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**EFFICIENCY AND COMPETITION
IN CHINA'S BANKING SECTOR**

Xiaoqing Fu

This Thesis Is Submitted For The Degree of Doctor of Philosophy

Cass Business School, City University (London)

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Declaration

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Abstract

China's banking sector has undergone remarkable changes during the last two decades, and banks in China today face more competitive pressure than ever before. The objective of this thesis is to investigate the efficiency and competition of the major Chinese banks over the period 1985-2002.

After reviewing the evolution of the banking sector over the past half-century, the thesis addresses an important aspect of competition: X-efficiency and its potential correlates. X-efficiency is found to be as low as 40%-50% on average, suggesting that it is an important issue which should receive more attention from researchers, bank regulators and managers. State-owned banks are found to be less X-efficient than joint-stock banks, confirming the need for a shift in favour of shareholder owned banks. X-efficiency is also found to be more pronounced in the first stage of banking reform, implying that further interest rate liberalisation is necessary to help bank managers to be better able to control their costs. Tests for the presence of economies of scale and scope follow. The evidence is mixed but suggests that banks' cost structures may improve if the law prohibiting universal banking is relaxed. Finally, both the market-power and efficient-structure hypotheses are examined using a random effects panel data model. Some evidence is found to support the relevant market-power hypothesis and the X-efficiency version of the efficient-structure hypothesis for banks in the first and second reform stages, respectively, suggesting that the government's gradual approach to reform has improved the competitive structure of the banking sector. However, policy should be directed at enabling the more efficient banks to gain larger market shares. For example, the expansion of the joint-stock banks should be encouraged. There is little evidence of a 'quiet life' for the big four (state-owned) banks. However, while interest rate liberalisation should improve bank efficiency, policy makers must be aware of possible negative effects such as excessive market power, 'quiet life' effects, and other anti-competitive behaviour.

Abbreviations

<i>ABC</i>	<i>Agricultural Bank of China</i>
<i>AC</i>	<i>average cost</i>
<i>ADB</i>	<i>Asian Development Bank</i>
<i>ADBC</i>	<i>Agricultural Development Bank of China</i>
<i>AMCs</i>	<i>asset management companies</i>
<i>bn</i>	<i>billion</i>
<i>BHSB</i>	<i>Bengbu Housing Savings Bank</i>
<i>BOC</i>	<i>Bank of China</i>
<i>BOCOM</i>	<i>Bank of Communication</i>
<i>CAB</i>	<i>China Association of Banks</i>
<i>CCB</i>	<i>China Construction Bank</i>
<i>CDB</i>	<i>China Development Bank</i>
<i>CEB</i>	<i>China Everbright Bank</i>
<i>CEGL</i>	<i>China Everbright Group Limited</i>
<i>CHIBOR</i>	<i>China inter-bank offered rate</i>
<i>CIB</i>	<i>China Investment Bank</i>
<i>CITIC</i>	<i>Chinese International Trust and Investment Corporation</i>
<i>CITIC IB</i>	<i>CITIC Industrial Bank</i>
<i>CMB</i>	<i>China Merchants Bank</i>
<i>CMBC</i>	<i>China Minsheng Banking Corporation</i>
<i>DEA</i>	<i>data envelopment analysis</i>
<i>DFA</i>	<i>distribution-free approach</i>
<i>EPSCE</i>	<i>expansion path scale economies</i>
<i>EPSUB</i>	<i>expansion path subadditivity</i>
<i>ES</i>	<i>efficient-structure</i>
<i>ESS</i>	<i>scale-efficiency version of the efficient-structure</i>
<i>ESX</i>	<i>X-efficiency version of the efficient-structure</i>
<i>EXIM</i>	<i>the Export-Import Bank of China</i>
<i>FBBs</i>	<i>foreign bank branches</i>
<i>FDH</i>	<i>free disposal hull analysis</i>
<i>FFIs</i>	<i>foreign financial institutions</i>
<i>GDB</i>	<i>Guangdong Development Bank</i>
<i>GDP</i>	<i>gross domestic product</i>
<i>HXB</i>	<i>Hua Xia Bank</i>
<i>IB</i>	<i>Industrial Bank</i>
<i>ICBC</i>	<i>Industrial and Commercial Bank of China</i>

<i>LMEs</i>	<i>large- and medium-sized enterprises</i>
<i>MOF</i>	<i>Ministry of Finance</i>
<i>MP</i>	<i>market-power</i>
<i>NPL</i>	<i>non-performing loan</i>
<i>OBS</i>	<i>off-balance-sheet</i>
<i>PBC</i>	<i>People's Bank of China</i>
<i>PSSE</i>	<i>product-specific scale economies</i>
<i>QL</i>	<i>quiet life</i>
<i>RCCs</i>	<i>rural credit cooperatives</i>
<i>RMB</i>	<i>renminbi</i>
<i>RMP</i>	<i>relative-market-power</i>
<i>ROA</i>	<i>return on assets</i>
<i>ROE</i>	<i>return on equity</i>
<i>SCALE</i>	<i>overall scale economies</i>
<i>SCOPE</i>	<i>overall scope economies</i>
<i>SCP</i>	<i>structure-conduct-performance</i>
<i>SDB</i>	<i>Shenzhen Development Bank</i>
<i>SFA</i>	<i>stochastic frontier approach</i>
<i>SMEs</i>	<i>small- and medium-sized enterprises</i>
<i>SPDB</i>	<i>Shanghai Pudong Development Bank</i>
<i>TFA</i>	<i>thick frontier approach</i>
<i>TICs</i>	<i>trust and investment companies</i>
<i>TVEs</i>	<i>township and village enterprises</i>
<i>UCCs</i>	<i>urban credit cooperatives</i>
<i>USD</i>	<i>US dollar</i>
<i>WTO</i>	<i>World Trade Organization</i>
<i>WPSSE</i>	<i>within-sample product-specific scale economies</i>
<i>WSCOPE</i>	<i>within-sample product-specific scope economies</i>
<i>YHSB</i>	<i>Yantai Housing Savings Bank</i>

Chapter 1. Introduction

"Bank professionals require a thorough grounding in the micro foundations of banking, if they are to make important managerial decisions, or implement banking policies."

Heffernan (Modern Banking in Theory and Practice, 1996, p.1)

1.1 Introduction

Both policymakers and bank managers are concerned with the issue of how efficiently banks transform their various inputs into multiple financial products and services, as well as how competitive the market is to enable banks with greater efficiency to attain higher profitability and a larger market share accordingly. Inspired by Heffernan (1996) and others, this thesis is devoted to the important micro issues of China's banking sector: efficiency and competition.

In the literature, two types of efficiency are discussed in the context of cost minimization. X-efficiency refers to the ability to select the optimal scale and/or mix of inputs, given the output bundle and input prices. Scale and scope efficiency, usually measured by economies of scale and scope, is the ability to choose the optimal scale and mix of outputs, assuming that all banks are approximately equally X-efficient (Berger, 1993; Berger and Humphrey, 1994). As argued by Berger and Humphrey (1991) and Kumbhakar (1991, 1996), X-efficiency and economies of scale and scope should be taken as complementary, rather than as substitutes for each other.

Efficiency is a critical issue for bank regulators. Improved banking efficiency should result in better resource allocation, which will benefit society by intermediating greater amounts of funds, providing more products with better prices and service quality for clients, improving bank profitability, and achieving greater safety and soundness in the banking sector if efficiency savings are applied towards improving capital buffers that absorb risk. Of course, the

converse applies if structural changes lead to less efficient intermediaries, with the additional danger of taxpayer-financed bailouts if substantial losses are sustained (Berger, Hunter, and Timme, 1993). For these reasons, over the last two decades a large number of developed and developing countries have undertaken extensive banking reforms aimed at raising the efficiency of the banking sector.

Efficiency is also an important issue for bank managers because deregulation-induced changes, technological progress and market integration release new competitive pressures and accelerate the capacity and need for change. In response to this new environment, banks have followed many different strategies, which include rationalization, restructuring, consolidation etc., to improve their efficiency (Molyneux, Altunbas, and Gardener, 1996).

Therefore, the study of efficiency could help banking regulators to design policies by assessing the effects of banking reform, mergers or market structure on efficiency. Bank managers could improve managerial performance by identifying “best and worst practices” associated with high and low X-efficiency respectively and encouraging the former practices while discouraging the latter. Bank managers could also design growth and risk strategies by identifying the optimal scale and mix of bank outputs.

The structure–performance relationship has been extensively investigated in the literature to address the question of how competitive the banking market is and/or whether anti-trust policy is an effective force. Usually two types of hypothesis have been tested: the market-power and the efficient-structure hypotheses. Under the market-power hypothesis, firms in a concentrated market or with a large market share and well-differentiated products may exercise market power in pricing and earn supernormal profits. Under the efficient-structure hypothesis, the low costs of production of relatively efficient firms enable them to compete more aggressively, capture a bigger market share and earn high profits.

These two hypotheses have directly opposing implications for anti-trust policy. If high profits are created by market power, then anti-trust enforcement may be socially beneficial, moving prices toward competitive levels and allocating resources more effectively. By contrast, if greater efficiency is the explanation for high profits, then breaking up efficient firms or forbidding efficient firms to acquire other firms may raise costs and lead to less favourable prices for consumers (Berger and Hannan, 1997).

1.2 Objectives of this Thesis

Over the past two decades, China's economy has achieved an average annual growth rate of 9.5 percent and accomplished a remarkable improvement in the standard of living of its population of 1.2 billion. China's GDP constituted almost one-fifth of the total GDP of all developing countries by 2002 (World Bank, 2004). Considering its enormous size, China's economic development and its transition to a market economy is of global significance.

At the centre of the economic reforms, China's banking sector has undergone significant changes over the last two decades. The reforms were gradual and in two stages, combining structural and conduct deregulation with new regulation. Technological progress has also enhanced competition by eliminating geographical barriers and facilitating product innovation. Therefore, banks in China today face more competitive pressure than ever before.

In response to these changes, banks have attempted to adopt strategies aimed at improving efficiency to enhance their competitive viability. The streamlining of the state-owned banks, the expansion of the joint-stock banks, the diversification of portfolios, the innovation in the off-balance-sheet activities, and, more recently, the joint-stock reform of the state banks can be interpreted as responses of this kind. A major motivation has been the drive to realize potential scale and scope economies, and also to eliminate X-inefficiencies.

In the light of these developments, and noting that China's WTO accession may lead to an increasingly integrated banking market, it is important to investigate X-efficiency and cost economies as well as the structure-performance relationship issues in China's banking sector. An empirical investigation may yield insights that will be of interest to academics, bankers and policymakers. However, to date, no published econometric analysis has appeared which investigates these critical issues. The purpose of this thesis is to fill this void.

The main objective of this thesis is to address the following questions:

- How X-efficient is China's banking sector?
- Has the gradual banking reform improved the X-efficiency of the banking system?
- Is there empirical evidence to support the view that significant efficiency improvements will result from the ongoing joint-stock reform of the state banks?
- Are there any economies or diseconomies of scale and scope in China's banking sector?
- Do economies or diseconomies of scale and scope differ across ownership types?
- Has the gradual banking reform improved the cost structure of the banking sector?
- How competitive is China's banking market? Does it follow the "market-power hypotheses" or the "efficient-structure hypotheses"?
- Do the big four state banks enjoy a "quiet life"?

This research contributes to the banking literature in the following ways. The thesis:

- collects and translates (into English) micro-banking data for China;
- provides a comprehensive overview of China's banking sector over the period 1949-2003;

- undertakes a preliminary exploration of bank performance using a random effects panel data model;
- for the first time, conducts an econometric analysis of X-efficiency in China's banking sector;
- for the first time, tests the presence of economies of scale and scope in China's banking sector;
- for the first time, tests a variety of hypotheses related to the structure-performance relationship, using Chinese data;
- uses the results of the econometric tests to discuss the effectiveness of China's banking reform, and provide policy suggestions for future reform.

This thesis is organized as follows:¹ Chapter 2 reviews the evolution of the banking sector during the period 1949-2003, providing a background for the more detailed econometric analyses of the key micro issues presented in subsequent chapters. After briefly describing the socialist banking model, the two-stage banking reform that occurred after 1979 is discussed in detail. Evidence is presented to show the impact of the most important developments on the institutional structure and market shares, trends in the non-performing loans and the composition of banking business, and trends in costs, profitability and efficiency. Finally, a random effects panel data model is estimated for a preliminary exploration of bank performance.

Chapter 3 estimates X-efficiency within the banking sector from 1985 to 2002. A stochastic cost frontier model is employed to measure X-efficiency, with three different assumptions (i.e., half-normal, exponential, and truncated-normal) being applied to the disturbance distribution. A two-stage regression model is then estimated to identify the potential correlates of X-efficiency. In light of the findings on X-efficiency, the question of how the gradual banking reforms influenced the respective X-efficiency is discussed. It is also possible to address

¹ The standard literature review does not appear immediately after this chapter, because separate literature exists for each of the main topics in this thesis. Literature reviews appear at the beginning of the chapters on X-efficiency, scale and scope economies and the structure-performance relationship.

the issue of whether X-efficiency was affected by differences in the type of bank ownership.

Chapter 4 tests for the presence of the economies of scale and scope in the banking sector over the last two decades using the stochastic frontier approach and the expansion path measures. For completeness, the traditional non-frontier approach and the standard measures are also applied. Economies of scale and scope between banks with different forms of ownership and/or in different reform stages are also compared.

Chapter 5 investigates the relationship between market structure and performance in the banking system over the same period. The random effects panel data model, which incorporates the measures of concentration, market share, X-efficiency, and scale efficiency directly in the regression, is employed to test both market-power and efficient-structure hypotheses. In addition, the issue of whether or not the big four banks enjoy a “quiet life” is tested. The standard pooled data regression model is also estimated to check for robustness. The findings are used to assess whether the reforms affected the competitive structure.

Chapter 6 concludes by summarizing the major findings, identifying the limitations of the study, and making suggestions for future research.

Chapter 2: China's Banking Sector: An Overview

2.1 Introduction

This chapter reviews China's banking sector pre- and post-1979, providing a background for the detailed empirical analyses of the efficiency and competition issues presented in subsequent chapters. Section 2.2 explains the monopolistic banking sector before 1979. Section 2.3 describes the first stage of banking reform between 1979 and 1992, which created a two-tier system. Section 2.4 discusses the second stage of banking reform after 1993, the aim of which was to create an efficient, competitive, and sound banking sector. Section 2.5 provides stylized facts on major Chinese banks from 1985 to 2002. A number of figures and tabulations of banking sector data are presented, which highlight the impact of the most important developments on the institutional structure and market shares, the composition of banking outputs, and trends in costs, profitability and efficiency. Section 2.6 undertakes a preliminary exploration of the issue of bank performance using a random effects panel data model. Section 2.7 concludes this chapter.

2.2 Pre 1979: A Banking Monopoly

Before 1979, China had a monopolistic system modelled after that of the Soviet Union. The People's Bank of China (PBC) acted as the centre of cash, credit and settlement, simultaneously engaged in both central and commercial banking operations. The main objective was to channel funds in accordance with the state plan. The PBC's functions included currency issue, transaction clearing, setting interest rates, and managing the foreign exchange reserves. Monetary and credit policy consisted of direct control of the credit aggregate and currency in circulation.

The major policy instrument used to control the credit aggregate was called "*tong cun tong dai*". The PBC centralized all deposits collected by its over 15,000 branches and sub-branches. Credits were allocated to production agents via its

branches according to the state physical production plan (Yu, Xin, and Qu, 2000).

Interest rates were uniform. There were only two different interest rates for deposits: one for current savings accounts and the other for fixed savings accounts. Interest rates for loans were the same for all credit to industrial and commercial enterprises, regardless of the duration of the loans, the uses for which the loan were granted, and whether the loans were overdue. Thus, they had no appropriate impact on the mobilization and allocation of funds (Zhou, 1992).

The PBC also had a monopoly over commercial banking, such as deposit collection and short-term lending. At the end of 1978, the total deposits and total loans of the PBC amounted to RMB113.45 bn (or USD70.94 bn) and RMB185 bn (or USD117.3 bn)², respectively³.

On the eve of reform, China had three other banks and a network of rural credit cooperatives. They were nominal banks: none operated as independent economic entities. The Agricultural Bank of China (ABC) was established in 1951. Between 1951 and 1978, it underwent several stages of merger and restoration, but was, effectively, a department of the PBC. The Bank of China (BOC) was initially founded in 1912. From the 1950's to the 1970's, it was a subsidiary of the PBC specializing in foreign exchange related banking business. The China Construction Bank (CCB)⁴ was first created in 1954. Prior to 1979, the CCB acted as a fiscal agent for processing annual budgetary allocations for capital construction from the Ministry of Finance (MOF) and disbursed and administered the funds designated in accordance with the state's plans for key construction projects.

The rural credit cooperatives (RCCs) were first established at bases of the Red Army before the People's Republic of China (PRC) was founded. At that time,

² The exchange rate at the end of each year is applied throughout this chapter. For details of exchange rates for each year, please see Appendix 2.1.

³ *Almanac of China's Finance and Banking* (1989).

⁴ China Construction Bank was known as the People's Construction Bank of China before March 1996.

they were called *peasant's own banks*. After the founding of the PRC, RCCs were gradually transformed into units of the Agricultural Bank of China (ABC) (Zhou, 1992). The RCCs were the grass roots of the ABC, and mobilized deposits from the rural population. They engaged in relatively little lending.

There were two reasons for the formation of the monopolistic banking system. First, household savings, the major source of bank deposits in developing market economies, were extraordinarily small, due to the low wage incomes policy that had been operated since 1957. In 1978, the entire cumulative stock of household savings was only RMB21.06 bn (or USD13.35 bn), about 5.8% of GDP⁵. Second, investments for firms' fixed assets were financed predominantly from interest-free budgetary grants. The state budget was even the source of much of the working capital of state-owned enterprises. Banks focused on short-term rather than long-term loans to state-owned enterprises. Under these circumstances, the major role of the banking sector was quite circumscribed.

2.3 The Two-tier Banking Sector (1979-1992)

The economic reforms in China started after the Third Plenary Session of the 11th Party Congress in 1978. One of the major goals of this economic reform was to improve the efficiency of resource allocation in the domestic economy. The policy changed to a focus on decentralization in the distribution of national income and the allocation of financial resources. As a result, government revenues as a proportion of the GDP have declined significantly since 1979. By the mid-1980s, Chinese households had emerged as the principal source of savings in the economy. In 1979 the government also declared that investment funds for enterprises' fixed assets would no longer be granted exclusively from the cost-free state budget. It also declared that bank loans, which were subject to interest charges, would gradually replace budgetary grants.

⁵ *Almanac of China's Finance and Banking* (2001).

Being central to the major goals, China's banking sector was reformed at the same time. The objective was for the banking sector to serve as an intermediary between savers and borrowers and to facilitate payments between economic units. This reform strategy was consistent with that of the overall economic reform in China, which, unlike many transitional economies in Eastern Europe, adopted a gradual approach. It is characterized by partial experimentation and a trial-and-error approach. The successes and failures of these experiments influenced the decisions on the future direction of reform policy (Jin, 1994).

There was a debate on the optimal pace and sequence of banking reforms. Some argued that China's gradual approach to banking reform would have a minimizing impact on the existing market order, preserved a high savings rate for economic development, and contributed to superior economic performance (e.g. Murrell, 1995; Walder, 1996). Although not denying the success of China's strategy, others argued that its initial conditions were unique and that the Chinese approach was not suitable for other transition economies (e.g. Woo, 1994; Sachs and Woo, 1994). More importantly, the economic cost of the gradual reform strategy in China was quite high, for example, the large and rising amount of non-performing loans (e.g. Lardy, 1998; Lo, 2001). The details of the debate are not covered here because the objective of this thesis is to focus on efficiency and competitive issues within the Chinese banking sector.

2.3.1 Reform of the PBC

To strengthen the central bank's capacity for macroeconomic management, the State Council decided, in September 1983, that the PBC should function as a central bank. After four state-owned specialized banks were rebuilt or established to take over part of its commercial business, on January 1, 1984 the PBC was left to deal mainly with central banking functions, while its institutional structure was left unchanged.

The main responsibilities of the PBC were stipulated in the *"Interim Regulations*

on *Bank Management*” in January 1986, according to which the PBC was responsible for issuing currency, the maintenance of price stability, setting interest rates on deposits and loans, devising state credit plans, exercising centralized control over credit funds, exercising uniform control over the working capital of state enterprises, and supervising China’s foreign exchange business. The PBC was also responsible for the supervision of all other financial institutions.

