes the need for major reform of the global financial system. Various proposals have been put forward by international organizations and policymakers that stress the necessity of strengthening financial regulation and supervision. It involves the balancing of several issues. The current crisis was blamed on profit-driven bankers who were motivated by short-term measures such as quarterly profit results and their year-end bonus. Therefore an effective corporate governance system should be designed to balance the short- and long-term profits, as well as short- and long-term risks and reward the managements accordingly. Another issue, the operational scope of banks, also triggered substantial controversies. The relationship between the traditional "narrow banking", deposit taking, extending loans and providing payment services, and a more complex financial product and service provider is again, a trade-off. Thirdly, financial innovation and development of the quasi-private market should be subject to increased oversight from associated regulatory departments. Their positive effect of wealth generation and risk diversification needs to be balanced with the potential risk involved. And finally, the extent to which the policy makers should influence the banks' decision making is another critical issue. Excessive political influence to the banks' operation should be avoided while ensuring that banks are managed effectively under the

general guidelines.

Apart form these "balancing issues", other aspects, such as reforming the IMF and World Bank to restore the legitimacy and effectiveness of the institutions; increasing international regulatory cooperation, especially the effective support from emerging countries; strengthening supervision and independence of the credit rating agencies; expending the coverage and quality of capital requirements to provide adequate buffer during crisis; enhancing human resource development to provide sufficient qualified people engaging in regulatory and supervisory work, had also been addressed. Each country should adjust their financial system according to their different situations.

For China, despite the banking industry disclosing positive financial results in 2008, the worsening global financial crisis, sluggish capital markets, interest rate adjustment and the sharp drop in the foreign demand of Chinese goods imposed greater downward pressure to their operation in 2009. The slowdown in the Chinese house market had impaired banks' profitability. Banks could no longer rely on expanding mortgage-lending business to boost profit in 2009. All the major SOBs acted prudently towards the approval of new personal housing loans, ensuring limited exposure of risk. For instance, mortgage lending to total loans of the ICBC in the first half of 2009 contracted to 12.9%, which was 0.3% lower than the same period of the previous year. In addition, a

series of interest rate adjustments from the PBOC reduced the net interest rate, directly leading to a decline of the banks' net income. While the downward trend has slowed since the second quarter of 2009, net interest income and operational income of the ICBC, for example, had declined by 11.9% and 4.3% respectively by the end of June 2009 (Official Website of ICBC). Facing increased competition, the banks need to accelerate business innovation to broaden income sources and cut expenditures to maintain healthy and robustness growth.

Hit by the US credit crunch, cash-strapped foreign banks started to off load their stakes in local lenders from the end of 2008 when the three-year lockup period expired. UBS sold its entire holding of 1.3% BOC stake on 31 December 2008, which initiated sell off of China holdings by foreign investors (Kjetland, 9 January 2009). This was quickly followed by BOA, which trimmed 2.5% off its 19.1% stake in CCB on 5 January 2009 and RBS, which off loaded its 4.3% stake in BOC on 14 January for $2.4 billion. Although HSBC bucked against the trend by reaffirming its strategic partnership with BOCOM, it was expected that such selling will continue during 2009 (Morrow, February 2009). Investment from foreign banks with global reputations assisted Chinese banks in an array of projects and eased their way to list overseas successfully in 2005 and 2006 (Leow and Fitzpatrick, 8 January 2009). However, the central government could not rely on the strategy of using

foreign expertise to build a world-class banking system now. Instead, the Chinese banks need to map out plans for foreign divestment and to prepare for the possible liquidity problems caused by capital flight. On the other hand, turbulent financial market led to the value of many world-renown institutions substantially undervalued, which gave the Chinese banks an excellent opportunity to refine their investment portfolios. In December 2007, the ICBC bought 20% of South Africa's Standard bank Group for $5.5 billion, sending a strong signal to the world that Chinese banks had begun the move to prominence on the world stage (Timewell, December 2007). Nonetheless, the banks should take steps cautiously to avoid expanding too rapidly, in particular for the SOBs, due to cultural differences and lack of experiences (Leow and Carew, 22 September 2008).