The objectives of monetary and credit policy were defined as ‘*promoting economic development and stabilizing price*’ in 1986⁶. As indicated by Wu (1998), in practice, development took precedence over price stability until 1995. The major instruments of monetary and credit policy included the credit-quota plan and the PBC “*zai dai kuan*” (PBC lending)⁷.

Within the framework of expected output and price developments, the PBC combined the fund sources of all banks to set up a credit-quota plan, which included an overall credit ceiling on both state-owned specialized banks and medium and small-sized commercial banks. To ensure that all banks remained within their credit limits, the banks were directed in their lending by the PBC (Zhou, 1992).

The PBC lending (*zai dai kuan*) allowed banks to supplement their loanable funds by borrowing from the PBC. The maturity of the PBC lending varied, including overnight lending (10-20 days), seasonal lending (2-4 months), discount loans (within 6 months) and annual loans (1-2 years). By the end of 1992, the total lending from the PBC to banks reached RMB678.02 bn (or USD117.88 bn), accounting for 25.6% of the total lending made by banks⁸.

⁶ Interim Regulations on Bank Management (*Almanac of China’s Finance and Banking*, 1987, IX-2).

⁷ In fact, the credit-quota plan was implemented from 1985. Before this, there was another transitional credit plan named “*cha e kong zhi*” (credit-gap control) introduced from 1981. “Credit-gap control” featured a national credit plan to control the credit gap between fund availability and fund usage for all local banks (Lu and Yu, 1998).

⁸ Here, banks include only the state-owned specialized banks and the medium and small-sized commercial banks.

On the other hand, the PBC still set all interest rates on deposits and loans⁹. However, interest rates were diversified according to the various durations and depositors or purposes of loans¹⁰. Moreover, banks could add a 20% to 50% surcharge on the interest for overdue loans, for loans to be used to cover working capital that was judged excessive, and for loans caused by overruns in capital construction. The general term was that interest rates should be used as an instrument of monetary control so as to direct funds to the more important enterprises, and to mobilize more financial savings from the public to curb inflation (Zhou, 1992).

2.3.2 Restoring and Establishing of State-owned Specialized Banks

Between 1979 and 1984, four state-owned specialized banks were rebuilt or established, and operated in well-defined, but different types of business. In 1979, the Agricultural Bank of China (ABC) was restored and specialized in lending to support agricultural production as well as rural industrial and commercial enterprises. The Bank of China (BOC) was separated from the PBC and specialized in foreign exchange related banking business. The China Construction Bank (CCB) was separated from the Ministry of Finance and specialized in the fixed-asset investment of state enterprises. In January 1984, the Industrial and Commercial Bank of China (ICBC) took over the deposit taking and lending functions of the PBC, specializing in lending to support the state-owned commercial and industrial enterprises.

Between 1985 and 1992, the segmentation of these four state-owned specialized banks gradually diminished. For example, in 1985, in addition to the BOC, the other three specialized banks were permitted to conduct foreign exchange business at some of their branches. Subsequently, more were allowed to enter the foreign exchange business (Lardy, 1998). In 1986, the BOC was permitted to conduct RMB deposit business (Dai, 1998). The CCB and ABC were allowed to

⁹ The inter-bank money market rate was determined by market supply and demand.

¹⁰ See Appendix 2.2 for a detailed example.

enter into a variety of commercial banking services, including accepting corporate and household deposits, offering fixed assets and working capital loans. Furthermore, the state-owned specialized banks engaged in universal banking by establishing their own trust, securities, or insurance companies (Wu, 1998). Like the PBC, the four state-owned specialized banks established branches throughout the country.

2.3.3 Creation of Medium and Small-sized Commercial Banks

Between 1985 and 1992, a number of medium and small-sized commercial banks were established through merger, restructuring or incorporation. These banks included the Bank of Communication (BOCOM), CITIC Industrial Bank (CITIC IB)¹¹, China Merchants Bank (CMB), Shenzhen Development Bank (SDB), Industrial Bank (IB)¹², Guangdong Development Bank (GDB), China Everbright Bank (CEB), and Hua Xia Bank (HXB)¹³.

A new force in China's banking sector, these banks had four distinguishing features by end-1992. Unlike the four specialized banks wholly owned by the state, some commercial banks were joint-stock-structured, including BOCOM, CMB, SDB, FIB, and GDB, meaning that they could raise funds from various channels besides the state. Among them, SDB was the first bank to list its shares on the Shenzhen Stock Exchange in April 1991, and remained the only one until

¹¹ CITIC stands for China International Trust and Investment Corporation.

¹² Industrial Bank was known as Fujian Industrial Bank before 2003.

¹³ During this stage, three other banks were founded, namely, China Investment Bank (CIB), Yantai Housing Savings Bank (YHSB) and Bengbu Housing Savings Bank (BHSB). CIB had been a state-owned bank specializing in raising funds abroad and responsible for the disbursement of loans from international financial organizations between 1981 and July 1994. After nearly 5 years of commercial operation, total assets reached RMB75.5 bn (or USD9.12 bn) at end-1998. It was then acquired by CEB in March 1999. Both housing savings banks were established in 1991. They were established as experiments to help facilitate the transfer of ownership of housing from enterprises to occupants. They do not take deposits from the public but rather depend on funds deposited by manufacturing and commercial firms. By year-end 1999, the total assets of YHSB were only RMB8.36 bn (or USD1.01 bn) and those of BHSB were only RMB0.84 bn (or USD0.1 bn). Given that these banks were engaged in specialized operations and were tiny (measured by assets), they are not discussed in this thesis (*Almanac of China's Finance and Banking*, 1999 p.432; 2000 p.454, 455).

November 1999. Most of these new commercial banks were allowed to engage in universal banking.

Nor did they rely on the PBC for funds: these commercial banks were required to ensure total loans did not exceed total deposits and had sole responsibility for their profits and losses. While the specialized banks were required to open branches in all provinces, cities, and counties, these national commercial banks set up branches anywhere, to best serve their commercial interest.

It should be emphasized that all the medium and small-sized commercial banks were largely state-owned. They were either fully affiliated to state-owned enterprises (such as CITIC IB, CEB, HXB, and CMB) or largely owned by the central or local governments (such as BOCOM, SDB, GDB, and FIB). Even the publicly listed bank, SDB, had a majority of its shares held by local government, solely state-owned enterprises, and other “legal persons” (about 60-70% of the total), and shares owned by the state and legal persons cannot be traded publicly on stock exchanges¹⁴.

2.3.4 Founding of Credit Cooperatives

The rural credit cooperatives (RCCs) and urban credit cooperatives (UCCs) could also undertake deposit and lending business with the public. RCCs were collectively-owned financial institutions operating in rural areas in China. They engaged in deposit and lending business with rural households, collective enterprises, and township and village enterprises (TVEs).

RCCs were the most active deposit collectors in rural areas because the flexible structure of the credit stations made it possible for them to reach a high number of depositors (Xu, 1998). During the first stage of banking reform, RCCs were put under the direct control of the Agricultural Bank of China (ABC), and were required to place a certain percentage of their deposits with it. ABC supervised

¹⁴ For details, please see Appendix 2.3.

their banking activities and provided them with clearing services. They therefore had little autonomy in management.

The first UCC was established on an experimental basis in Henan Province in 1979, but most appeared after 1987. UCCs raised equity capital only from collective and private enterprises, as well as individual households. They focused on providing banking services to individuals, collectives, and private enterprises in a given city. UCCs were supervised by the PBC. Both the rural and urban credit cooperatives were controlled by the local government.

2.3.5 Treatment of Foreign Banks

As an important part of its economic reform, China has also opened its banking sector to foreign competition. To encourage more foreign capital and the expertise of foreign banks and institutions, the Chinese government has, since 1979, gradually eliminated the market entry and business restrictions on foreign financial institutions. Table 2.1 summarizes the major steps of the opening of China's banking industry during the first stage of reform. The table indicates that, in 1992, foreign banks in China could only provide foreign exchange business to foreign firms and citizens in 13 cities. These initiatives were formally legitimized by a number of rules.

In summary, compared to the monopolistic banking system, four key changes occurred during the first stage of banking reform. First, the institutional structure was changed from one of monopoly to a two-tier banking sector with a central bank, state-owned specialized banks, medium and small-sized commercial banks, credit cooperatives, and foreign banks. Second, the credit-quota plan and PBC lending became major policy instruments to manage aggregate credit. Third, a range of deposit and loan rates were offered according to their use but were controlled by the central bank. Fourth, the scope of banking activities was expanded by allowing universal banking business.

Table 2.1 Opening of China's Banking Sector (1979-1992)

Year	Events
1979	The Export and Import Bank of Japan set up the first foreign bank representative office in Beijing in China.
1982	The first foreign bank subsidiary in China, Nanyang Commercial Bank (Hong Kong) Shenzhen Branch, opened. It was restricted to engage in foreign exchange business with foreign firms and citizens inside the Special Economic Zones (namely, Shenzhen, Zhuhai, Xiamen, Shantou, and Hainan).
1983	Introduction of the <i>Management Measures on Representative Offices of Overseas-invested and Foreign-invested Financial Institutions in China</i>
1985	Introduction of the <i>Regulations on the Administration of Foreign Banks and Sino-Foreign Joint-Venture Banks in the Special Economic Zones</i>
1990	Pudong, Shanghai is opened up to operational foreign financial institutions (FFIs).
1992	The list of the cities where operational foreign financial institutions (FFIs) could operate were expanded to cover Dalian, Tianjin, Qingdao, Nanjing, Ningbo, Fuzhou and Guangzhou.

Sources: *Almanac of China's Finance and Banking (1986-1993)*

2.4 The Modern Banking Sector (1993-present)

To extend and accelerate banking reform, the State Council announced the blueprint for the second stage of banking reform in 1993. *The Decision on Financial System Reform* stipulated three objectives. The first was to transform the PBC into a modern central bank to implement monetary policy under the leadership of the State Council. The second was to transform the state-owned banks into genuine commercial banks by separating policy lending from commercial lending, and to create a commercial banking sector in which the state banks and other forms of banking institutions could coexist and compete under regulations set by the central bank. The third was to ensure a sound financial sector (Wu, 1998).

2.4.1 Independence of the Central Bank

During the first stage of banking reform, the PBC lacked independence, and even though as the central bank, it still made commercial loans. According to the *Interim Regulations on Bank Management* of January 1986, the PBC was required to continue to issue policy loans for special priority government projects. It also had to continue to finance a large part of the government budget deficit. These arrangements led to episodes of macroeconomic instability during this period. In

order to achieve its key objective of price stability efficiently, the PBC needed to maintain independence in the conduct of monetary policy.

From 1984 to 1998, however, the organizational structure of the PBC mirrored the administrative structure of the government. The PBC had an administrative rank lower than a ministry; for example, the director of a local bank branch was ranked lower than the local government treasurer (Jin, 1994). This situation meant that the PBC branches would succumb to pressure from local government for credit expansion. A reorganization of the PBC's branches was necessary if the central bank was to overcome localism.

The Law of the People's Bank of China of the People's Republic of China (Central Bank Law) was promulgated in March 1995 and gave the PBC a high level of independence from all other levels of government, stipulating that the objective of monetary policy is to maintain price stability and thereby promote economic growth. As provided by this law, the main functions of the PBC are to implement monetary policy and supervise the financial system under the leadership of the State Council¹⁵. Specifically, the PBC is entrusted to issue and administer the circulation of RMB; formulate and implement monetary policy; manage the state foreign exchange and gold reserves; license and supervise financial institutions; regulate financial markets; act as fiscal agent; maintain the payments and settlements system; collect and analyze financial statistical data; participate in international financial cooperation on behalf of the state.

As a consultative body for monetary policy formulation, the Monetary Policy Committee of the People's Bank of China was established in July 1997. The responsibility of the Committee is to advise on the formulation and adjustment of monetary policy and policy targets for a certain period, the application of monetary policy instruments, the major monetary policy measures, and the coordination between monetary policy and other macroeconomic policies. The committee meets quarterly and plays its advisory role on the basis of

¹⁵ *Almanac of China's Finance and Banking*, 1996.

comprehensive research on macroeconomic situations and the macro targets set by the government¹⁶.

In 1998, the PBC underwent substantial restructuring, which aimed at improving the conduct of monetary policy, and ensuring the soundness of the financial system by strengthening financial supervision. During the first phase of restructuring (between May and August, 1993), the PBC relinquished responsibility for the supervision of securities and insurance business, which resulted in the segregation of financial supervisory responsibilities¹⁷. At the same time, the PBC also reorganized the functional departments at its head office based on the idea of the consolidation of the functions of supervision of each type of financial institution.

The second phase of restructuring took place in September 1998, and resulted in the closure and merging of 148 duplicate city branch offices. The functions of the county-level sub-branches were also refocused on the supervision of rural credit cooperatives. During the third phase (between November and December, 1998), the PBC replaced the 31 provincial branches with nine regional branches¹⁸. After the restructuring, senior managers of the branches are appointed by the PBC, rather than the local governments. This change would probably prevent local governments from encouraging banks to finance their favoured projects, many of which are not profitable (Mo, 1999). In 2003, the PBC's monetary and

¹⁶ According to *the Rule of the Monetary Policy Committee of the PRC*, the Committee consists of the Governor and two Deputy Governors of the PBC, a Vice Minister of the State Development and Planning Commission, a Vice Minister of the State Economic and Trade Commission, a Vice Minister of Finance, the Chairman of the State Administration of Foreign Exchange, the Chairman of the China Insurance Regulatory Commission (since 2000), the Commissioner of the National Statistics Bureau (since 2001), the Chairman of the China Banking Regulatory Commission (since 2003), the Presidents of two state-owned commercial banks, and a financial expert (People's Bank of China, 2003b).

¹⁷ In 1998, the China Insurance Regulatory Commission was established. Meanwhile, the responsibility of the supervision of securities firms was transferred from the PBC to the China Securities Regulatory Commission, which was established in October 1992.

¹⁸ People's Bank of China, 1999.

supervisory functions were split, and the China Banking Regulatory Commission was established to supervise banking institutions in China¹⁹.

2.4.2 Commercialization of State-owned Specialized Banks

According to *the 1986 Interim Regulations on Bank Management*, the state-owned specialized banks were not enterprises but independent economic accounting entities in the socialist planned economy. In 1992, the State Council announced the decision of establishing the socialist market economy in China in *the 14th Conference of China Communist Party Report*. To establish a banking sector in harmony with the development of the socialist market economy, the State Council further announced the transformation of the state-owned specialized banks into state-owned commercial banks in 1993 (Wu, 1998).

From 1993 onward, measures were introduced to change both the internal and external conditions of the state-owned commercial banks. The main objectives were to give the state-owned banks more autonomy in credit decision-making, operational profits and losses, and to encourage self-reliance and self-discipline. A series of measures were introduced: (1) creation of policy banks; (2) recapitalization; (3) establishment of asset management companies (AMCs); (4) reorganization; (5) joint-stock reform.

Creation of Policy Banks

To accelerate the transformation of state-owned specialized banks into fully-fledged commercial banks and to increase the flexibility and capacity of the central bank for macro-economic management, three policy banks were

¹⁹ To further improve the financial supervisory regime, the State Council decided to establish the China Banking Regulatory Commission to exclusively supervise banking institutions, including banks, asset management companies and trust and investment companies on December 27, 2003. After the above-mentioned financial supervision function being removed, the PBC is mainly responsible for formulating and implementing monetary policy, keeping on improving rules on the operation of financial institutions, so as to better fulfill its duty as a central bank in macroeconomic management and financial risk prevention and mitigation. Accordingly, *the Central Bank Law* was amended at the same time.

established in China in 1994. They are the China Development Bank (CDB), the Export-Import Bank of China (EXIM), and the Agricultural Development Bank of China (ADBC). They are wholly owned by the state and directly under the leadership of the State Council.

The CDB was established in March 1994, with its head office in Beijing. Its primary function is to provide financial support to the industries and key projects that have significant bearing on the national economy.

The EXIM was founded in July 1994. Its major task is to implement industrial and trade policies by providing policy-oriented financial support and services to boost the export of mechanical and electronic products, complete sets of equipment, and new high tech products, as well as to promote Sino-foreign economic and technological cooperation and exchange through providing export credit and related loans.

The ADBC was created in November 1994. Its main responsibility is to programme and provide funds for agricultural development, including the procurement of agricultural products and the priority agricultural development projects in line with the state agricultural development policy and credit policy.

Re-capitalization of the State-owned Commercial Banks

In March 1998, a special Treasury bond (amounting to RMB270 bn, or USD32.61 bn) was issued to strengthen the capital bases of the state-owned commercial banks and to raise their capital adequacy ratio to 8%. The bonds were purchased by these four banks with funds freed up by a lowering of the required reserve ratio from 13% to 8% (Xie, 1999).

The re-capitalization plan raised the capital of the state-owned banks to RMB478 bn (or USD57.74 bn) from RMB208 bn (or USD25.12 bn) without changing the size of their aggregate balance sheets. The re-capitalization could also improve the

income streams of these banks, through the yields arising from investment in the bonds, and from reducing their interest costs caused by the decrease in central bank credits (Mo, 1999).

Establishment of Asset Management Corporations

In the 1990's, the bulk of the state banks' non-performing loans (NPLs) increased rapidly, the average NPL ratio peaking at 40%²⁰. To quickly reduce the non-performing assets and maintain the reputation and international competitiveness of these banks, the government decided to establish asset management companies (AMCs), which purchased the NPLs of the state-owned commercial banks, and took over the management and handling of the non-performing assets. In April 1999, Cinda AMC was established. Three other AMCs, Oriental, Great Wall, and Huarong, were founded in October 1999. Their aim is to dispose of the bad assets, which existed before 1995, of the relevant state banks.

The purchase of NPLs was completed by the end of August 2000. The four AMCs had purchased NPLs and interests worth RMB1.39 trillion (or USD0.18 trillion) from the state-owned commercial banks and the China Development Bank. The asset purchases reduced the average NPL ratio of the four state banks by about 10% (Jiang, 2001). The AMCs managed and handled the purchased assets through asset restructuring, sale, auction, contracting, collection of principal and interest, and leasing.

In 2002, the four AMCs handled debt of RMB132.73 bn (or USD16.04 bn) using various methods; the average recovery ratio was 35.73%. In total, the four AMCs recovered cash to the amount of RMB31.75 bn (or USD3.84 bn) - the cash recovery ratio averaged 23.92%²¹. By the end of 2002, 587 enterprises had signed debt-equity swap agreements with the AMCs, involving RMB334.78 bn (or USD40.45 bn). Another 578 enterprises had obtained the approval of the State

²⁰ *Almanac of China's Finance and Banking*, 2000.

²¹ *Almanac of China's Finance and Banking*, 2003.

Council for debt-equity swaps of RMB319.24 bn (or USD38.57)²².

Organizational Changes

From 1996, in order to improve efficiency, the state banks began their organizational restructuring by combining provincial branches with municipal branches in provincial capitals, and closing down those county sub-branches or deposit taking outlets that either made losses or did not fit into the overall strategy. From 1998, all of these banks except the Agricultural Bank of China adjusted their organizational structure to facilitate a gradual shift in the priority of their services towards large and medium-sized enterprises based in large and medium-sized cities. Between 1998 and 2002, these banks reduced the branches by 55,324, either through closure or merger, and cut staff by 362,900²³.

Joint-stock Reform

A three-stage reform plan for the state-owned commercial banks has been in operation since 2002. According to this plan, the comprehensive reform would proceed in steps in accordance with the principles of good corporate governance. At the first stage, the state-owned commercial banks would be supervised as state-owned financial intermediaries and participants in the money market to improve their institutional setup as state-owned companies. At the second stage, they would be transformed into state-controlled joint-stock commercial banks by joint-stock restructuring. Finally, they would be listed on the stock exchange at an appropriate time.

The objective for the joint-stock reform of the four state-owned commercial banks is to transform the banks into internationally competitive joint-stock commercial

²² The debt-equity swap programme makes the AMCs the owners of the borrowing enterprises instead of their creditor. In practice, the AMCs receive loans from the central bank and purchase the creditor's rights to enterprises at face value from respective commercial banks, then swap them into equity of enterprises. Finally, all the AMCs shall exit from the enterprises and repay the PBC lending by selling equity and through other means.

²³ www.pbc.gov.cn/english/speeches and *Almanac of China's Finance and Banking* (2003, p. 66).

banks with adequate capital, strict internal controls, safe and sound business operations, quality products and services as well as desirable profitability, within the transitional period provided by China's WTO agreement. To this end, this reform shall focus on improving the banks' management systems and corporate governance, transforming their operating mechanisms and hence boosting their profitability. This reform will be carried out in a manner that each bank formulates and implements its own reform policies and strategies (Tang, 2004).

The joint-stock reform of the state-owned commercial banks was initiated in late 2003 with a massive capital injection of USD45 bn (or RMB372.47 bn) into the two pilot banks, the Bank of China and China Construction Bank. In order to secure the success of the pilot reform, *The Guidelines on Corporate Governance Reforms and Supervision of Bank of China and China Construction Bank* was formulated and implemented in March 2004. According to the *Guidelines*, the two banks should meet a number of specific targets set out by the China Banking Regulatory Commission (CBRC) before 2007. Ten guidelines for building up sound corporate governance and a number of benchmarks to assess the performance of the two banks in terms of their profitability, asset quality and prudent operations were stipulated in the *Guidelines* in particular²⁴.

2.4.3 Transformation of Medium and Small-sized Commercial Banks

During the first stage of the banking reform (1979-1993), most of the medium and small-sized commercial banks were regional banks. In addition, some of them only had one owner. To encourage greater competition, these banks became national joint-stock commercial banks in 1993. For instance, when established in 1992, the Hua Xia Bank (HXB) was fully owned by the Capital Iron and Steel Company, which capitalized the bank with equity of RMB1 bn (or USD0.17 bn). In March 1995, HXB changed to a national joint-stock commercial bank held by thirty-three owners with an expansion of registered capital to RMB2.5 bn (or USD0.3 bn).

²⁴ For details of the *Guidelines*, please see Appendix 2.4.

The China Everbright Bank (CEB) completed its joint-stock-restructuring programme in 1996. Through restructuring, the CEB has transformed itself from a commercial bank wholly owned by China Everbright Group Limited (CEGL) into a joint-stock commercial bank, 51 percent owned by CEGL, 49 percent owned by 130 domestic enterprises and institutions as well as the Asian Development Bank (ADB). With capital restructuring, CEB added RMB2.4 bn (or USD0.29 bn) to its capital base, raising its total capital to RMB4.4 bn (or USD0.53 bn).

In January 1993, a new joint-stock commercial bank, the Shanghai Pudong Development Bank (SPDB) was created, followed by the China Minsheng Banking Corporation (CMBC) in January 1996, becoming China's first national joint-stock commercial bank with participation mainly from non-state enterprises. By the end of 2002, some shares of four national joint-stock commercial banks were listed on the stock exchange, including SDB, SPDB, CMBC, and CMB. The total capital equity of the ten national joint-stock commercial banks increased from RMB48.49 bn (or USD5.84 bn) in 1996 to RMB104.23 bn (or USD12.59 bn) in 2002²⁵.

Although most of the medium and small-sized commercial banks are joint-stock, they are still largely owned by the government via local governments and state-owned enterprises. The state holds more than 50% of the shares in all joint-stock banks, with one exception, the CMBC (Xie and Jiao, 2002)²⁶. The Chinese joint-stock ownership scheme differs from privatization in other developing countries. Privatization implicitly assumes capitalistic private ownership, but, under the joint-stock ownership scheme, the state is still a majority shareholder of the firm, thus preserving communism's public ownership principle (Sun, Tong, and Tong, 2002). However, this raises the issue of how much the state controls these banks and whether their behaviour differs from the state banks.

²⁵ *Almanac of China's Finance and Banking* (2003).

²⁶ For the definition of various shares issued in the stock exchange markets in China, please see Appendix 2.3.

As indicated by Tang (2004), the four state banks have made remarkable contributions to China's economic development. These banks provided the needed funding and support for numerous development and infrastructure projects, regional development, and general investment policies. China has lacked the private capital to fund such projects because of 50 years of communism, where the state assumed responsibility and provided the capital. It is only just recently that the State Council accepted the principal of private ownership (at the Third Plenary Session of the 16th Central Committee of the Communist Party of China in October 2003). The country's private equity markets are still in an embryonic stage and can play only a modest role when it comes to raising finance. Second, these banks were central to economic and social restructuring campaigns and assumed part of the associated cost. For example, they assisted state-owned enterprises with mergers or bankruptcy liquidation. Finally, the four banks have subsidized student education, and programs for finding unemployed workers new jobs, and other social undertakings as part of the policy of "employment and education to all". Given their particular role in the banking system, the state banks were subject to the "soft" budget constraints²⁷.

Therefore, although the joint-stock banks are effectively owned by the state, the issues of social welfare objectives and "soft" budget constraints are more applicable to the state banks than the joint-stock banks. The joint-stock banks were also expected to assist with the implementation of state policy – especially in the early days – but it was far less pronounced.

2.4.4 Rectification of Credit Cooperatives

The urban and rural credit cooperatives (UCCs, RCCs, respectively) played an important role in supporting the development of small and medium businesses. However, due to a lack of risk management skills, and even defiance of relevant laws and regulations, many UCCs and RCCs incurred severe losses and some of them ended up becoming insolvent. For example, by the end of 1996, the net loss

²⁷ The budget constraint of a firm means that the firm cannot spend more than its wealth.

of all UCCs reached RMB0.73 bn (or USD0.09 bn). There were 26,000 RCCs running in the red, with reported losses of more than RMB14 bn (or USD1.68 bn) in the same year (Lardy, 1999). The ratio of non-performing loans over total loans of all RCCs stood at 38%²⁸.

To solve these problems, the credit cooperatives (CCs) were reorganised in 1995. One major way was to merge and transform the UCCs into city commercial banks. City commercial banks were established in 1995 through the merger of urban credit cooperatives with shares held by urban enterprises, residents and local government. These are local shareholding commercial banks, but their business is limited to small- and medium-sized enterprises (SMEs) in the cities where they are located. Between 1995 and 2002, more than 2,000 urban credit cooperatives were reorganized into 111 city commercial banks, which had 4,961 outlets and 107,913 employees²⁹.

Reform of the rural credit cooperatives is important for agricultural development in China. Therefore, in 1996, the PBC took over supervision of RCCs from the Agricultural Bank of China (ABC). Three rural commercial banks were established by merging the RCCs in 2001, on a trial-basis. All are located in Jiangsu Province, a relatively developed agricultural province. They are owned by local non-state owned enterprises and the staff of the merged RCCs, making them the first group of truly “private” banks (Liu, 2002).

Insolvent credit cooperatives were also closed. In 1997 and 1998, the PBC closed 23 insolvent UCCs and 18 insolvent RCCs (Liu, 1999). At the end of 2002, there were only 758 UCCs, a fall of 81% since 1992. The number of RCCs fell but less dramatically, leaving 35,544 at the end of 2002, a fall of 33% since 1992³⁰. The RCCs have become the key providers of financial services in the rural areas and play an increasingly important role in supporting rural economic development,

²⁸ *Almanac of China's Finance and Banking*, 1997.

²⁹ *Almanac of China's Finance and Banking*, 2003.

³⁰ *Almanac of China's Finance and Banking*, 2003.

and hence improving the living standards of the rural population³¹.

2.4.5 Treatment of Foreign Banks

Rapid Development of Foreign Banks before China's WTO Accession

Between 1993 and 2001, the PBC introduced a series of measures to accelerate the development of foreign banks in China. Table 2.2 illustrates the major changes during this stage: it indicates that controls over foreign banks were eased gradually in terms of location, scope of business, and clients. The major achievement at this stage was allowing foreign banks to engage in RMB business. The geographic scope of the operation of foreign banks was also enlarged.

Table 2.2 Opening of China's Banking Sector (1993-2001)

Time	Events
Feb. 1994	Introduction of the <i>Regulations of the People's Republic of China on Administration of Foreign-funded Financial Institutions</i>
Apr. 1996	Introduction of the <i>Implementation Rules for the Regulations of the People's Republic of China on Administration of Foreign-funded Financial Institutions</i> , and the <i>Rules on Administration of Representative Offices in China Established by Foreign-funded Financial Institutions</i> .
Dec. 1996	From December 1996 to December 2001, the PBC approved 31 foreign banks in Shanghai Pudong and Shenzhen to conduct RMB business with foreign firms.
Apr. 1998	The PBC allowed eight foreign banks handling RMB business in Shanghai Pudong to enter the inter-bank lending market of China.
Jan. 1999	Foreign banks were allowed to operate branches and representative offices in any major cities in China, subject to the approval of the PBC.
Jul. 1999	Foreign banks in Shanghai and Shenzhen were allowed to do business in adjacent provinces or autonomous regions.
1999	1. Foreign banks were allowed to participate in RMB loan syndication for Chinese businesses. 2. The ratio of total RMB debt to foreign exchange debt for foreign banks was raised from 35% to 50%. 3. Foreign banks could borrow long-term RMB funds from domestic banks in domestic inter-bank lending market. 4. Foreign banks were permitted to raise funds through the issue of transferable deposit certificates at an appropriate time.

Sources: *Almanac of China's Finance and Banking (1994-2002)*

³¹ www.pbc.gov.cn/english/speeches/

China's WTO Commitments and the Banking Sector

On 11 December 2001, China joined the WTO after 16 years of negotiations. According to China's WTO commitments, China will phase out restrictions on foreign banks. Table 2.3 illustrates the major commitments made by the Chinese government on opening the banking sector. All the non-prudential restrictions on ownership, and operational and organizational setup, including restrictions on number of branches and licenses, will be removed by 2006. Foreign banks will enjoy "equal treatment" in China, meaning that they will be treated no differently from the domestic banks³².

Table 2.3 WTO Commitments on the Banking Sector

Activities subject to restriction	1. Deposits & lending 2. Financial leasing 3. Settlements & remittances 4. Guarantees and commitments	
Licensing restrictions	2001—1. Total assets more than \$10 billion to establish subsidiary or joint venture. 2. Total assets more than \$20 billion to establish a branch. 3. Further licensing requirements to engage in RMB business are 3 years business operations in China, being profit making for 2 consecutive years prior to the applications. 2006— All licensing restrictions removed.	
Other restrictions	Geographic restrictions	Customer restrictions
RMB business	2001 Shenzhen, Shanghai, Dalian, Tianjin. 2002 As in 2001 plus Guangzhou, Zhuhai, Qindao, Nanjing, Wuhan. 2003 As in 2002 plus Jinan, Fuzhou, Chengdu, Chongqing. 2004 As in 2003 plus Kunmin, Beijing, Xiamen 2005 As in 2004 plus Shantou, Ningbo, Shenyang, Xian. 2006 No geographic restrictions.	2001 Foreign enterprises & Overseas citizens 2002 2003 All firms. 2004 2005 2006 No customer restrictions.
Foreign exchange business	No restrictions since 11/12/2001. (Foreign banks can conduct foreign exchange business with all the customers in the country.)	

Sources: Bonin and Huang (2002, p.1079) and Almanac of China's Finance and Banking (2002, p.384)

To comply with China's commitments to the WTO, the PBC adopted numerous measures to open up China's banking sector. First, the PBC formulated the legal

³² Almanac of China's Finance and Banking, 2002.

foundations for the operation of foreign banks. Restrictions on the operations of foreign banks in China are gradually being lifted. Since December 2001, foreign banks can offer foreign exchange services to all customers, including Chinese enterprises and individuals. By 2002, about 70 foreign banks in China had started to increase and provide foreign exchange services.

In addition, since December 2001, the foreign banks in Shanghai, Shenzhen, Tianjin and Dalian have been allowed to engage in RMB banking business. The same privileges were extended to the foreign banks in Guangzhou, Zhuhai, Qingdao, Nanjing and Wuhan from December 2002. This brought the total number of cities where foreign banks could conduct RMB business to nine, which is consistent with the WTO commitments. Meanwhile, the PBC further standardised and simplified the market entry and exit procedures for foreign banks.

2.4.6 Other Comprehensive Banking Reform Measures

In addition to those discussed in previous sections, additional reform measures were undertaken in the banking sector. They included: (1) separation of commercial and investment banking business; (2) promulgation of the Commercial Bank Law; (3) the introduction of asset-liability management; (4) improvement of external supervision; (5) development of an inter-bank market; (6) interest rate deregulation.

Separation of Commercial and Investment Banking Business

Until 1993, most Chinese banks engaged in universal banking by setting up affiliated securities, trust, and/or insurance companies. Universal banking was believed to be a source of financial instability (Wu, 1998), though there is little hard evidence to support this. At the beginning of 1993, the authorities separated the activities of commercial banks, securities, and insurance firms, citing a number of reasons.

First, the financial market in China has not matured enough - bank financing still represented over 85% of all financing activities nationwide. Second, the internal risk management level was weak, and, until there were better systems in place, universal banking was considered inappropriate in China. Third, the central bank lacked experience in financial regulation³³.

It was argued that the separation could prevent contagion from spreading across different industries such as banking, securities and insurance. Moreover, it could prevent large volumes of funds from being used for speculation on the capital market via the banking system. Finally, it could prevent non-bank financial institutions from gaining unfair competitive advantages by affiliating with banks. Accordingly, the supervision of these industries is also segregated³⁴.

Promulgation of the Commercial Bank Law

In May 1995, *the Commercial Banking Law of the People's Republic of China (the Commercial Bank Law)* was enacted³⁵. The new law further strengthened the legal status of the commercial banks, and stipulated that commercial banks shall operate independently, bear risks on their own, and take responsibility for their own profits and losses.

The Introduction of Asset-liability Management

In 1996, the commercial banks began to introduce asset-liability management to ensure sound operations in line with the state industrial and regional development policies as well as state credit guidelines. However, credit allocation in China was still mainly based on a mandatory credit-quota system under which the PBC set the credit ceilings on new annual loans and allocated them to specific sectors. This system meant that banks could not lend according to commercial considerations.

³³ One reason for the recent division of regulation and central banking is to improve regulatory standards.

³⁴ Since 2003, the China Banking Regulatory Commission has taken over the function of bank supervision from the PBC.

³⁵ *Almanac of China's Finance and Banking* (1996).

In January 1998, the credit ceilings on commercial banks were completely replaced by asset-liability management techniques together with an indicative, non-binding target, which serves only as a reference for commercial banks to plan their business.

Improvement of External Oversight

External inspections have been strengthened and the self-discipline system has been improved. Since 2000, the system of state dispatched supervisory boards³⁶ has been in place and the supervision of state banks has been strengthened. The China Association of Banks (CAB) was established to encourage discipline within the banking sector. The CAB had 27 member banks by the end of 2001, of which 4 are wholly state-owned commercial banks, 3 are policy banks, 10 are shareholding commercial banks, and 10 are city commercial banks. External auditing has been introduced by permitting outside intermediary agencies to supervise bank statements.

Development of Inter-bank Market

China has an inter-bank money market. It emerged in the mid-1980s, consisting of small markets located in different provinces. In January 1996, a centralized inter-bank money market was created and the China Inter-bank Offered Rate (CHIBOR) was initiated. Since then, the inter-bank money market has developed very quickly, and has mainly consisted of the inter-bank lending market, the repurchase agreements market, and the commercial paper market. By the end of 2000, the transaction value of this market reached RMB2,315 bn (or USD19,164 bn), an increase of 216 percent compared to 1999 (Shi, 2001). The inter-bank money market has become the major trading place for banks to manage their liquidity positions.

³⁶ The state dispatched supervisory boards are composed of representatives from the PBC, Ministry of Finance, State Economic and Trade Commission, State Auditing Commission and also economists and legal experts. The supervisory boards exercise supervision of state-owned banks on behalf of the state. They comprehensively evaluate financial conditions, risk control mechanisms and the performance of the management of the banks (People's Bank of China, 1999).

In addition, China established an inter-bank bond market in June 1997. Banks are allowed to conduct repo and spot transactions of government securities and financial bonds issued by policy banks. The inter-bank bond market has grown very fast and has become the important platform for the open market operation of the central bank.

Interest Rate Deregulation

In accordance with the government policy of gradually introducing a market determined interest rate system based on the central bank rate, the PBC has taken important steps to liberalize interest rates³⁷. In 1995, the *PBC Programme of Deepening Interest Rate Reform during the Ninth Five-year Plan Period* marked the beginning of interest rate liberalisation. The general approach to interest rate liberalisation is to liberalise the foreign currency interest rate before that for domestic currency, the lending rate before the deposit rate, and the large and long term funds before the small and short term funds³⁸.

- From June 1, 1996, the inter-bank money market rate was freely determined by market supply and demand.
- In June 1997, the rates for both repurchase and outright security transactions in the inter-bank bond market were liberalised.
- In March 1998, the pricing mechanism for the rediscount rate and the discount rate was reformed and liberalised.
- In September 1998, policy financial bonds were floated on the market and the yield was determined by the market.
- In September 1999, state bonds were issued through public tendering on the inter-bank bond market.
- In October 1999, the interest rate for large fixed-term deposits by insurance companies became negotiable, i.e., the interest rate on insurance company

³⁷ In 1993, the *Decision on Certain Issues Pertaining to the Development of Socialist Market Economic System* and the *State Council Decision on Financial System Reform* drew the original blueprint for interest rate liberalisation.

³⁸ People's Bank of China, 2003b.

deposits that exceeded RMB 30 million with a maturity of more than 5 years could be negotiated between the insurance companies and the commercial banks.

- The lending rate band was widened and interest rate categories simplified. In 1998, lending rates to small enterprises were allowed to widen from 10 to 20 percent of the central rate. Rural credit cooperatives were allowed a lending rate band of 50 percent of the central rate, up from 40 percent. From 1999, financial institutions below the county level were allowed to raise the lending rate by 30 percent. The original 30 percent band for small enterprises now applied to medium-sized enterprises as well. Interest rate categories continued to be simplified and most of the interest subsidy was eliminated. The mortgage rate system was improved.
- Foreign exchange interest rate administration was reformed on September 21, 2000. The foreign exchange lending rate was liberalised. Interest rates for deposit of over USD3 million could be negotiated between the financial institution and the depositor. After March 2003, small foreign exchange deposits by Chinese residents with foreign banks should be the same as those with domestic banks so that domestic and foreign financial institutions enjoy fair treatment with regard to the interest rate policy of foreign exchange deposits.
- In 2002, interest rate reforms for rural credit cooperatives were expanded. The interest rate administration for foreign exchange was the same for domestic and foreign financial institutions.

2.4.7 Non-performing Loans

The Loan Classification Systems

In China, there was little effort to classify bank loans by quality in the 1980s. In 1993 and 1994, each of the major banks used its own system and standards for classifying non-performing loans (NPLs). However, these procedures were largely futile because the central bank set ceilings on the portion of loans that could be

classified, regardless of the actual quality of a bank's loan portfolio³⁹. In 1995, the central bank set forth the loan classification system formally, and classified NPLs into three types, based on payment status. These included past due loans, doubtful loans, and bad debt. "Past due loans" refers to loans not repaid when due or not repaid after the due date has been extended. "Doubtful loans" includes loans that have been past due two years or more or loans that have been extended to a borrower who has suspended production or whose project is no longer being developed. "Bad debt" refers to the value of a loan that has not been repaid after the borrower has been declared bankrupt and gone through liquidation⁴⁰.

However, as indicated by Lardy (1998), this scheme was far more lenient than those prevailing in the modern banking systems for three reasons. First, these banks were allowed to delay classifying loans as non-performing. The amount of time during which delay of repayment was allowed was longer and the classification of loans was usually tied to failure to repay principal instead of interest. Second, these banks considered each loan separately. They would not simultaneously classify the entire sum of all loans outstanding to that particular borrower when they classified any loan as past due. Lastly, the banks had little authority to write off loans they had extended to enterprises that were liquidated⁴¹. Thus, they had to delay the complete write-off of loans not repaid from the proceeds of the liquidation of a borrower.

A risk-based five-category loan classification system was introduced for the commercial banks in 1998, and was implemented in all banks in China from the beginning of 2002. This system uses international standards, dividing banking loans into five categories: normal, special mention, substandard, doubtful and

³⁹ The central bank dictated that the specialized banks could classify no more than 2% of all their loans as "bad debt", that is, the volume of loans not recoverable from the proceeds from bankruptcy and liquidation; no more than 5% as "problem loans" referring to loans on which interest is still being paid but for which principal repayments are more than three years past due; and a maximum of 8% as "of concern" referring to borrowers who were more than one year behind on principal repayments (Lardy, 1998, p.115-116).