In response to the tough economic condition, the Chinese government unveiled a series of key adjustment policies and rescue packages to expand domestic demand and promote development, which also in turn proposed great opportunities to the further development of banks. While the rest of world is still suffering from the lingering effects of the financial crisis, Chinese bank lending has been expanded rapidly. In the first half of 2009, bank loans totalled RMB 7.4 trillion, three times the pace in the same period of last year and the strongest six-month lending surge on record (Roach, 29 July, 2009). In the year 2009, total bank lending surged to more than RMB 9 trillion (Cookson, 6

January 2010). ICBC's new loans in the third quarter more than doubled to RMB 144 billion from a year earlier while BOC issued RMB 388 billion worth of new loans in the same period, more than eight times it lent a year earlier (Anderlini, 30 October 2009). However, such over-expansion of loans had not fully translated into correspondingly larger profits for the banks as the government slashed lending rates faster than deposit rates at the end of last year to cope with the crisis. Increase in the net profit of ICBC, BOC and CCB in the third quarter of 2009 was only 19%, 19% and 18.6% respectively compared with same period last year. Nevertheless, the outlook for Chinese banks is less certain as huge jump in loan granting is unlikely to be sustained, not to say the potential risk of bad debt and asset bubble. Such outsized bank directed investment stimulus raised serious concern about the quality of the loans. As most of the funds have gone to local government backed entities to help in the financing of their stimulus-related infrastructure projects, rather than credit-starved small businesses, the situation is unlikely to get as bad as in the 1990s, when NPL ratio of the banks could be as high as 50% (Batson, 15 January 2009). Nevertheless, how long such aggressive credit expansion can be maintained remains uncertain. While benefiting from investments in infrastructure projects to boost loan income and engineering cost consultancy business, the banks need to act prudently as bad debt and over capacity could return to haunt the banks in the future.

Moreover, in the process of continued globalisation, Chinese commercial banks need to further strengthen their risk management ability to become more resistant to the increasingly complicated and volatile business environment. Cooperating with other institutions, the banks need to build up their customer credit tracking system to ensure limited risk exposure in future loan granting. Financial innovation is important in banks' profit generation and risk diversification. However, how to use these new financial mechanisms to amplify their positive effects is crucial for the development of Chinese commercial banks.

Last but not least, to avoid any further risks associated with the US securities, the Chinese government should adjust the weight of its US investment assets in its whole foreign reserves. By the end of 2008, around $130-150 billion Chinese foreign reserves were invested in the US mortgage securities. If the crisis becomes worse, this will directly result in $10-12 billion loss within the next three years (Wang and Fan, 2008). Additionally, after several interest rate cuts, the yield on US government bonds had dropped significantly. If the Chinese government could swap part of the US government bonds to some highly undervalued but yet good quality MBS and redeem them back when the crisis is over, higher investment proceeds can be generated. This could also have some positive effects on appeasing the fluctuation of the international financial market.

7.5 Chapter Summary

In this chapter, we first review the negative impact of the US credit crunch on world economy and then shift our discussion to whether a similar crisis might be replicated in China. As the Chinese and the US housing and financial markets shared some similarities recently, it has been argued that another round of financial turbulence originated from the Chinese house market might be coming soon.

Three reasons, aggressive interest rate adjustments, irresponsible lending activities of the banking and non-banking mortgage originators, and asset securitization were regarded as the fuse for the US sub-prime crisis. China possesses two of the above conditions. However, given the specific nature of the Chinese economy and culture, it had also been argued that what happened in the US today would hardly occur in China in the same way.

In 2008, China's GDP continued to grow at a high level of 9%, despite natural disasters and the slump of global financial markets. Thanks to limited exposure to US sub-prime mortgage, the performance of most Chinese commercial banks have not been critically impaired. However, rising consumer prices, energy shortages, a struggling stock market and a cooler housing market suggest that China, especially its commercial banks, cannot be complacent about a potential house market crash and wider financial crisis. Instead, China

should review the causes of this crisis critically, grasping the opportunity to strengthen their own operations and be prepared for increased competition in future.

Chapter 8 Conclusion and Further Research Directions

8.1 Conclusion

This thesis discusses the development of Chinese financial system and its influence on the wider economy in three aspects. These comprise the effect of stock listing on banks' corporate governance improvement; the efficiency of Chinese commercial banks and impact of the US credit crunch on China's financial sector and its commercial banks.