⁴⁰ People's Bank of China, 1995.

⁴¹ Since 1992, the banks could write off loans of less than a half billion yuan. However, larger amounts required specific approval from the State Council (Lardy, 1998).

lost⁴². Moreover, the banks have been given more discretion to write off losses since the *Guidance on Provisioning for Bank Loan Losses* was implemented in 2002⁴³. These changes are clearly an advance in credit risk management.

Non-performing Loans

The substantial and growing amount of non-performing loans (NPLs) has become the most serious problem in China's banking sector since the middle of the 1990s. Just before he became governor of the central bank in June 1995, Dai Xianglong revealed that the ratio of non-performing loans to total loans (NPL ratio) of the four state banks had been rising by 2 percentage points per annum from 1993 to 1995. This assessment was confirmed by the deputy director of the Planning and Information Department of the ICBC in early 1996. According to his statement, the NPL ratio of the big four banks at the end of 1994 was estimated to be 20.4%, increasing by 2% in 1995.

Table 2.4 shows the official reported NPLs based on the old (payment-based) loan classification system for the two types of commercial banks over the period 1993-2002. The pre-1998 data for the joint-stock banks are not available. NPLs of the state banks increased four-fold between 1993 and 1999. Their NPL ratio also doubled during that period, but fell between 1999 and 2002. The large, 10% decline from 1999 to 2000 was due to the establishment of the asset management companies (AMCs). The NPL ratio of joint-stock commercial banks also declined over the same period, although their NPLs still increased by 44%.

These figures are significant underestimates because of the leniency of China's old loan classification system compared with standard international practice. Also, these banks usually excluded inter-bank and trust lending, as well as credit that was concealed in their balance sheets as "other items"⁴⁴. Independent analysts' estimates of the NPL ratio of the state banks are as high as 50% to 60% (Whalley,

⁴² For details, please see Appendix 2.5.

⁴³ www.pbc.gov.cn/quanwenjiansuo/detail.asp?col=cinwen&ID=387&keyword

⁴⁴ The PBC acknowledged the bias in 2001 (*Almanac of China's Finance and Banking*, 2002).

2003).

Table 2.4 Non-performing Loans: State-owned vs. Joint-stock Banks

Unit: billion RMB

Years	State-owned Commercial Banks		Joint-stock Commercial Banks	
	NPLs	NPL ratio	NPLs	NPL ratio
1993	534	18%	NA	NA
1994	674	20.4%	NA	NA
1995	864	22%	NA	NA
1996	1095	23%	NA	NA
1997	1280	24%	NA	NA
1998	1808	29%	NA	NA
1999	2541	38.88%	149	20.77%
2000	1866	29.18%	153	16.36%
2001	1772	25.37%	164	12.94%
2002	1706	21.41%	215	12.39%

Sources: Jiang (2001, p.69, 134); Almanac of China's Finance and Banking (1994-2003)

Note: NPL ratio: the ratio of non-performing loans to total loans.

Lardy (1998) claimed that most of the NPLs were not inherited from the pre-reform period, 1949-1978, but that the problem arose in the 1990s as a by-product of the gradual strategy. Under this strategy, the state banks were required to make policy loans to prop up the loss-making state-owned enterprises (SOEs), in order to avoid a decline in output and an increase in unemployment. The profits of state-owned industrial enterprises fell from around 7% of GDP in 1987 to only 2% by 1994. In the first quarter of 1996, the SOEs as a whole reported losses for the first time ever. The absolute level of enterprise losses reached a record high of almost RMB80 bn (or USD9.64 bn).

As indicated by Lardy (1998) and others, the explanations for declining financial performance of the SOEs include:

- (1) The erosion of monopoly power and abnormal profits due to the rapid expansion of non-state enterprises.
- (2) Accounting reforms. The introduction of the modern accounting rules in 1993 required the adoption of accrual accounting instead of cash-based accounting. This led to more accurate accounting of interest expenditures, which meant that the profits of the SOEs in earlier years were overstated.
- (3) Excessive wage payments. With insider control, SOE managers might ignore

the interests of the state and pay workers too much. The growth of total compensation (wages plus various subsidies and benefits) outstripped the growth of labour productivity, contributing to a decline in profitability.

- (4) Excess employees. SOEs were required to employ redundant workers to help the government to maintain full employment in urban areas.
- (5) Excessive social expenditures. SOEs not only provided subsidized housing for most of their workers, but also shouldered substantial costs for education and health.
- (6) Asset stripping. That is, the illegal transformation of state assets to non-state enterprises via “false bankruptcies” by SOE managers.

Tang (2004) indicated that the accumulation of NPLs by the state banks was only partly explained by these banks’ rigid mechanisms, weak internal management and external regulation. Other factors were also important. First, the enterprises were heavily dependent on bank loans because other forms of financing in China were non-existent or underdeveloped. Second, the four state banks were expected to engage in “directed lending”, i.e., making loans to support government industrial policies, system transition and the restructuring of the state-owned enterprises. Third, the banks were faced with debt evasions by borrowing firms. Finally, there were deficiencies in accounting practice that allowed false profit reporting. Thus, the losses of these four banks represent the cost incurred by China in the transition towards a market-oriented economic system.

Wu (1999) argued that directed lending to the loss-making SOEs can only explain the NPLs accumulated in the 1980s. Most of the NPLs initiated in the 1990s were in the form of failed investments in real estate and the financial market. This suggests that, in addition to the loss-making SOEs, bad lending decisions by the banks themselves also contributed to the substantial NPLs.

In summary, compared to the first stage of banking reform, reform during the second stage was a mixture of deregulation and new regulations. Competition among banks has been increased by gradually introducing more banks to the

sector. In addition, China's WTO accession means that there should be a greater involvement of foreign banks than ever before, which will lead to intensified competition in the sector. On the other hand, banks have been given more autonomy and chances to improve their performance by commercialising the state-owned specialized banks, removing the credit ceiling, developing the inter-bank market and liberalizing interest rates marginally.

In addition to this structural and conduct deregulation, new regulations, such as the segmentation of commercial and investment banking business, have also been introduced to the banking sector during this stage. This has limited the services and products that the banks could offer, which has reduced their opportunities to improve their performance. In response to these changes, banks have attempted to adopt strategies aimed at improving efficiency, and hence competitive capability. The strategies include the streamlining of the state-owned banks, the expansion of the joint-stock banks, the diversification of portfolios, innovation in off-balance-sheet activities, and, more recently, the joint-stock reform of the state banks.

The second stage reform was profound, but the high proportion of non-performing loans poses a substantial challenge to the sector during the second stage of reform. Therefore, most of the reform measures of this stage also aimed at resolving this critical problem. These measures included the separation of the commercial and investment banking business, the re-capitalization of the state banks, the abolition of the credit ceilings, the introduction of the risk-based loan classification system, and the establishment of the asset management companies. Although the Chinese banks have made a degree of progress in improving the quality of their loans, their average ratio of non-performing loans is still very high, suggesting that improving asset quality remains the major task for these banks.

While the state banks are wholly owned by the state, the joint-stock banks are also effectively owned by the state via local governments and state-owned enterprises. They are not private banks typical of the west. However, the issues of social welfare objectives and "soft" budget constraints are more applicable to the state

banks, given that they are the mainstream of China's banking sector, and directly controlled by the government.

2.5 China's Banking Sector: Descriptive Statistics

2.5.1 Institutional Structure of China's Banking Sector: 1992 vs. 2002

Table 2.5 shows changes in the institutional structure of the banking industry during the second stage of reform. First, the types of banks increased from 6 to 9. Three new types of banks were created, including city commercial banks, rural commercial banks, and policy banks. Second, the number of commercial banks increased from 74 to 308⁴⁵. Third, the ownership structure was diversified. Foreign ownership was introduced to the joint-stock commercial banks, and the truly private banks emerged. Fourth, universal banking was forbidden, and banks could only conduct commercial banking operations.

Despite the gradually increasing number of entrants, the banking sector is segmented. Generally, this sector can be divided into "four tiers" according to the differences in service areas among these banks (Xie and Jiao, 2002):

- State-owned commercial banks: operating domestically and internationally ⁴⁶;
- Joint-stock commercial banks: operating nationwide, mainly in the large and medium-sized cities;
- City commercial banks: operating in local cities;
- Urban and rural credit cooperatives and rural commercial banks: operating in local counties and rural areas⁴⁷.

⁴⁵ Commercial banks only include state-owned, joint-stock, city, rural, and foreign banks.

⁴⁶ By the end of 2002, domestic (Chinese) banks had set up 674 overseas operational banking institutions, including 610 or 90.5% set up by these big four banks. Total assets of all the overseas operational banking institutions reached USD 166.21 billion, out of which USD 147.42 billion or 88.7% was from these banks (*Almanac of China's Finance and Banking*, 2003).

⁴⁷ The service areas of foreign banks were between city commercial banks and the joint-stock commercial banks: some could only operate locally, while some could operate in the adjacent provinces.

Table 2.5 Institutional Structure of China's Banking Sector: 1992 vs. 2002

Bank Types		Numbers		Ownership		Functions	
1992	2002	1992	2002	1992	2002	1992	2002
Central Bank	Central Bank	1	1	State	State	Formulating and implementing monetary and credit policy through direct policy instruments; Supervising all the financial institutions.	Formulating and implementing monetary policy through indirect policy tools; Supervising financial institutions (exclude securities and insurance companies)*.
State-owned Specialized Banks	State-owned Commercial Banks	4	4	State	State	Universal banking business to both retail and wholesale customers all over the country.	Domestic and overseas commercial banking services mainly to large and medium-sized enterprises, and residents.
Medium and Small-sized Commercial Banks	Joint-stock Commercial Banks	8	10	State, collective, private	State, private, foreign	Universal banks for retail and wholesale customers, but operations combined in the large and medium-sized cities.	Commercial banking services mainly to enterprises and residents in large and medium-sized cities.
Rural Credit Cooperatives	Rural Credit Cooperatives	52,763	35,544	Collective, private	Collective and private	RMB banking services to rural households, collective enterprises, and township and village enterprises.	RMB banking services to small local enterprises and residents in rural areas.
Urban Credit Cooperatives	Urban Credit Cooperatives	4,001	758	Collective, private	Collective and private	RMB banking services to collective and private enterprises and households in the located city.	RMB banking services to small local enterprises and residents in urban areas.
Foreign Banks	Foreign Banks	62	180	Foreign-funded; joint-venture	Foreign funded; joint-venture	Foreign exchange banking services to foreign investment enterprises and foreign citizens in 13 cities.	Foreign exchange banking business to both residents and non-residents all over the country; RMB banking business to non-residents in 9 cities.
	City Commercial Banks		111		State, private, foreign		Commercial banking services to medium and small-sized local enterprises, and residents in cities.
	Rural Commercial Banks		3		Private		Commercial banking services to medium and small-sized local enterprises, and residents in rural areas.
	Policy Banks		3		State		Policy lending; Funds mainly come from the issuance of financial bonds and loans from the PBC.

Sources: *Almanac of China's Finance and Banking (1986-2003)*

Note: * China Banking Regulatory Commission has taken over the function of supervision from the PBC since 2003.

Therefore, although the increasing number and types of banks could enhance competition generally, the segmentation of the banking sector might lead to a distorted picture. That is, intensified competition exists in the large cities in which the state-owned banks, joint-stock banks, city commercial bank, and foreign banks all have branches, whereas there is little competition or even a monopoly in the poor rural areas (Xie, 2001)⁴⁸.

2.5.2 Market Structure of China's Banking Sector: 1992 vs. 2002

Table 2.6 summarizes the market structure of China's banking sector. At the end of 2002, total assets of the banking sector amounted to RMB6,785.14 bn (or USD819.74 bn), an increase of 128% over the figure of 1992. Total deposits and total loans reached RMB5,097.29 bn (or USD615.82 bn) and RMB4,091.93 bn (or USD494.36 bn), an increase of 238% and 169%, respectively. In terms of total assets, the market share of the state-owned banks fell from 84% in 1992 to 61% in 2002, whereas it had doubled for non-state-owned commercial banks since 1992⁴⁹.

In particular, the market share of joint-stock commercial banks increased by over 9 percentage points, which is consistent with the rapid expansion strategy adopted by these banks during this stage. The market share of the rural credit cooperatives hardly changed. The decrease of the market share of the urban credit cooperatives could be fully explained by the increase of the market share of the city commercial banks. Foreign banks had slight improvements in their market share. The figures on the market share in terms of deposits and loans also show the same trend as the asset figure.

⁴⁸ However, the data for bank branches in each city is unavailable, so detailed research on this issue is impossible at this moment.

⁴⁹ The non-state-owned commercial banks refer to joint-stock, city, and foreign banks. Rural commercial banks are not included in this table because the data is unavailable.

Table 2.6 Market Structure of China's Banking Sector: 1992 vs. 2002

(Unit: bn RMB)

Bank Types		Assets (% of total)		Deposits (% of total)		Loans (% of total)	
	2002	1992	2002	1992	2002	1992	2002
State-owned Specialized Banks	State-owned Commercial Banks	2,498.78 (83.89%)	4,143.89 (61.07%)	1,180.53 (78.24%)	3,395.10 (66.61%)	1,278.16 (84.17%)	2,399.14 (58.63%)
Medium & Small-sized Commercial Banks	Joint-stock Commercial Banks	133.28 (4.47%)	928.47 (13.69%)	85.55 (5.67%)	638.10 (12.52%)	68.10 (4.49%)	439.94 (10.75%)
Rural Cooperatives	Rural Credit Cooperatives	268.24 (9.01%)	669.16 (9.86%)	191.41 (12.68%)	601.19 (11.79%)	135.16 (8.89%)	421.59 (10.3%)
Urban Cooperatives	Urban Credit Cooperatives	60.80 (2.04%)	36.09 (0.53%)	45.64 (3.02%)	30.56 (0.6%)	27.37 (1.8%)	20.10 (0.49%)
Foreign Banks	Foreign Banks	17.64 (0.59%)	98.02 (1.45%)	5.71 (0.39%)	23.68 (0.46%)	9.86 (0.65%)	46.57 (1.14%)
	City Commercial Banks		329.85 (4.86%)		387.31 (7.6%)		252.73 (6.18%)
	Policy Banks		579.66 (8.54%)		21.34 (0.42%)		511.85 (12.51%)
Total		2,978.75	6,785.14	1,508.84	8,097.29	1,518.56	4,091.93

Source: *Almanac of China's Finance and Banking (1993, 1994, 2003)* and Liu (2000, p.266)

Note: All values are deflated by the CPI, with 1985 as the base year.

Taken together, China's banking sector is characterized by a decline in the market share of state-owned banks. In addition, increasing foreign bank presence, rapid expansion of the joint-stock banks, as well as transforming urban credit cooperatives to city commercial banks, indicate that market concentration is decreasing, and hence point to heightened competition among these commercial banks during the second reform stage.

2.5.3 State-owned vs. Joint-stock Banks: 1985-2002

Given that the state-owned commercial banks and the joint-stock commercial banks are the two major types of banks in China⁵⁰, and that their data are available for research, the study below concentrates on these two types of banks.

Composition of Banking Business: State-owned vs. Joint-stock Banks

Figure 2.1 (a) indicates that, starting in the mid-1990s, traditional banking activities (e.g., lending) have decreased in importance with investment (investing in treasury bills and other finance bonds), and off-balance-sheet activities (agent services⁵¹, letters of credit) have grown. The average ratio of total investment to total loans, for instance, increased from 12% in 1993 to 36% in 2002.

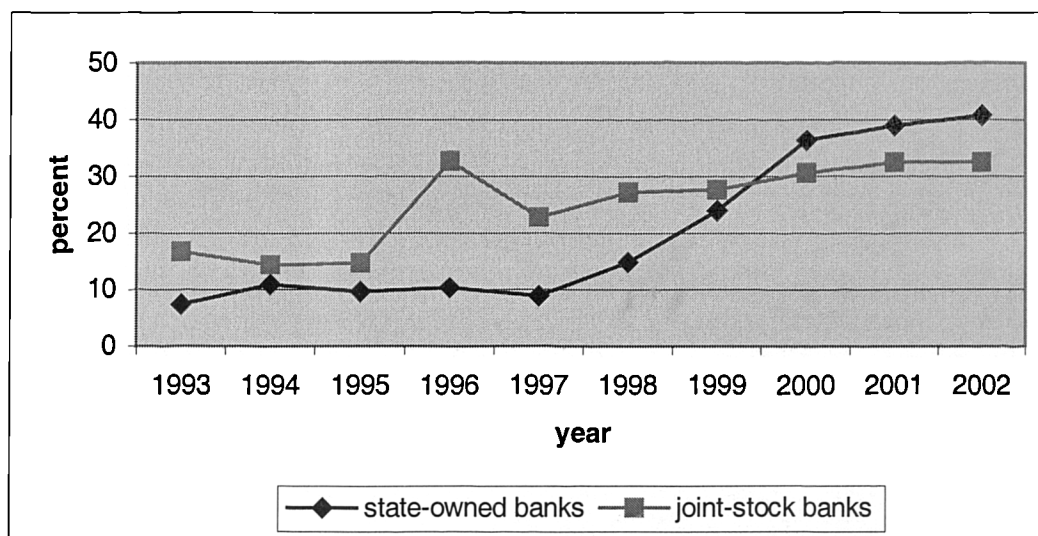
This ratio for state banks has grown faster than that of joint-stock banks since 1997, which means that the state banks took an active part in diversifying their portfolio by making more investments. On the other hand, this ratio has increased continuously for both types of banks, especially after 1997, reflecting the influence of the creation of a centralised inter-bank market in 1996, which provides an appropriate platform for these banks to diversify their assets.

⁵⁰ At the end of 2002, their market share of the entire banking sector (in terms of total assets) was 75%, and 93% if only the commercial banks are taken into account. The name list of the state-owned commercial banks and the joint-stock commercial banks are presented in Appendix 2.6.

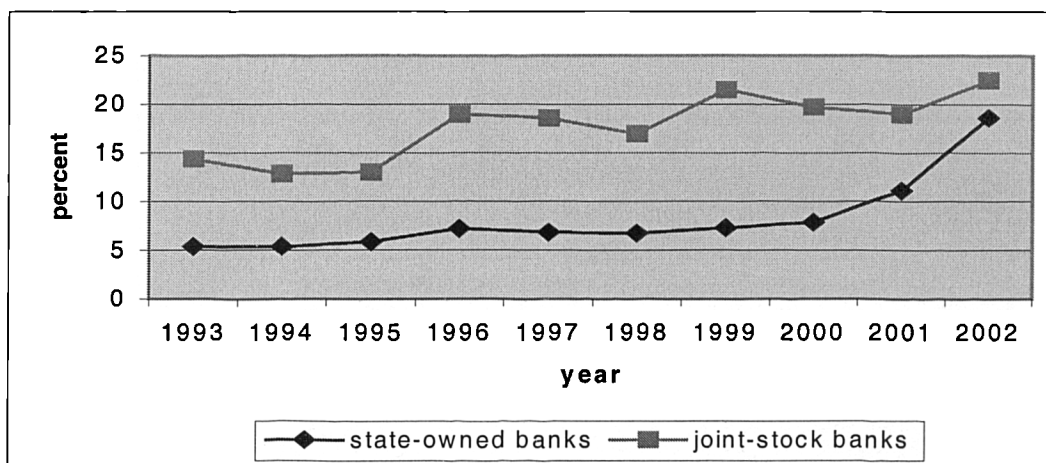
⁵¹ Agent services mainly refer to activities such as collecting and paying fees on a customer's behalf, acting as an agent for securities and insurance firms. For example, banks have affiliated with securities firms and opened telephone banking businesses that allow the clients to buy or sell stock using their deposits accounts. Also, banks can provide bank/security transferable accounts (Shi, 2001).

Figure 2.1 Composition of Banking Business: State-owned vs. Joint-stock Banks

(a) Ratio of Investment to Loans



(b) Ratio of Non-interest Income to Total Income



Sources: *Almanac of China's Finance and Banking (1994-2003)*

Notes: 1. All the figures are based on the mean value of the relative year.

Similarly, the average non-interest income to total income ratio, which captures the effects of fees and commission based services for banks, increased by about 247% in 2002 compared to the figure for 1993 (Figure 2.1 (b)). For joint-stock banks, this ratio is constantly higher than the state-owned banks, which means that the joint-stock banks took greater advantage of the off-balance-sheet activities than did the state banks.

Re-organisation: State-owned vs. Joint-stock Banks

Figure 2.2 (a) indicates that the fixed assets of the big four banks kept on increasing over the period 1985-2000, and dropped a little in 2001-2002. This reflects the influence of the closure of some non-profitable county-level sub-branches (offices) during this period.

Figure 2.2 (b) shows that, from 1996 to 2002, the average number of employees of these banks declined by nearly 19%. Both results show that the state commercial banks began to streamline their branches and staff as well as adjust their fixed assets structure during the second stage of banking reform.

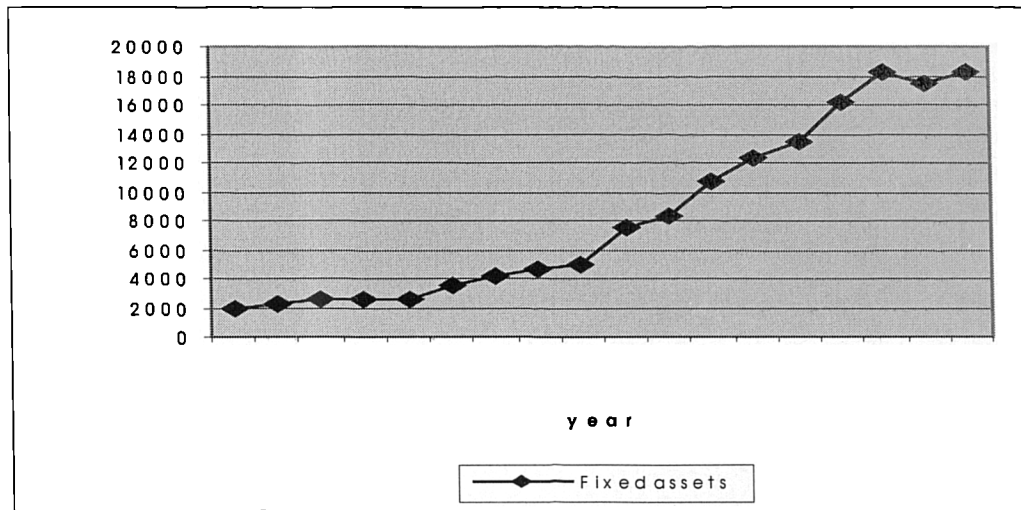
Figure 2.3 presents the development of fixed assets and the number of employees for the joint-stock commercial banks during the period 1987-2002. In contrast to the covered U shape of the graphs for the state banks, both measures for the joint-stock banks show an upward trend: their average numbers of employees increased by more than 94%, and the increasing rate of their average fixed assets was about 411% over the period 1993-2002. This result is consistent with the active expansion strategy adopted by the joint-stock banks during the second stage.

Operational Efficiency: State-owned vs. Joint-stock Banks

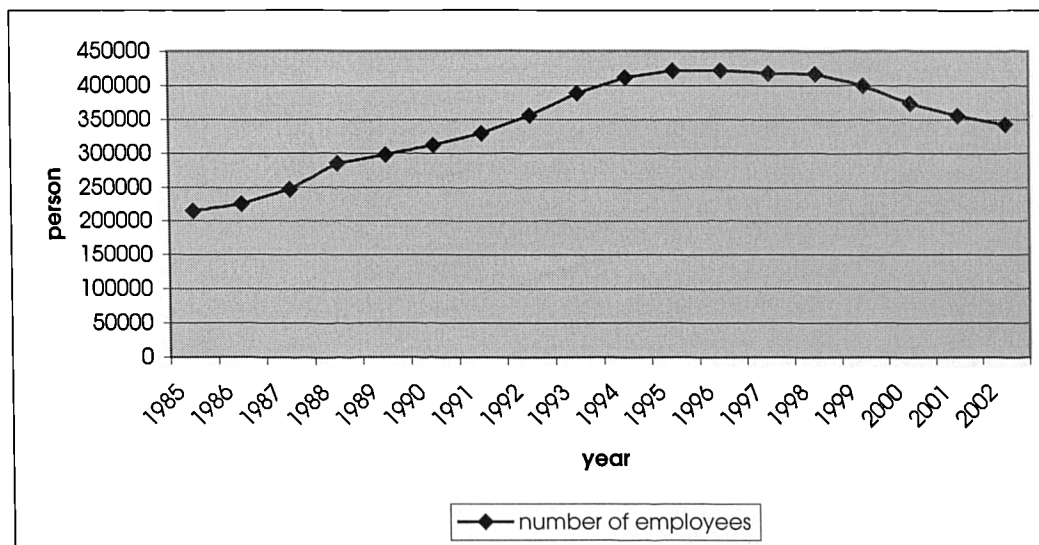
The cost to income ratio is a raw measure of operational efficiency, and the lower the ratio the higher the efficiency. Figure 2.4 shows that the trend in the cost to income ratios for both types of banks has been varied during the last two decades. Specifically, between 1985 and 1992, the state banks witnessed continuous efficiency losses, but, for the joint-stock banks, the trend was random. During the second stage, there were obvious efficiency improvements for the state banks, whereas the efficiency of the joint-stock banks hardly changed. Overall, the joint-stock banks have been more efficient than the state banks from 1985 to 2002.

Figure 2.2 Fixed Assets and Number of Employees of State-owned Banks

(a) Fixed Assets



(b) Number of Employees



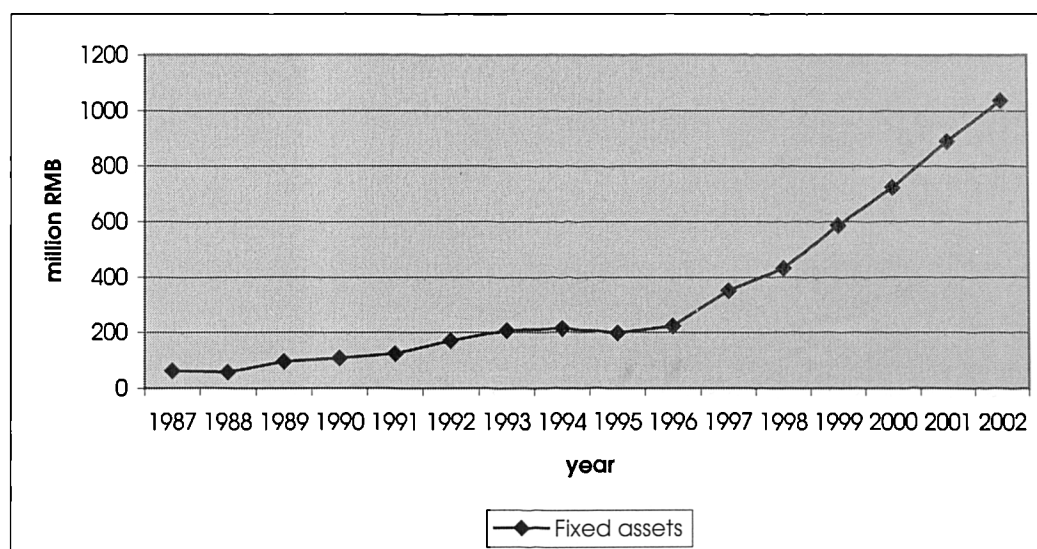
Sources: *Almanac of China's Finance and Banking (1986-2003)*

Note: 1. Values of fixed assets are deflated by the CPI, with 1985 as the base year.

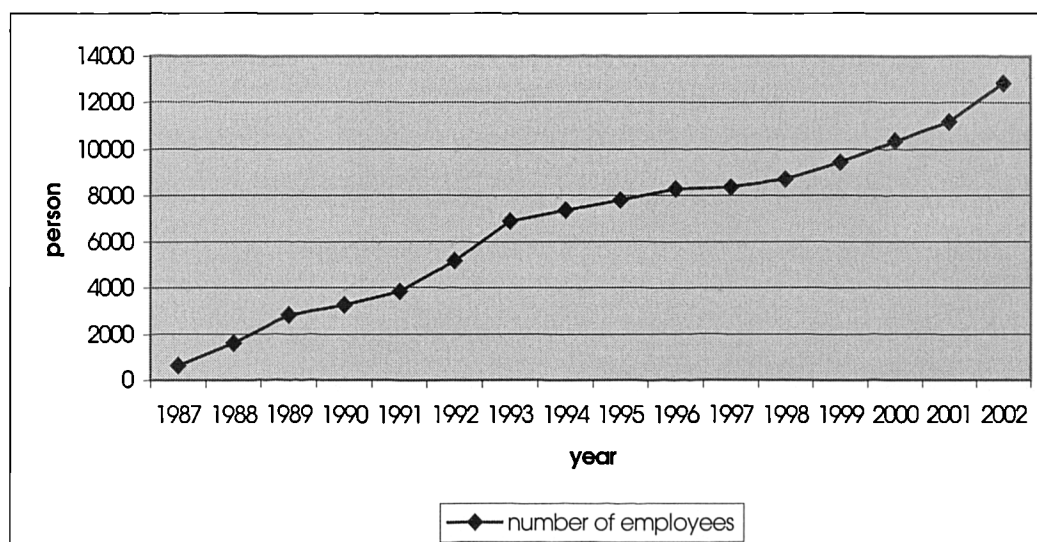
2. All the figures are based on the mean value of the relative year.

Figure 2.3 Fixed Assets and Numbers of Employees of Joint-stock Banks

(a) Fixed Assets



(b) Number of Employees

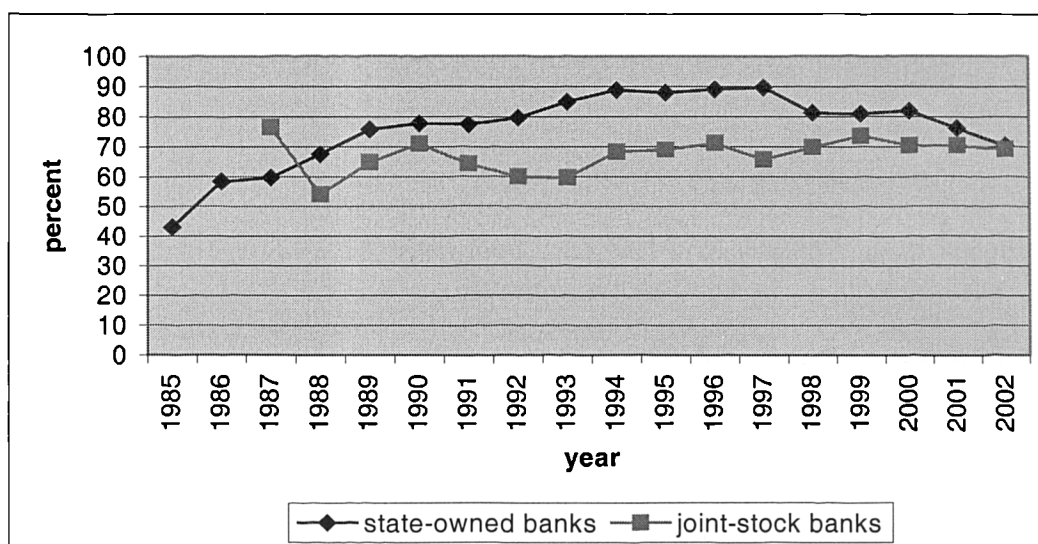


Sources: *Almanac of China's Finance and Banking (1988-2003)*

Note: 1. Values of fixed assets are deflated by the CPI, with 1985 as the base year.

2. All the figures are based on the mean value of the relative year.

Figure 2.4 Cost to Income Ratios: State-owned vs. Joint-stock Banks



Sources: *Almanac of China's Finance and Banking (1986-2003)*

Notes: 1. All the figures are based on the mean value of the relative year.

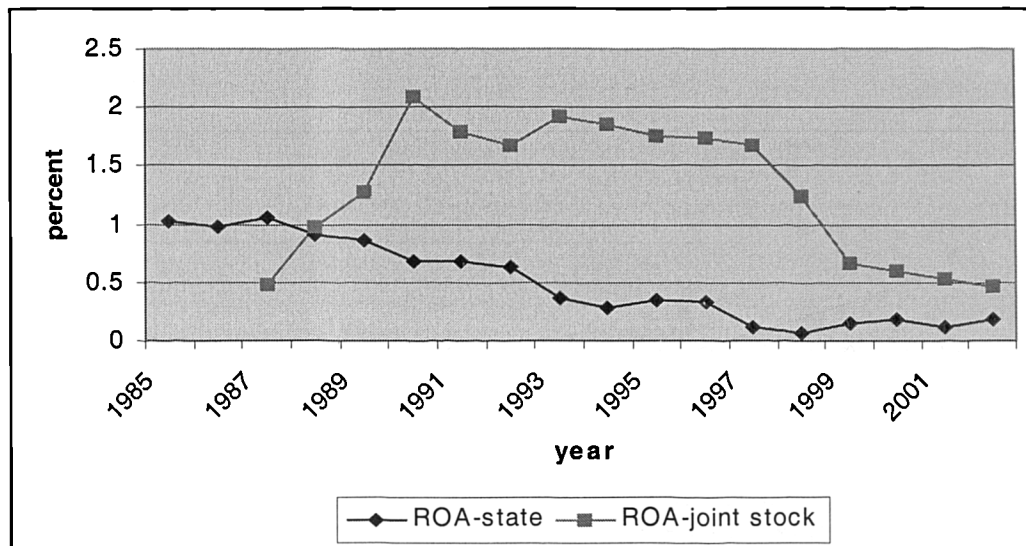
ROA and ROE: State-owned vs. Joint-stock Banks

Figure 2.5 (a) shows that the ROA of the state banks has fallen slowly but continuously since 1987, and reached the lowest point in 1998. The ROA of the joint-stock banks increased considerably before 1990, but again shows a declining trend afterwards. The ROA of the joint-stock banks has been higher than that of the state banks since 1988.

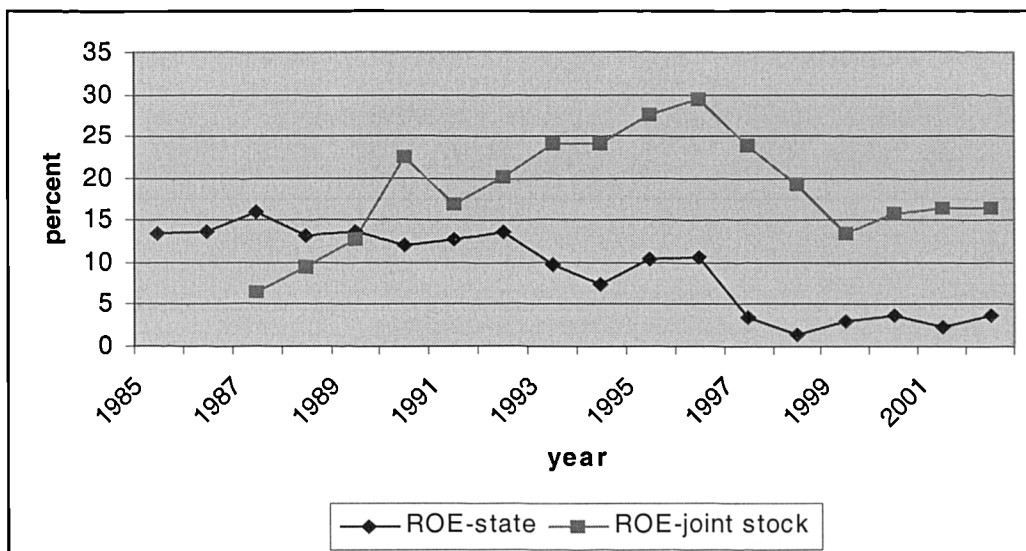
Figure 2.5 (b) shows that the ROE of both types of banks hardly changed during the entire period. However, the trend for state banks was basically downwards, whereas, for the joint-stock banks, the trend was roughly a reverse U-shape. The big drop after 1996 was probably due to a change of the taxation policy for financial enterprises, i.e., the rate of tax on turnover was raised from 5% to 8% (Xie and Jiao, 2002). The ROE of the joint-stock banks has been higher than that of the state banks since 1989.

Figure 2.5 ROA and ROE: State-owned vs. Joint-stock Banks

(a) ROA



(b) ROE



Sources: *Almanac of China's Finance and Banking (1986-2003)*

Note: 1. Return on assets (ROA) is the ratio of earnings to total assets. Return on equity (ROE) is the ratio of earnings to total equity. 2. In this study, pre-tax net income was used to calculate ROA and ROE instead of after-tax net income because of missing corporate tax figures. 3. Total equity (net worth) of the four state-owned banks refers to the paid-in capital, which corresponds closely to Tier 1 capital in the Basel Accord, plus retained profits and other surpluses to paid-in capital. Thus, it is roughly comparable to the sum of Tier 1 and Tier 2 capital (Lardy, 1999). 4. All the figures are based on the mean value of the relative year.

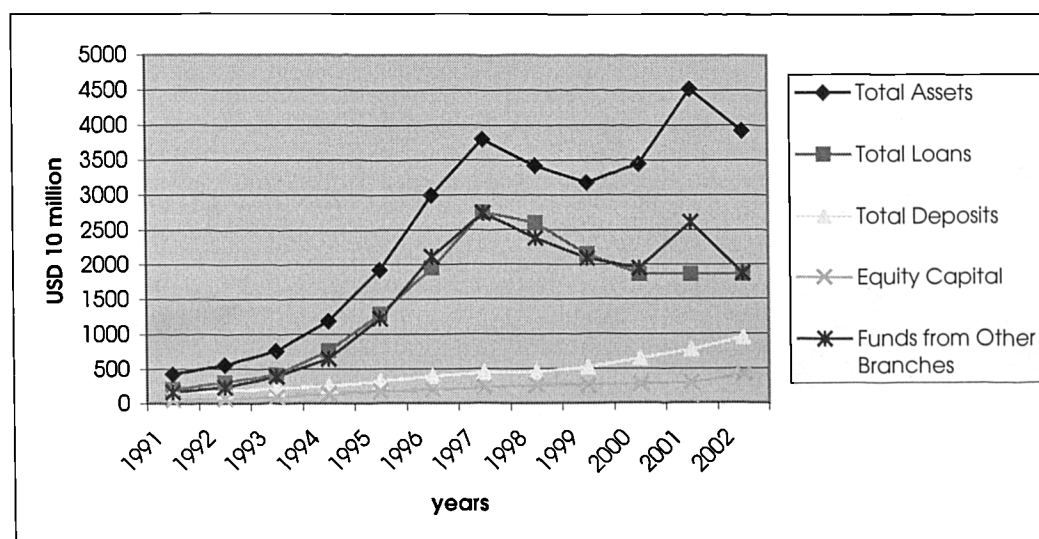
Overall, given that the ROA and ROE of both types of banks showed a downward trend during the second stage of banking reform, and the number and type of

banks increased, this might suggest that competition increased during this stage. In addition, technological progress is assumed to enhance competition by eliminating geographical barriers and facilitating product innovations. With heightened competition, banks tried to improve their efficiency by restructuring their product composition and by re-organization. However, the large amount of non-performing loans might also change the economies of China's banking business, since more problem loans may incur higher labor expenses for extra monitoring and negotiating, and, in addition, may necessitate the payment of higher rates for funds.

2.5.4 Development of Foreign Banks

Figure 2.6 illustrates the development of foreign banks during the period 1991-2002. It shows that foreign banks were largely dependent on external sources of finance. The total deposits of foreign banks was quite low over the period, while the change in total loans is highly consistent with changes in the funds of other branches, suggesting that the lending business of foreign banks in China was mainly supported by funds borrowed from other branches abroad.

Figure 2.6 Development of Foreign Banks (1991-2002)



Sources: *Almanac of China's Finance and Banking (1992-2003)*

In addition, there was new growth following China's WTO membership. In 2002, the total deposits and total equity of foreign banks increased compared to the previous year. At the same time, funds from the branches overseas decreased from USD26.1 bn in 2001 to USD18.7 bn in 2002, which resulted in a drop in the total assets of foreign banks. This change suggests that, with China's entry to the WTO, the foreign banks appear to be using the domestic markets more for funds, relying less on overseas funds.

Table 2.7 provides the distribution of the home countries of foreign banks at the end of 2002. It shows that nearly all of the foreign banks come from Asia, Europe and North America. Among them, Asia is the largest investor. The value of total assets of foreign banks from Asia was RMB2,401 bn (or USD290 bn) by the end of 2002, accounting for 61% of the total assets of all the foreign banks. Europe and North America are in second and third place, accounting for 21% and 17% of whole total assets, respectively. In terms of the number of foreign bank branches and sub-branches, Hong Kong (Special Administration Zone), Japan, France, USA and Singapore are the top five home countries, accounting for 66% of the total number of foreign bank branches by the end of 2002.