After a series of bank reforms, Chinese reformers adopted partial privatization approach through stock listing as the final step in the process to strengthen bank performance. Starting from 1999, the government injected funds or stripped-off NPLs that totalled RMB 2.62 trillion from the three biggest SOBs to help them build up a sound balance sheet. The pilot bank CCB was successfully listed on the HKSE in October 2005, followed by the BOC and ICBC in 2006. By the end of 2007, 14 Chinese commercial banks had been listed. The market reacted positively to these listings, which coincided with a bullish run of the Chinese stock markets.

One fundamental objective of stock listing is to improve the corporate governance practice of listed firms and consequently their performance. To get

a detailed understanding of in what aspects had the corporate governance of the

listed banks been improved after IPO, the CCB was chosen to conduct a case

study in Chapter 3. The 2004 *OECD Principles of Corporate Governance* was

employed as the analytical criteria. Through careful comparison of annual

reports of CCB from 1999 to 2008, I found that in all major areas required by

the Principles, the bank had displayed a very high level of compliance. For

instance, in the area of Disclosure and Transparency, the CCB clearly outlined

the operating and regulatory structures and risks to its investors and had good

tracking records of communications. The requirements of OECD Principles on

equitable treatment of shareholders, rights of shareholders and the provision of

a framework for effective corporate governance had also been well followed by

the bank.

However, despite outstanding improvements, flaws in some fundamental

aspects of its corporate governance still existed. The highlighted responsibility

of the independent non-executive directors was not fully reflected in its board

composition. In most of the sample period even after stock listing, the

percentage of independent NED of CCB was about 30%, just passing the

threshold of HKSE but far less than the higher requirement of NYSE. This

level of independent director disabled board of CCB to exercise its function,

such as monitoring complex transactions effectively. As more Chinese

companies attained stock listing in recent years and the pool of qualified people

been built up, CCB should try to attract more of these high-quality independent directors to address the current imbalanced board and consequently to achieve better corporate governance in future.

Nevertheless, clear changes and significant improvements had been identified since the bank obtained listing in 2005, which was also consistent with our hypothesis. In addition, due to the US credit crunch in 2007 and the subsequent world-wide financial crisis from October 2008, financial markets throughout the world had plummeted but the annual reports of the Chinese commercial banks continued to show encouraging results. These raise our central research question: the extent to which China's recent efforts to partial privatise SOBs via stock listing had helped improve bank efficiency. In chapter 6, employing data of the 14 listed Chinese commercial banks from 1999 to 2008, both non-parametric (DEA) and the parametric (SFA) approach were applied to estimate the efficiency rating of the listed banks.

We first applied the DEA-CCR, constant return to scale model. The mean efficiency of the listed Chinese commercial banks was about 0.86, suggesting that there was still significant potential for further efficiency improvement. With an average efficiency score of 0.79, performance of the SOBs remained poorer than the JECBs (0.89) and the CCBs (0.87), despite the latest reforms focusing on them. Within 139 sample DMUs, 13 were fully efficient but none

of them was state-owned.

Result of the scale economy estimation showed that in average, about 7% of the DEA-CCR inefficiencies came from the scale diseconomies. For the SOBs, this ratio was as high as 18%, indicating that they were the most scale inefficient banks. To assess the pure technical efficiency of the banks, we further apply the DEA-BCC, or various return to scale model. The overall efficiency rating using this approach improved significantly to 0.92, with the efficiency gap among different banking groups reduced greatly over the years. The mean efficiency of the SOBs reached 0.96 and became the most efficient banking group among all the listed banks, implying that the main source of inefficiency of the SOBs came from scale diseconomies. Despite continued improvement of their productivity and profitability, large overhead expenses due to redundant staffing and over-expansion made the overall efficiency of the SOBs still inferior to the JECBs. In terms of pure technical efficiency, however, the SOBs had already outperformed all other banks.