Table 2.7 Home Countries of Foreign Banks (2002)

Continents	Total Assets (RMB bn)	% of total	Home Countries	Number of Foreign Bank Branches	% of total
Asia	2401.2	61%	Hong Kong	36	25%
Europe	806.9	21%	Japan	20	14%
North America	649.9	17%	France	16	11%
			USA	13	9%
			Singapore	11	8%
Total	3915.4		Total	146	
CR3	99.3%		CR5	65.75%	

Source: Almanac of China's Finance and Banking, 2003

Table 2.8 provides the geographical distribution of foreign bank branches (FBBs) in China at the end of 2002. Foreign bank branches were highly concentrated in selected geographical regions. The top-three-city concentration ratio, in terms of total assets, was as high as 76%. In terms of number of foreign bank branches, the

top-five-city concentration ratio was as high as 73%⁵². Shanghai was the main location for foreign bank branches. By the end of 2002, Shanghai hosted 52% of total foreign bank assets, with 40 foreign bank branches. It also had the largest foreign bank size by assets. Shenzhen and Beijing came next to Shanghai, each with 19 foreign bank branches. Shenzhen had more foreign banks' assets. The other two main cities for foreign banks were Guangzhou and Tianjin.

Table 2.8 Distribution of Foreign Bank Branches (2002)

Cities	Total Assets (RMB bn)	% of total	Cities	Number of FBBs	% of total	Assets per FBBs (RMB bn)
Shanghai	2026.4	52%	Shanghai	40	27%	54
Shenzhen	547.9	14%	Beijing	19	13%	21
Beijing	406.8	10%	Shenzhen	19	13%	29
			Guangzhou	15	10%	24
			Tianjin	14	10%	27
Others	934.3	24%	Others	39	27%	
Total	3915.4		Total	146		
CR3	76%		CR5	73%		

Source: *Almanac of China's Finance and Banking, 2003*

Note: FBBs refers to foreign bank branches.

2.6 Econometric Analysis

This section attempts to use the qualitative findings in the previous sections to conduct a simple econometric analysis of bank performance in China. This is a preliminary exploration to round off this chapter, and the thesis explores more complex models in Chapter 5⁵³. Following Molyneux and Thornton (1992) and others, a simple linear equation is employed and specified below:

$$ROA_{i,t} = \alpha + \beta_1 NPL_{i,t} + \beta_2 EL_{i,t} + \beta_3 NIIA_{i,t} + \beta_4 CI_{i,t} + \beta_5 LR_{i,t} + \beta_6 OWN_i + \beta_7 TT_i + \beta_8 LGTD_{i,t} + \beta_9 CONC_i + \beta_{10} AIP_i + \varepsilon_{i,t} \quad (2.1)$$

where

$ROA_{i,t}$ = return on assets, a proxy for the profitability, of bank i at time t ;

⁵² m -city concentration ratio is defined as the ratio of foreign bank assets (or number of foreign banks) of the m largest cities to total foreign bank assets (or total number of foreign banks) of all the cities in a given year.

⁵³ Given that this chapter is an "overview", and not the central part of this thesis, there is no attempt to review the relevant literature.

$NPL_{i,t}$ = the ratio of non-performing loans to total loans, an indicator of the asset quality, of bank i at time t ;
 $EL_{i,t}$ = the ratio of total equity to total loans, a crude measure of capital adequacy, of bank i at time t ;
 $NIIA_{i,t}$ = the ratio of net interest income to total assets, a measure of the interest rate margin, of bank i at time t ;
 $CI_{i,t}$ = cost to income ratio, a proxy for operational efficiency, of bank i at time t ;
 $LR_{i,t}$ = the ratio of cash and bank deposits to total assets, an indicator of the asset liquidity, of bank i at time t ;
 OWN_i = an ownership dummy, 0 for state-owned and 1 for joint-stock banks;
 TT_t = time trend variable, equal to 0 to 17 for years 1985 to 2002, respectively;
 $LGTD_{i,t}$ = the natural logarithm of total deposits, a proxy for size, of bank i at time t ;
 $CONC_t$ = the Herfindahl-Hirschman Index ($HERF$)⁵⁴, a measure of market concentration, at time t ;
 AIP_t = average (annual) income per person, a proxy for the supply of deposits to banks, at time t ;

The random effects panel data approach is used to estimate the equation (2.1). As indicated by Greene (2000), the advantage of a panel data set over a cross section and/or a time-series is that it gives the researcher greater flexibility in modelling differences in behaviour across individuals and/or time periods. The random effects model is preferred over the fixed effects model because the fixed effects estimator requires within-group variation in all variables for at least some groups. However, there are time-invariant regressors, such as the ownership dummy, in this study. Thus, the fixed effects estimator cannot be computed. Moreover, a fixed effects model would lead to a substantial loss of degrees of freedom (Baltagi, 1995). A brief introduction to the random effects panel data approach appears in Appendix 2.7.

Data were collected on the four state-owned commercial banks and the ten joint-stock commercial banks. The full sample covers the period from 1985 through

⁵⁴ $HERF$ is defined as the sum of squared market shares of deposits of the sample of banks in a given year. $HERF$ is slightly greater than 0 for a perfectly competitive market and 100 for a monopoly (Waldman and Jensen, 2001).

2002 with 187 observations. In addition, the data were split to obtain the first stage reform sub-sample (1985-1992), and the second stage reform sub-sample (1993-2002). Table 2.9 presents the summary statistics for the variables used to estimate this equation.

Table 2.9 Variables Used in the Preliminary Model

Variable	Description	All		1 st stage		2 nd stage	
		Mean	S.D.	Mean	S.D.	Mean	S.D.
<i>ROA</i>	Return on assets	0.010	0.008	0.011	0.008	0.009	0.008
<i>NPL</i>	Non-performing loans/total loans	0.140	0.077	0.055	0.028	0.175	0.063
<i>EL</i>	Total equity/total loans	0.129	0.116	0.175	0.177	0.110	0.072
<i>NIIA</i>	Net interest income/total assets	0.057	0.035	0.029	0.031	0.056	0.037
<i>CI</i>	Cost/income	0.711	0.144	0.659	0.196	0.732	0.110
<i>LR</i>	Cash and bank deposits/total assets	0.239	0.086	0.184	0.074	0.261	0.081
<i>LGTD</i>	Natural logarithm of total deposits	10.649	1.921	10.298	2.264	10.791	1.752
<i>CONC</i>	Herfindahl-Hirschman Index	0.236	0.034	0.284	0.018	0.217	0.013
<i>AIP</i>	Average income per person	0.855	0.266	0.546	0.043	0.981	0.210
Number of observations		187		54		133	

Sources: *Almanac of China's Finance and Banking (1986-2003)*; *Lardy (1998, 1999)*.

Notes: 1. All refers to all banks in the sample; 1st stage refers to banks existed in the first stage of banking reform (1985-1992); 2nd stage refers to banks existed in the second stage of banking reform (1993-2002). 2. Official data for non-performing loans (NPLs) are quite limited to outside observers. The NPL data are only available for the state banks over the period 1993-2002, and for the joint-stock banks over the period 1999-2002. Since the majority of the NPLs were created in the 1990s, in this chapter, the NPL ratio of the state banks is defined as 5% for the period 1985-1989, and 10% for 1990-1992. For the joint-stock banks, it is defined as 1% for 1987-1989, and 5% for 1990-1992. From 1993 to 1998, its growth rate was 2%, similar to that of the state banks. 3. Both deposits and average income per person are deflated by the CPI, with 1985 as the base year.

Compared to the banks in the first stage, Table 2.9 shows that banks in the second stage operated in a more competitive market, given that the Herfindahl-Hirschman Index decreased by 23%. Average income per person increased by 80%, which means that there was an enhanced potential for greater supply of household bank deposits. They had lower asset quality (NPL ratio increased by 220%) and reduced capital adequacy – the ratio of total equity to total loans fell by 37%. The cost to income ratio increased suggesting reduced efficiency. The banks were

more liquid, as the liquidity ratio increased by 42%. On average, the return on assets fell by 17%, and the banks were larger in size in the second stage.

Table 2.10 provides the results of the empirical test. Before analysing the results, Chow's Breakpoint test was conducted to test the poolability of the data. The result shows that there was a structural change in 1993 (F statistic is 5.24, and p -value is zero). Thus, the empirical analysis focuses on the two sub-samples. The LM statistics are 16.19 and 7.08 with low p -values (i.e. 0.000 and 0.008, respectively) for the first and second stage sub-samples, respectively. The results show that the random effects panel data model is more appropriate than the standard regression model for both sub-samples.

The coefficient of the ratio of non-performing loans to total loans is not significantly different from zero for the first stage sub-sample and significantly positive for the second sub-sample. This wrong-signed coefficient might be explained by two factors. One is that total assets were substantially overstated because large quantities of non-performing loans (NPLs) were carried on bank balance sheets as assets. Also, the practice of accruing interest on NPLs overstated the interest income of banks. Banks added the unpaid interest to the principal of the loan without officially extending a new loan. Since the accrued interest was treated as income, as if it had actually been paid by the borrower, it overstated income (Lardy, 1998). Thus, the high NPLs of the Chinese banks overstate both the numerator and denominator of the ROA, which may explain why the coefficient is wrong signed.

The ratio of total equity to total loans is insignificant for both sub-samples, and wrong signed but significant for the sample as a whole. This finding is consistent with the fact that bank equity rarely acted as a cushion against poorly performing assets during the sample period (Lardy, 1998, 1999). Thus, it may not be a good measure of capital adequacy.

Table 2.10 Empirical Results of the Simple Model of Bank Performance

Variable	Description	All		1 st stage		2 nd stage	
		Coef.	S.E. (p value)	Coef.	S.E. (p value)	Coef.	S.E. (p value)
<i>C</i>	Constant	0.068	0.014 (0.000)	-0.074	0.028 (0.008)	0.132	0.019 (0.000)
<i>NPL</i>	Non-performing loans/total loans	0.002	0.009 (0.793)	-0.013	0.038 (0.733)	0.030	0.011 (0.008)
<i>EL</i>	Total equity/total loans	-0.008	0.004 (0.075)	-0.002	0.005 (0.686)	0.004	0.006 (0.436)
<i>NIIA</i>	Net interest income/total assets	0.026	0.013 (0.038)	0.007	0.024 (0.775)	0.031	0.011 (0.007)
<i>CI</i>	Cost/income	-0.031	0.003 (0.000)	-0.002	0.004 (0.591)	-0.042	0.004 (0.000)
<i>LR</i>	Cash and bank deposits /total assets	-0.004	0.006 (0.507)	-0.008	0.010 (0.441)	-0.009	0.005 (0.093)
<i>OWN</i>	Ownership dummy	0.008	0.003 (0.007)	0.027	0.007 (0.000)	0.007	0.003 (0.009)
<i>TT</i>	Time trend	0.001	0.001 (0.186)	-0.001	0.001 (0.211)	-0.002	0.001 (0.096)
<i>LGTD</i>	Natural logarithm of total deposits	0.0004	0.001 (0.516)	0.004	0.001 (0.000)	-0.001	0.001 (0.383)
<i>CONC</i>	Herfindahl-Hirschman Index	-0.098	0.036 (0.006)	0.089	0.050 (0.072)	-0.287	0.065 (0.000)
<i>AIP</i>	Average income per person	-0.034	0.006 (0.000)	0.019	0.029 (0.507)	-0.011	0.014 (0.423)
<i>LM statistics</i>		13.06	(0.000)	16.19	(0.000)	7.08	(0.008)
Number of observations		187		54		133	

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002). 2. Coef. stands for coefficients, and S.E. for standard errors. 3. White Heteroscedasticity consistent standard errors are applied. To provide correct estimates of the coefficient covariances in the presence of heteroskedasticity of unknown form, White (1980) derived a heteroskedasticity consistent covariance matrix estimator. 4. Coefficients significant at 10% level are in bold type. 5. LM (Lagrange multiplier test) is devised by Breusch and Pagan (1980), and used to test for the random effects model based on the OLS residuals. Under the null hypothesis, LM is distributed as chi-squared with one degree of freedom. The null hypothesis is that the classical regression model with a single constant term is appropriate. The alternative hypothesis is that the panel data model is appropriate.

The coefficient on net interest income to total assets has significantly positive effects on ROA only for the whole sample period and the second stage sub-sample. The absence of a significantly positive coefficient for the first stage sub-sample may be because these banks tended to focus on the real estate and stock markets via their own trust and/or securities companies (Wu, 1998). However,

they concentrated on investing in government and finance bonds⁵⁵ after 1993, because of the separation of commercial and investment banking business and the development of an inter-bank market during the second stage.

The cost to income ratio is insignificant for the first stage, and significantly negative for the second stage. It indicates that the lower the cost efficiency, the lower the profitability for banks in the second stage of reform. The coefficient for liquidity is insignificant for the first stage sub-sample, but significantly negative for the second stage sub-sample. This indicates that the higher the asset liquidity, the lower the bank profitability, which is consistent with the expectation, since assets with greater liquidity usually have lower returns.

The significantly positive value of the ownership dummy suggests that the joint-stock banks earned higher profits than the state banks during the whole reform period. The time trend variable is insignificant for the first stage sub-sample, but significantly negative for the second sub-samples. This indicates that bank profitability has been deteriorating significantly since 1993.

The significantly positive sign on the coefficient for the log value of total deposits shows that for banks in the first reform stage, the larger the size, the better the performance. In the second stage, it was not found to be significant. The concentration coefficient is significantly positive for the first stage sub-sample, and negative for the second stage sub-sample. This suggests that banks in the first stage earned higher profits because of greater market power. However, by the second stage, the reduced concentration in the market negatively affected bank profits.

The coefficient of the average income per person is insignificant for both sub-samples. Deposits rose steadily throughout the period (28.75% between 1979 and

⁵⁵ Finance bonds is one issued by the financial institutions.

2002) and to the extent that rising income proxies these rising deposits, it appears that the banks were unable to profit from them⁵⁶.

Overall, these findings suggest that efficiency and competition have influenced banks' performance in China over the last two decades, and further research might focus on them. The decision to allow joint-stock banks appears to have improved performance, even though the reduced market concentration had a negative effect. The peculiar treatment of bad loans by banks during the period makes it difficult to comment on the effect of asset quality. Given the distorted figures on assets, equity/loans was used as a proxy for capital adequacy, but any comment on the effects of capital adequacy should be reserved until a more accurate measure is available. Indeed, the fact that bad loans ended up inflating the asset figures may have undermined the entire estimating equation, because the dependent variable was also affected. Finally, looking at bank performance in aggregate has its limitations, even if the difference in ownership type is allowed for.

2.7 Conclusions

This chapter has reviewed the evolution of China's banking sector from 1949 to 2002. Before 1979, the banking sector was monopolistic, with the People's Bank of China (PBC) simultaneously engaged in both central and commercial banking operations. Thus, the major role of the banking system was quite circumscribed during the period 1949-1979. To strengthen the role of the banking sector in the mobilization and allocation of financial resources, reforms in banking have been introduced since 1979. Consistent with the strategy of overall economic reform in China, a gradual approach has been used.

The first stage of banking reform (1979-1992) transformed the monopoly into two-tier banking, consisting of the central bank, state-owned specialized banks, medium and small-sized commercial banks, rural and urban credit cooperatives,

⁵⁶ Almanac of China's Finance and Banking (2000-2003). Appendix 2.8 provides a figure of the growth rates of household deposits.

and foreign banks. The credit-quota plan and central bank lending became the major policy instruments to manage aggregate credit. Interest rates on deposits and loans were under the control of the central bank. In 1986, the scope of banking activities was expanded by allowing universal banking business. Despite the emergence of the medium and small-sized commercial banks and foreign banks, the system was dominated by the state-owned specialized banks. In addition, the activities of the banking sector were largely directed by the government as a means to implement its development strategy. Both prudential regulation and corporate governance of the banking sector were quite weak.

The second stage of banking reform (1993-2002) was initiated with the objective of developing a sound banking system, i.e., an effective, competitive, and safe banking sector. To achieve this aim, a reform strategy consisting of deregulation and new regulations was adopted. Structural deregulation, such as lowering the entry barriers, brought more players to the market. Technological progress also enhanced competition by eliminating geographical barriers and facilitating product innovations.

Some conduct deregulation, such as removing the credit ceilings, commercializing the state-owned banks, allowing an inter-bank market, and some marginal interest rate liberalization, also took place. These measures gave banks more chances to adjust their product and cost structure, and improve their performance accordingly. However, new regulation, such as the segmentation of commercial and investment banking business, was also introduced. This measure limited the services and products that the banks could offer, and probably reduced their opportunity to enhance their performance.

In response to these changes, banks attempted to adopt strategies aimed at improving efficiency to expand output and increase the range of services offered. The streamlining of the state-owned banks, the expansion of the joint-stock banks, the diversification of the portfolio, innovation in the off-balance-sheet activities, and, more recently, the joint-stock reform of the state banks can be interpreted as

responses of this kind. A major motivation has been to realize potential scale and scope economies, and to eliminate inefficiencies. Given the above factors and new pressures under China's membership of the WTO, it is of interest to investigate the progress of China's banking system with respect to efficiency and competition.

The second stage reform was profound, but the high proportion of non-performing loans poses a substantial challenge to the sector during the second stage of reform. Although the Chinese banks have made certain progress in improving the quality of their loans, their average ratio of non-performing loans is still very high, suggesting improving asset quality should still be the major task for these banks.

While the state banks are wholly owned by the state, the joint-stock banks are also effectively owned by the state via local governments and state-owned enterprises. They are not private banks typical of the west. However, the issues of social welfare objectives and "soft" budget constraints are more applicable to the state banks, given that they are the mainstream of China's banking sector, and directly controlled by the government.

Furthermore, a random effects panel data model was employed for the preliminary exploration of the issue of bank performance over the last two decades. The results suggest that efficiency and competition have influenced bank performance in China over the last two decades. Therefore, the next two chapters explore a different perspective by looking at X-efficiency and scale/scope economies, before returning to the more complex models of structure-performance and relative efficiency.

Appendix 2.1

Table of Exchange Rate for the Period 1978-2002

Unit: RMB yuan

Year	Exchange rate at the end of the year (USD 100)	Annual average exchange rate (USD 100)	Year	Exchange rate at the end of the year (USD 100)	Annual average exchange rate (USD 100)
1978	157.71	168.36	1991	543.42	532.22
1979	149.62	155.49	1992	575.18	551.46
1980	153.03	149.84	1993	580.00	576.20
1981	174.55	170.50	1994	844.62	861.87
1982	192.27	189.25	1995	831.74	835.09
1983	198.09	197.57	1996	829.82	829.90
1984	279.57	232.70	1997	827.96	828.98
1985	320.12	293.67	1998	827.91	827.91
1986	372.21	345.28	1999	827.93	827.83
1987	372.21	372.21	2000	827.72	827.84
1988	372.21	372.21	2001	827.68	827.70
1989	472.21	376.51	2002	827.72	827.70
1990	522.21	478.32			

Sources: China's Financial Statistics 1952-1996 (1997); Almanac of China's Finance and Banking (1998-2003)

Appendix 2.2

Deposit and Lending Rates (March 15, 1989)

Unit: % (annual rate)

Type of Deposits	Maturity	%	Type of Loans	Maturity	%
Residential Saving Deposits	Current account	2.88	Working Capital Loan	Loans to industrial and commercial enterprise	11.34
	1 year	11.34		Loans to procure cereals, cotton, and edible oil	9.00
	3 years	13.14	Fixed-asset Loan	Less than 1 year	11.34
	8 years	17.64		1-3 years	12.78
Government Agency Deposits	Current account	2.88		3-5 years	14.40
	Time deposits	Same as residential time deposits		5-10 years	19.20

Source: Zhou (1992)

Note: Interest rates mentioned in this table are only a small part of the interest structure of the Industrial and Commercial Bank of China.

Appendix 2.3

Definition of Shares in China's Stock Exchange Markets

A company in China may issue five different types of shares on either the Shanghai or Shenzhen Securities Exchanges: state shares, legal person shares, employee shares, A shares and B shares. In addition, they may issue shares in Hong Kong and on overseas exchanges. There is no cross-listing between the two Chinese exchanges.

State shares designate holdings in the state-owned enterprises (SOEs) by the central government, local governments, or solely SOEs. To preserve the economy's socialist structure, most of the companies permitted to go public have to issue shares to the government, in addition to various categories of shares representing claims from different entities. Legal person shares are shares owned by domestic institutions which are themselves partially owned by the central or local government.

Legal persons are typically business agencies or enterprises of local governments that helped in starting up the public company either by giving permission to operate or by allowing public resources to be used for the start up. Therefore, the legal persons would behave very similarly as state shareholders. Both state shares and legal person shares are not tradable on the stock market, but transferable to domestic institutions upon approval of the China's Securities Regulatory Commission (CSRC).

A-shares are similar to ordinary equity shares, except that they are exclusively available to Chinese citizens and domestic institutions. They are mostly held and traded by individuals. It is required that A-shares should account for no less than 25% of total outstanding shares when a company makes its initial public offering. For most listed companies, the top 10 shareholders are normally the state and legal persons.

B-shares are issued to attract foreign portfolio investors. Since the Chinese currency is not convertible on the capital account, B-shares are quoted and traded in either US dollars on the Shanghai Stock Exchange or Hong Kong dollars on the Shenzhen Stock Exchange. Prior to February 2001, only non-PRC (the People's Republic of China) residents were allowed to trade B-shares. Employee shares are offered to workers and managers of a listed company, usually at a substantial discount. After a holding period of 6 to 12 months, the company may file with the CSRC to allow its employees to sell their shares on the open market. Once sold on the market, they become A-shares. H shares are shares of mainland Chinese enterprises listed on the Hong Kong Stock Exchange.

Source: Sun et al. (2002)

Appendix 2.4

Guidelines on Corporate Governance Reforms and Supervision of Bank of China and Construction Bank of China (China Banking Regulatory Commission)

Chapter I General Provisions

Article 1: Given the significance of the joint-stock reforms of State-owned commercial banks as a brand new experience of financial sector reforms, the Guidelines on Corporate Governance Reforms And Supervision of Bank of China and Construction Bank of China (hereinafter is referred to as the Guidelines) is formulated for the purpose of securing the success of the pilot joint-stock reforms of the Bank of China and China Construction Bank (hereinafter referred to as “two pilot banks”).

Article 2: The objective of the joint-stock reforms of the two pilot banks is to build, within three years, the two pilot banks into modern and internationally competitive joint-stock commercial banks with adequate capital, strict internal controls, safe and sound business operations, quality services and desirable profitability. To this end, the reforms shall be centered on innovating the banks’ management regime and systems, improving their corporate governance, innovating their operating mechanisms and thereby boosting their profit-earning capacity.

Article 3: The two pilot banks shall, through reforms, meet and keep at the average level of the world top 100 banks in terms of both corporate governance and financial conditions measured by internationally accepted criteria.

Chapter II Corporate Governance

Article 4: The two pilot banks shall have in place a standard corporate governance structure comprising the general shareholders meeting, a board of directors, a board of supervisors and an executive management.

Each pilot bank shall, with reference to the corporate governance required for a modern corporate entity, segregate the functions and powers of the general shareholders meeting, the board of directors, the board of supervisors and the executive management, adopt an organizational structure required for a joint-stock commercial bank and in compliance with the Company Law of the People's Republic of China, and establish sound and efficient mechanisms for policy making, enforcement and oversight so as to ensure independent operations of each organ and necessary checks and balances among different organs.

Article 5: The two pilot banks shall be encouraged to introduce domestic and foreign strategic investors to diversify their equity structure, and shall select the investors in a fair and impartial manner.

By introducing strategic investors, in particular the foreign strategic investors, each pilot bank shall aim at building up its financial strength, optimizing its equity structure, bringing its management systems and operating concepts in line with those of the world advanced banks by learning from the international advanced management expertise, technology and methodology.

Article 6: The two pilot banks shall have in place clear-cut development strategies with an aim at maximum profitability.

Each pilot bank shall identify its core and market competitive advantages in light of its own profile and market situations, and on this basis, adopt a comprehensive package of development strategies consistent with its development goals. The implementation of the strategies shall be rolled out and assessed on an annual basis.

Article 7: The two pilot banks shall have in place sound mechanisms for decision-making, internal controls and risk management.

Each pilot bank shall adopt a system of risk management, which covers the credit risk, market risk and operational risk, and is effective in identifying, measuring, monitoring and controlling risks.

Article 8: The two pilot banks shall optimize their organizational set-up, improve the allocation of resources and conduct their business in an efficient and cost-effective manner by way of reducing the layers of hierarchy, adopting a line management structure and streamlining their business and management procedures.

Article 9: The two pilot banks shall, with reference to the human resources management schemes required for a modern financial corporate entity, deepen the reforms of personnel management, adopt market-oriented mechanisms for human resources management and for providing incentives and imposing disciplines.

Article 10: The two pilot banks shall, with reference to the requirements for a modern financial corporation and a listed commercial bank, have in place policies and procedures for both prudent accounting practices and stringent information disclosure, and shall enforce these policies and procedures to improve their financial management and information disclosure activities.

Article 11: The two pilot banks shall build up their information technology system to secure quality management and services.

Article 12: The two pilot banks shall have in place strategies for building up a quality staff through proper training and recruitment of qualified personnel for key positions, and at the same time pay due attention to effective allocation of human resources, and give full play to the initiative and creativity of the existing human resource.

Article 13: The two pilot banks shall give a full play to the professional advantages of intermediary institutions and proceed with the joint-stock restructuring in a prudent manner.

Chapter III Performance Assessment Indicators

Article 14: The joint-stock reforms of the two pilot banks shall be assessed by using such indicators as the ROA (Return on Assets), the ROE (Return on Equity), cost/income ratio, non-performing asset ratio, capital adequacy ratio, largest exposure concentration and the NPL provisioning coverage ratio.

Article 15: The net ROA ratio of the two pilot banks shall reach 0.6 per cent by 2005, and shall be further increased to the level required for an internationally competitive bank by 2007.

Article 16: To reinforce the effectiveness and ensure the return of the capital injection, the net ROE ratio of the two pilot banks shall reach 11 per cent by 2005, and shall be further increased to 13 per cent or above by 2007.

Article 17: Starting from 2005, the cost/income ratio of the two pilot banks shall be controlled within the range of 35 to 45 per cent each year.

Article 18: Starting from 2004, the two pilot banks shall apply the five-category classification system to the classification of their non-credit assets and assessment of the quality of their entire asset portfolio, while controlling the non-performing asset ratio within the range of 3 to 5 per cent.

Article 19: Starting from 2004, the two pilot banks shall manage their capital strictly in accordance with the Regulation Governing Capital Adequacy of Commercial Banks, and their capital adequacy ratio shall be maintained at the level above 8 per cent at any point of time.

Article 20: The two pilot banks shall take effective measures to strictly control their exposure to a single customer. Starting from 2005, each pilot bank's lending to a single client shall be no more than 10 per cent of its total capital.

Article 21: By the end of 2005, the NPL provisioning coverage ratio shall reach 60 per cent for the Bank of China and 80 per cent for China Construction Bank, which shall be further increased by the end of 2007.

Chapter IV Examination and Reporting System

Article 22: The two pilot banks shall take immediate measures to dispose of their non-performing assets.

While resolving the historically accumulated non-performing assets, the two pilot banks shall probe into their illegal or rule-breaking business activities and take strict disciplinary actions against the entities and personnel that are found in violation of rules and regulations, so as to prevent the debt evasions by their corporate customers and guard against moral hazards during the process of reforms, and thereby safeguarding the value of their assets. For this purpose, the two pilot banks shall submit an initial appraisal report by the end of 2004.

Article 23: The two pilot banks shall establish and enforce a clearly defined responsibility system under which the responsibility and accountability shall be assigned in line with the tasks and objectives set out by the State Council on the State-owned commercial bank reforms. The chairman of the board of directors of each pilot bank shall be the person who takes the primary responsibility.

The two pilot banks shall adopt a target-driven management system, conduct periodical performance evaluation and submit the evaluation report, on a quarterly basis, to the Taskforce for Pilot Joint-stock Reforms of State-owned Banks under the State Council. In addition, each pilot bank shall conduct comprehensive

examinations on an annual basis, and shall disclose their progress of reforms to the public in a proper manner so as to subject their performance to market oversight.

Article 24: The China Banking Regulatory Commission shall examine the performance of both corporate governance reforms and financial indicators of the two pilot banks by way of an overall inspection, annual examinations and quarterly surveillance reports. The findings of both examinations and surveillance shall be reported to the Taskforce for Pilot Joint-stock Reforms of State-owned Banks under the State Council respectively on an annual and quarterly basis.

Chapter V Supplementary Provisions

Article 25: The China Banking Regulatory Commission shall have the power of the interpretation of the Guidelines.

Article 26: The Guidelines shall enter into effect on the date of promulgation.

Source: www.cbrc.gov.cn/english/falvfagui/detail.asp?id=24

Appendix 2.5

The Five-category Loan Classification in China

To reflect the quality of loans in an authentic, comprehensive and dynamic manner, control, prevent and mitigate risks and enhance banks' credit management skills, the PBC initiated the risk-adjusted loan classification approach in 1998, initially in Guangdong Province on a trial basis and eventually nationwide. In 1999, the PBC modified the *Guiding Principles on Risk based Loan Classification (Provisional)* and required the commercial banks to classify their loans accordingly. In December 2001, the PBC issued the *Notice on the Implementation of Five-category Loan Classification*, together with the *Guiding Principles on Risk-based Loan Classification*. This five-category classification approach was implemented in all banks in China from the beginning of 2002. By the end of 2002, the 4 state-owned and 10 joint-stock commercial banks had established the five-category classification management system. Hence, the results of the classification are reported to the PBC on a quarterly basis as required.

Depending on the degree of risk, the Guiding Principles on Risk-based Loan Classification classify bank loans into five categories, i.e., normal, special mention, substandard, doubtful and lost. Their definitions are as following: (1) normal: the debtor is able to perform the loan contract and the bank does not have sufficient reason to doubt the full servicing of the loan in time. (2) Special mention: the debtor is able to service the loan at present, however, there are factors that can adversely affect the repayment of the loan. (3) Substandard: there are clear weaknesses in the debtor's repayment capability. The loan cannot be fully serviced with the debtor's normal business income. Some losses will occur even if the guarantees are executed. (4) Doubtful: the debtor is unable to service the loan in full and significant losses will occur even if the collateral is executed. (5) Lost: the principal and interest cannot be recovered or can be recovered in a small part after legal actions are taken.

Source: PBC Annual Report, 2002, p.49.

Appendix 2.6

List of Major Commercial Banks in China

Bank Type	Number	Bank Name
State-owned Commercial Banks	1	Industrial and Commercial Bank of China (ICBC)
	2	Agricultural Bank of China (ABC)
	3	Bank of China (BOC)
	4	China Construction Bank (CCB)
Joint-stock Commercial Banks	1	Bank of Communication (BOCOM)
	2	CITIC Industrial Bank (CITICIB)
	3	China Merchants Bank (CMB)
	4	Shenzhen Development Bank (SDB)
	5	Guangdong Development Bank (GDB)
	6	Industrial Bank (IB)
	7	China Everbright Bank (CEB)
	8	Hua Xia Bank (HXB)
	9	Shanghai Pudong Development Bank (SPDB)
	10	China Minsheng Banking Corporation (CMBC)

Sources: Almanac of China's Finance and Banking (2003)

Note: Yantai House Savings Bank was transformed to the 11th joint-stock commercial banks, namely Evergrowing Bank, in 2003.

Appendix 2.7

Panel Data Approach

Panel data refers to the pooling of observations on a cross-section of households, countries, firms, etc. over several time periods (Baltagi, 1995). A panel data regression differs from a cross-section or time-series regression in that it has a double subscript on its variables, i.e.

$$y_{it} = \alpha + \beta'x_{it} + \varepsilon_{it} \quad i = 1, \dots, N; t = 1, \dots, T$$

with i denoting households, individuals, firms, countries, etc., and t denoting time. Therefore, the i subscript, denotes the cross-section dimension whereas t denotes the time-series dimension. α is a scalar, β is $K \times 1$ and x_{it} is the it th observation on K independent variables.

Most of the panel data applications use a one-way error component model for the disturbances, with

$$\varepsilon_{it} = \mu_i + \nu_{it}$$

where μ_i denotes the unobservable individual specific effect and ν_{it} denotes the remainder disturbance.

Under the fixed effects approach, the μ_i are assumed to be group specific fixed parameters to be estimated, i.e., they are assumed to be constant over time. The random effects approach takes μ_i as a group specific disturbance, similar to ν_{it} except that for each group, there is but a single draw that enters the regression identically in each period (Greene, 2000).

As indicated by Hsiao (1985, 1986) and Baltagi (1995), there are several benefits from using panel data, which include:

- Controlling for individual heterogeneity.
- Giving more informative data, more variability, less collinearity among the variables, more degrees of freedom and more efficiency.

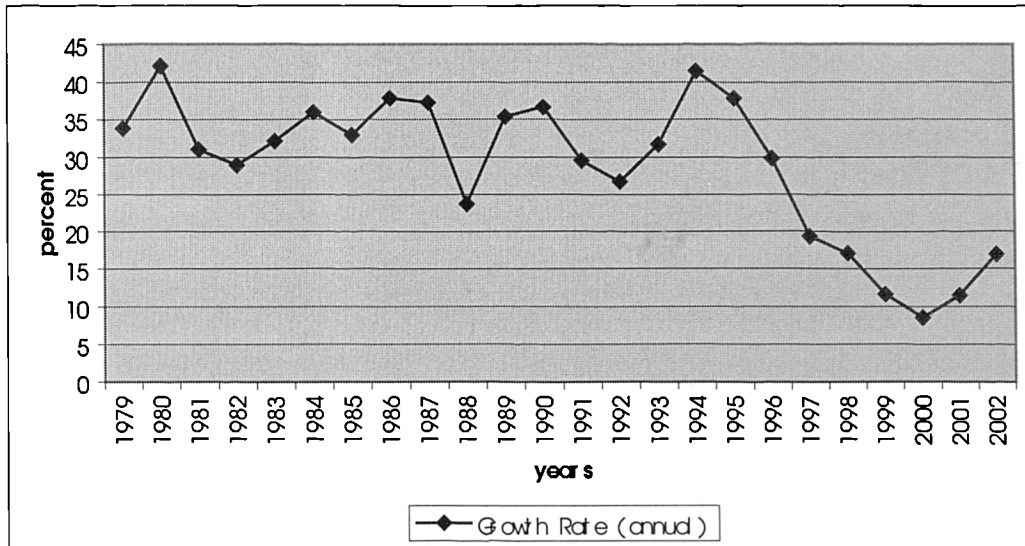
- Being better able to study the dynamics of adjustment.
- Being better able to identify and measure effects that are simply not detectable in pure time-series or pure cross-sections data.
- Allowing us to construct and test more complicated behavioral models than purely time-series or pure cross-sections data.
- Eliminating biases resulting from aggregation over firms or individuals, since panel data are usually gathered on micro units.

However, the limitations of panel data include:

- Design and data collection problems.
- Distortions of measurement errors.
- Selectivity problems, such as self-selectivity, nonresponse, and attrition.
- Short time-series dimension.

Appendix 2.8

Annual Growth Rate of China's Household Deposits (1979-2002)



Source: *Almanac of China's Finance and Banking (2000-2003)*

Chapter 3. X-efficiency in China's Banking Sector

3.1 Introduction

The main purpose of this chapter is to investigate X-efficiency in China's banking sector from 1985 to 2002. A particular emphasis is placed on investigating how gradual banking reform has influenced X-efficiency, as well as whether different forms of bank ownership have affected X-efficiency. The rest of the chapter is organized as follows: Section 3.2 reviews previous studies, which focus on X-efficiency in the banking sector. Section 3.3 describes the major methodology and the data used. The stochastic cost frontier model is employed to estimate X-efficiency, with three different assumptions (i.e., half-normal, exponential, and truncated-normal) being applied to the disturbance distribution. In Section 3.4, a two-stage regression model is estimated to identify the significant variables influencing X-efficiency, and empirical results are presented. Section 3.5 concludes this chapter.

3.2 Literature Review

3.2.1 Theory of X-efficiency

The concept of economic efficiency is normally viewed as consisting of two separate components, technical and allocative. Technical efficiency refers to the ability to avoid waste by maximizing outputs for a given set of inputs or minimizing inputs for a given set of outputs. Allocative efficiency refers to the ability to combine inputs and outputs in optimal proportions given prevailing prices. Thus, economic efficiency refers to the ability to select the input and/or output levels and mixes to optimize an economic goal, usually cost minimization or profit maximization (Lovell, 1993).

Koopmans (1951) provided a formal definition of technical efficiency: a producer is technically efficient if an increase in any output requires a reduction in at least

one other output or an increase in at least one input, and if a reduction in any input requires an increase in at least one other input or a reduction in at least one output.

In the literature, economic efficiency is substituted by a very popular term, X-efficiency, which was introduced by Leibenstein (1966). For the first time, he argued that production is bound to be inefficient as a result of one important type of price and quantity distortion. This distortion has to do with the motivation, information, and monitoring of managers, and, more generally, agency problems within the firm. Since the (in)efficiency was initially undefined, he referred it as X-(in)efficiency.

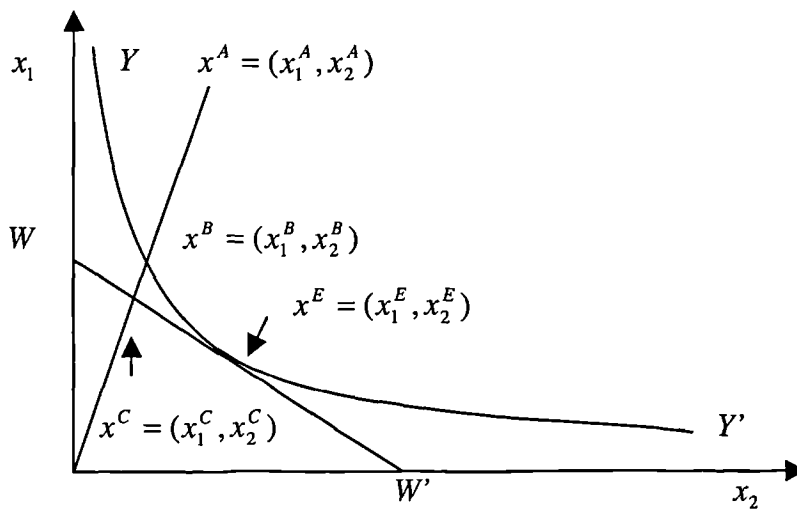
Farrell (1957) was the first to measure X-efficiency empirically. Usually, technical efficiency is measured either as a ratio of observed to maximum potential outputs obtainable from the given inputs, or as a ratio of minimum potential to observed inputs required to produce the given outputs. X-efficiency is obtained by comparing observed and optimum cost, profit, or any other economic goal, subject to the appropriate constraints on quantities and prices. In this thesis, cost minimization is chosen over profit maximization because it is the more commonly specified and accepted X-efficiency concept in the literature.

In a simple case of two-inputs (x_1, x_2) and a single-output (Q), Figure 3.1 illustrates the meaning of X-efficiency. The efficiency isoquant is labelled YY' , which shows the minimum potential inputs required to produce the given output. Relative to the actual input choice, which is labelled x^A , the technically efficient input vector is labelled x^B , which acts as a benchmark. Thus, the technical efficiency of x^A can be measured as $\|x^B\| / \|x^A\|$, where $\| \ \|$ denotes the length of the vector. This ratio tells how far x^A is from the isoquant. The gradient of line WW' gives (minus) the price ratio of the two factor inputs, assuming perfect divisibility and that the prices are observed price ratio.

The technically and allocatively efficient input point is x^E , given output and the observed input price vector. Allocative efficiency at x^A can be measured

as $\|x^C\| / \|x^B\|$. This measure gives the increase in costs (inefficiencies) solely due to the fact that x^A picked a suboptimal input mix (factor input ratio). Then the X-efficiency of x^A can be measured as $\|x^C\| / \|x^A\|$, because the mix of inputs at x^A is the same as that at x^B by construction. Note that (1) the input mix of x^A and x^C are the same, and that (2) the total costs of production at x^C are the same as those at x^E (Greene, 1993).