In the following part, we applied the parametric approach, SFA. The average technical efficiency of the 14 listed banks over 10 years sample period was 0.95, improving steadily from 0.88 in 1999 to over 0.99 in 2008. Similar to the DEA results, the SFA also identified a converged movement of efficiency rating among different banking groups. Despite the JECBs still leading the

whole banking industry, the SOBs and CCBs had caught up rapidly and reduced the mean efficiency gap from more than 10% before 2001 to less than 1% in 2007 and 2008.

In terms of the effect of stock listing on banks' efficiency improvement, all three models support the hypothesis. DEA-CCR model reported that the average efficiency score of the banks was 6% higher in their IPO year while the figure under SFA estimation was 2.5%. However, it was also identified that the efficiencies of several banks deteriorated immediately after IPO. This worsening performance may reflect the earlier "window-dressing" of the balance sheets before IPO year or it may simply a reflection of the tough economic conditions worldwide in 2008. Therefore further research becomes necessary.

Apart from calculating the efficiency ratings, we also estimated the technical inefficiency model to explore the determinants of bank efficiency. Both DEA and SFA result suggested that four variables—ownership, IPO, t, E/A and GDP growth—influence the efficiency of the banks significantly. The SOBs were less efficient than the non-state owned banks over the sample period and the IPO could improve the efficiency of listed banks by about 5%.

To examine the robustness of the estimated efficiency ratings, we first tested

the correlation of efficiency scores estimated by DEA-CCR and SFA techniques, then compared their rank-order correlations and finally compared the frontier results with the traditional performance indictors. Our findings were consistent with prior literatures. The efficiency scores estimated by the two approaches were not directly comparable, whereas their ranking orders were fairly closely correlated. Both measures were found to be related to financial indictors to some extent, while the SFA proved to be a better approximation of traditional performance measures.

Finally, in Chapter 7, we analysed the possible spill over effect of the US credit crunch on China's financial market. Three factors, aggressive interest rate adjustments, irresponsible lending activities of the banking and shadow mortgage originators, and asset securitization were regarded as the fuse for the US sub-prime crisis. China possesses two of the above conditions. However, the specific nature of the Chinese economy and culture suggested that the US experience was unlikely to reoccur in China in the near future. Fast development of the Chinese economy boosted income of the household and consequently promoted the prosperity of the Chinese real-estate market. Rising house prices had been well supported by real market demand. In addition, the consumption and saving habits of the Chinese people and their risk-averse tradition meant that Chinese mortgage borrowers were less likely to default on bank loans compared to their western counterparts. However, rising consumer

prices, energy shortages, a struggling stock market and a cooler housing market

suggested that China, especially its commercial banks, cannot be complacent

about a potential house market crash and wider financial crisis.

The world financial turmoil invokes the need for major reform of the global

financial system and it could also be valued as a "once in a century"

opportunity for China to speed up its economic convergence with the

industrialized world. In the process of continued globalization, the Chinese

banks need to further strength their risk management ability through importing

advanced risk control system of the foreign banks and building up their own

credit tracking system to reduce risk exposure in future loan granting.

Moreover, facing increased competition after the entrance of foreign banks, the

Chinese banks need to accelerate business innovation to broaden income

sources and cut expenditures to maintain healthy and robustness growth.

8.2 Further Research Directions

Large scale listing of Chinese commercial banks has only begun. Efficiency

issues will attract more attention as the reform of the Chinese financial system

goes further. This is the first study to apply two different frontier approaches to

explore the relationship between efficiency improvement and IPO. Although

the results confirmed the positive effect of listing on efficiency improvement

and provided enormous management implications, the impact of prices changes

have not been considered in the technical efficiency analysis. When price information, such as wages of the employees, is available, cost efficiency and profit efficiency analysis can be conducted by both DEA and SFA again to provide a more comprehensive measure of the performance of the Chinese commercial banks.

In addition, as five out of our 14 sample banks were listed on the stock exchanges in 2007 and their performance might be influenced significantly by the 2008 US financial crisis, our conclusion about the deterioration in the efficiency rating after IPO year may need to be reviewed. When the banks have chalked up a few more years on the exchanges, we can replicate this research to obtain new average efficiency scores. In particular, we could compare the three years prior listing with the three years after to evaluate the effect of the IPO on the efficiency of banks while controlling for the influence of external market fluctuations related to the financial crisis of 2007-2009.

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