Figure 3.1 The Efficiency Frontier with Two Factor Inputs



Source: Greene (1993, P.91)

Notes: x_1 : input 1; x_2 : input 2; x^A : the actual input choice; x^B : the technically efficient input vector; x^C : benchmark of x^E ; x^E : the economic efficient input vector; WW' : the observed price ratio; YY' : efficiency isoquant, the minimum potential inputs needed to produce the given output.

3.2.2 Review of Methodologies

In the literature, there are two empirical ways to measure X-efficiency: nonparametric methods and parametric methods⁵⁷. The most common nonparametric techniques are data envelopment analysis (DEA) and free disposal hull analysis (FDH). DEA is a linear programming technique developed by Charnes, Cooper, and Rhodes (1978). It was originally intended for use in the public sector and not-for-profit institutions where typical economic behavioural objectives, such as cost minimization or profit maximization, may not apply.

⁵⁷ See Lovell (1993), Greene (1993), Grosskopf (1993), Berger and Humphrey (1997), and Kumbhakar and Lovell (2000) for comprehensive surveys.

Since DEA could be used with just input and output data, most of the early DEA studies focused on technical efficiency. In this radial form of DEA, efficient firms are those for which no other firm or linear combination of firms has as much or more of every output (given inputs) or as little or less of every input (given outputs). The DEA frontier is formed as the piecewise linear combinations that connect the set of these best-practice observations, yielding a convex production possibilities set.

A potential problem of self-identifiers and near-self-identifiers may arise when DEA is applied. Under the radial form of DEA, input mix (output mix) is held constant, so firms with unusual input (output) mixes may be found to be self-identifiers or near-self-identifiers. This potential problem can be minimized through applying a cost-based DEA approach. In the cost-based DEA, input prices are employed and, therefore, efficient firms are those which minimize the cost of producing their observed outputs given the best-practice technique and input prices. By applying the cost-based DEA, any input mix can be compared by combining input prices and quantities and comparing total costs, rather than having to compare firms in every input dimension as in the radial forms of DEA (Bauer, Berger, Ferrier, and Humphrey, 1998).

Free disposal hull analysis (FDH) was introduced into the frontier literature by Deprins, Simar, and Tulkens (1984), and is a special case of the DEA model where the points on lines connecting the DEA vertices are not included in the frontier. Instead, the FDH frontier is composed only of the DEA vertices and the free disposal hull points interior to these vertices. Thus, the FDH frontier envelops the data more tightly, and has a more restrictive notion of domination, than the DEA frontier does. Since the FDH frontier is either congruent with or interior to the DEA frontier, FDH will generate larger estimates of average efficiency than DEA (Lovell, 1993).

As Berger (1993), Berger and Humphrey (1997) and Bauer et al. (1998) conclude, the advantages of these nonparametric techniques are: (1) they permit efficiency

to vary over time; (2) they do not require the explicit specification of a functional form and so impose very little structure on the shape of the efficient frontier. The key drawback of these nonparametric techniques is that they usually do not allow for random error due to measurement problems associated with using inaccurate accounting data, good or bad luck which temporarily raises or lowers inputs or outputs, or specification error such as excluded inputs and outputs and imposing the piecewise linear shape on the frontier. If there is any random error in a bank that is not on the estimated frontier, it will be mistakenly included in that bank's measured efficiency. This effect may be quite large. For example, if there is a random error in a bank on the frontier, it will be mistakenly reflected in the measured efficiency of all banks that are measured relative to that part of the frontier.

The most common parametric X-efficiency estimation techniques are the stochastic frontier approach (SFA), the thick frontier approach (TFA), and the distribution-free approach (DFA). The SFA originated with three papers published nearly simultaneously by three teams: Aigner, Lovell, and Schmidt (1977), Meeusen and van den Broeck (1977), and Battese and Corra (1977). This approach has been applied to banking by Ferrier and Lovell (1990). The SFA specifies a functional form for the cost relationship among inputs, outputs, and other factors, and allows for random error. In the SFA, the X-inefficiency and random error components of the composite error term are disentangled by making explicit assumptions about their distributions.

The X-inefficiency term is assumed to follow an asymmetric distribution, usually the half-normal, while the random error term is assumed to follow a symmetric distribution, usually the standard normal. The logic behind these assumptions is that the X-inefficiencies cannot reduce costs, and so must be drawn from a truncated distribution, whereas random error can both increase and decrease costs, and so can be drawn from a symmetric distribution. Thus, the X-efficiency results depend critically on the skewness of the data, i.e., any X-inefficiency components that are more or less symmetrically distributed will tend to be measured as random

error, and any random error components that are asymmetrically distributed will tend to be measured as X-inefficiency. In addition, both the X-inefficiencies and the errors are assumed to be orthogonal to all of the independent variables specified in the estimating equation.

The distribution free approach (DFA) was introduced by Berger (1993). It also specifies a functional form for the frontier, as does SFA, but DFA separates the X-inefficiencies from the random error in a different way. It does not impose strong assumptions regarding the specific distributions of the X-inefficiencies or random errors. Instead, DFA assumes that there is a core X-efficiency or average X-efficiency for each bank over time. The core X-inefficiency is assumed to be stable over time, while random errors tend to average out to zero over time.

The reasonableness of these assumptions about the error term depends on the length of period studied. If too short, the random errors might not average out, and would be attributed to X-inefficiency. If too long, the bank's core X-efficiency becomes less meaningful because of changes in management and other events, so core X-efficiency might not be stable over the time period. Using 1984-1994 data on US commercial banks and assuming a translog cost model, DeYoung (1997) showed that a six-year time period could reasonably balance these concerns, making DFA a panel estimation method (Berger and Mester, 1997). One disadvantage is that DFA cannot capture X-efficiency changes within a bank over time owing to replacement of managers or internal restructuring. If there were changes in relative X-efficiency due to, for example, new management, the approach would only pick up the average X-efficiency.

The thick frontier approach (TFA) was introduced by Berger and Humphrey (1991). It, too, specifies a functional form. It does not impose distributional assumptions on either X-inefficiency or random error, except to assume that X-inefficiencies differ between the highest and lowest performance quartiles and that random error exists within these quartiles. The approach has two disadvantages. First, the measured X-efficiency is sensitive to the assumptions about which

fluctuations are random and which represent X-efficiency differences. Specifically, if X-inefficiencies follow a thin-tailed distribution and tend to be small, while random errors follow a thick-tailed distribution and tend to be large, then TFA may mistake one for the other. Second, generally, TFA gives an estimate of X-efficiency differences between the highest and lowest quartile to indicate the general level of overall X-efficiency, but does not provide exact point estimates of X-efficiency for individual banks (Berger, 1993; Berger and Humphrey, 1997; Bauer et al. 1998).

The advantage of the parametric methods is that they allow for random error, so making measurement or specification errors less likely to be misidentified as inefficiency. Moreover, the parametric methods will always rank the efficiencies of the banks in the same order as their cost (profit) function residuals, independent of the specific distributional assumptions imposed. That is, banks with lower costs (higher profits) for a given set of independent variables will always be ranked as more efficient, because the conditional mean or mode of the inefficiency term is always increasing in the size of the residual. The disadvantage of the parametric methods is that they have to impose more structure on the shape of the frontier by specifying a particular functional form. If the functional form is misspecified, measured efficiency may be confounded with the specification errors.

Estimating technical efficiency requires only input and output data, while measuring X-efficiency also requires price data. As a result, most of the nonparametric studies (especially those employing the radial DEA approach) have focused on technical efficiency, although some have employed a non-radial cost-based DEA to estimate X-efficiency⁵⁸. In contrast, virtually all recent parametric (SFA, TFA, and DFA) studies have examined X-efficiency. Among them, the SFA is the most popular.

⁵⁸ See Aly, Grabowski, Pasurka, and Rangan (1990), Resti (1997), Bauer et al. (1998), Eisenbeis, Ferrier, and Kwan (1999), Isik and Hassan (2002), McKillop, Glass, and Ferguson (2002), Rezvanian and Mehdian (2002) for examples.

The studies by Resti (1997), Bauer et al. (1998), Eisenbeis et al. (1999), and Isik and Hassan (2002) compared estimates using both the nonparametric and parametric approaches. The parametric approach was found to yield higher efficiency values than the nonparametric approach in the three later studies, but Resti (1997) found little difference between the techniques. This result is consistent with the difference between the two methods, i.e., the nonparametric approach does not allow for a random error owing to luck, data problems, or other measurement errors, while the parametric approach does. The studies by Bauer, Berger, and Humphrey (1993), Allen and Rai (1996), Berger and Mester (1997), Bauer et al. (1998), Mertens and Urga (2001), and Clark and Siems (2002) compared estimates using two or more of the parametric approaches, but the results were mixed.

3.2.3 Review of Empirical Studies

Berger and Humphrey (1997) surveyed 130 X-efficiency studies from 21 countries and various types of financial institutions. Most of the studies on banking X-efficiency focus on the banks of developed economies (mostly US). More recently some X-efficiency studies have been applied to the developing economies (e.g. Isik and Hassan, 2002; Mertens and Urga, 2001; Hardy and Patti, 2001). Table 3.1 summarizes the results of studies from both the developing countries and (a few) from the developed countries.

A large number of countries have, over the last two decades, undertaken extensive reforms aimed at raising the X-efficiency of the banking sector. However, the results of empirical studies on X-efficiency have been mixed. Altunbas, Gardener, Molyneux, and Moore (2001c), Hasan and Marton (2003), and Girardone, Molyneux, and Gardener (2004) reported that higher X-efficiency was found for banks in the post liberalization environment.

By contrast, Hardy and Patti (2001) and Isik and Hassan (2002) indicated that the X-efficiency of sample banks decreased significantly during periods of financial

reform. In addition, Bauer et al. (1998), DeYoung, Hasan, and Kirchhoff (1998), and Hao, Hunter, and Yang (2001) found that bank reform had little or no significant effect on the X-efficiency of sample banks.

According to Berger and Humphrey (1997), the outcome of bank reforms may differ from what was anticipated because of differences in industry conditions prior to reforms. For example, a desire to rapidly expand market share in Turkey, or competition to pay higher deposit interest rates in the US and Pakistan, may result in reduced X-efficiency after deregulation.

Of the studies that have investigated the relationship between X-efficiency and ownership of banks, some have focused on comparing the differences between state-owned banks and private banks. The empirical results are mixed. Isik and Hassan (2002) reported that private banks were more X-efficient than state banks in Turkey during the period 1988-1996. By contrast, Hardy and Patti (2001) found state banks to be more X-efficient than private banks in Pakistan over the period 1981-1997, and for Croatia, Kraft and Tirtiroglu (1998) reported similar findings for the period 1994-1995. Finally, Altunbas, Evans, and Molyneux (2001b) found little evidence to suggest that privately owned banks were more efficient than their public sector counterparts in Germany between 1989 and 1996.

These inconclusive results are not surprising. The agency cost theory suggests that agents might act in their own interest rather than in the principal's interest. This principal-agent problem can occur in any bank where there is separation between owners and managers. The source of the problem is asymmetric information, i.e., the manager knows more than the principals about the daily operation and position of the bank (Heffernan, 2004). Thus, this problem is not limited to state banks, but can also occur with managers of private banks.

Table 3.1 Summary of Banking Studies on X-efficiency

Author (s)	Country	Data	X-efficiency	Method	Remarks
Kraft and Tirtiroglu (1998)	Croatia	43 banks for each year (1994 and 1995), total 86 observations.	0.55 - 0.88	SFA	1. State banks (0.82) were more efficient than private banks (0.78).
Hardy and Pati (2001)	Pakistan	33 banks, total 389 observations between 1981 and 1997.	0.52 for the first period; and 0.27 for the second period.	DFA	1. The first sub-period covers the years 1981-1992 before and during reform, and the second 1993-1997, by when the major reforms should have begun to take effect; 2. X-efficiency of all sample banks decreased significantly in the deregulated period; 3. State banks were more efficient than other banks over the 17 years.
Mertens and Urga (2001)	Ukraine	79 banks in 1998	0.67	SFA	1. Under the thick frontier approach, the X-efficiency score is 0.81.
Isik and Hassan (2002)	Turkey	Total 109 observations: 36 from 1988, 50 from 1992 and 53 from 1996	0.90	SFA	1. X-efficiency had worsened over time in the post liberalization environment; 2. Private banks were more X-efficient than state banks.
Hasan and Marton (2003)	Hungary	Total 193 observations: 34 (1993), 33 (1994), 30 (1995), 29 (1996), 34 (1997) and 33 (1998).	0.71	SFA	1. Bank reforms helped to build a more efficient banking system. X-efficiency score increased from 0.62 in 1993 to 0.78 in 1998.
Berger and Mester (1997)	US	Total 5,949 observations for 5 years (1990-95, excluding 1992).	0.94	SFA	1. Using the distribution free approach, the X-efficiency score is 0.87. 2. The information about the number of banks for each year is unavailable.
Bauer et al. (1998)	US	683 banks over the 12-year period 1977-1988, total 8,196 observations.	0.88	SFA	1. X-efficiency had remained relatively stable despite many changes in both regulatory and market conditions in the early 1980s. 2. Other methodologies (e.g. DEA, DFA, and TFA) were also used, but here just the result of the stochastic frontier approach is reported for comparison.
DeYoung et al. (1998)	US	3,997 banks with headquarters in metropolitan statistical areas in 1992.	0.66	SFA	1. X-efficiency worsened in the first few years after the implementation of local laws (i.e., the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994) but improved later.
Altunbas et al. (2000)	Japan	Total 550 observations: 139 for each year from 1993 to 1995 and 136 in 1996.	0.94 - 0.95	SFA	1. Using random effects panel data approach
Altunbas et al. (2001a)	Germany	Total 7,539 observations: 125 from 1989, 140 from 1990, 186 from 1991, 532 from 1992, 1,405 from 1993, 1,824 from 1994, 1,816 from 1995, and 1,511 from 1996.	0.78 - 0.86	SFA	1. The sample includes three types of bank: commercial banks (listed, private, and foreign banks), public ("state-owned") savings banks, and mutual cooperative banks. 2. Tests revealed no substantial differences in X-efficiency between the three groups of banks.
Altunbas et al. (2001b)	EU	Total 4,104 observations between 1989 and 1997.	0.76 - 0.82	SFA	1. Under the DFA, the X-efficiency score is between 0.86 and 0.87. 2. The 1992 single market programme led to higher efficiency across 15 EU members; 3. Using random effects panel data approach;
Hao et al. (2001)	Korea	19 banks for each year between 1985 and 1995, except 17 in 1986. Total 207 observations.	0.89	SFA	1. The information about the number of banks for each year is unavailable. 2. The financial deregulation of 1991 was found to have had little or no significant effect on the level of sample bank efficiency.
Pinho (2001)	Portugal	Total 140 observations from 1987 to 1991	0.83	SFA	1. State banks were less efficient than private banks.
Girardone et al. (2004)	Italy	Total 1,958 observations from 1993 to 1996.	0.85 - 0.87	SFA	2. The information about the number of banks for each year is unavailable. 1. Including non commercial banks, such as credit cooperatives. 2. Large private banks were more efficient than large public banks. 3. The deregulation resulting from the EU's 1992 Single Market Programme may have had a positive impact in improving the X-efficiency of the Italian banking system.

Notes: SFA: stochastic frontier approach; DFA: distribution free approach.

However, there are two possible explanations for the difference in efficiency between state and private banks. One is the difference in bank objectives. While private banks usually aim at cost minimization and profit maximization, state banks might not necessarily minimize costs and pursue profits. State-owned banks might pursue government-imposed objectives, such as lending to loss-making state-owned enterprises to ensure that there are no sudden falls in unemployment. The other is the difference in budget constraints. Private banks are subject to relatively “hard” budget constraints, but state banks might be subject to “soft” budget constraints since they might be required by the government to carry out direct lending (Isik and Hassan, 2002). In short, state banks could be less effective if they are subject to the social welfare objective and “soft” budget constraints.

No empirical study has estimated the differences in X-efficiency between the state-owned and joint-stock banks in China. As indicated in Chapter 2, the state banks are wholly owned and controlled by the state. The joint-stock banks are effectively owned by the state: they are not private banks typical of the west. However, the issues of social welfare objective and “soft” budget constraints are more serious for the state banks, given that they are the mainstream of China’s banking sector and entirely controlled by the government. Taken together, it would be expected that the X-efficiency of the joint-stock banks might be superior to that of the state banks.

3.3 Methodology and Data

3.3.1 The Concept of X-efficiency as Applied to Banks

X-efficiency measures the extent to which a bank’s costs approximate the costs of the “best practice” or least cost bank, producing an identical output bundle under the same conditions. The measure is derived from a cost function where the dependent variable is total costs of each bank, and the independent variables include the prices of inputs, the quantities of variable outputs, and a composite error term. A general version of this cost function may be written as

$$C = C(w_i, y_i) + \varepsilon_i \quad (3.1)$$

where

C = total costs

w_i = the input prices

y_i = the output quantities

$\varepsilon_i = u_i + v_i$

u_i = an X-inefficiency factor that may raise costs above the best-practice level

v_i = the random error that incorporates measurement error and chance that may give banks high or low costs occasionally

The X-inefficiency factor u_i incorporates both technical inefficiencies from using too much of the inputs to produce the same outputs, y_i , and allocative inefficiencies from failing to react optimally to relative prices of inputs, w_i . The standard assumption is that the X-inefficiency and random error terms can be multiplicatively separated from the remainder of the cost function. After taking logs of both sides of equation (3.1), the cost function can be depicted as

$$\ln C = f(w_i, y_i) + \varepsilon_i \quad (3.2)$$

X-efficiency is defined as the ratio of the predicted minimum costs that would be used if the bank were as efficient as the best-practice bank in the sample facing the same exogenous variables (w, y) to the predicted actual costs, adjusted for random error. According to Berger and Mester (1997), a bank-specific measure of X-efficiency can be calculated as follows:

$$X\text{-EFF}^i = \frac{\hat{C}^{\min}}{\hat{C}^i} = \frac{\exp[\hat{f}(w_i, y_i)] \times \exp(\hat{u}^{\min})}{\exp[\hat{f}(w_i, y_i)] \times \exp(\hat{u}_i)} = \frac{\hat{u}^{\min}}{\hat{u}_i} \quad (3.3)$$

where

$\hat{C}^{\min}$ = the predicted minimum costs as used by the best-practice bank;

$\hat{C}^i$ = the predicted actual costs;

$\hat{u}^{\min}$ = the minimum of the $\hat{u}_i$ across all banks in the sample;

$\hat{u}_i$ = the predicted actual cost inefficiency of a specific bank.

X-efficiency is the proportion of costs or resources that are used efficiently, so that an X-EFF ratio of 0.80 would indicate that the bank is 20% less efficient in terms of costs relative to the best-practice bank operating under the same

conditions. X-efficiency theoretically falls in the interval (0,1], and equals one for a best-practice bank within the observed data. The limitation of this definition is that the estimated X-efficiency is only a relative measure against the best practice bank within the sample, the best practice bank itself may not be efficient when compared to banks outside the sample.

3.3.2 The X-efficiency Estimation Technique

To measure the X-efficiency of the Chinese banks, this thesis adopts the widely used parametric technique - the Stochastic Frontier Approach (SFA). Under the SFA, bank-specific estimates of X-inefficiency, u_i , can be obtained by using the distribution of the X-inefficiency term conditional on the estimate of the entire composite error term, as proposed by Jondrow, Lovell, Materov, and Schmidt (1982). The mean of this conditional distribution for the half-normal model is shown as

$$E(u_i | \varepsilon_i) = \frac{\sigma\lambda}{1 + \lambda^2} \left[\frac{\phi(\varepsilon_i\lambda / \sigma)}{1 - \Phi(\varepsilon_i\lambda / \sigma)} + \frac{\varepsilon_i\lambda}{\sigma} \right] \quad (3.4)$$

where

$$\lambda = \sigma_u / \sigma_v$$

$$\sigma^2 = \sigma_u^2 + \sigma_v^2$$

$\phi(.)$ = the standard normal density function

$\Phi(.)$ = the cumulative standard normal density function

The half-normal assumption for the distribution of X-inefficiencies is relatively inflexible and assumes that most banks are clustered near full X-efficiency. Following Greene (1993), two alternatives have also been applied in this thesis. For the model with exponentially distributed disturbance developed by Aigner, Lovell, and Schmidt (1977),

$$E(u_i | \varepsilon_i) = (\varepsilon_i + \theta\sigma_v^2) + \frac{\sigma_v\phi[(\varepsilon_i + \theta\sigma_v^2) / \sigma_v]}{\Phi[(\varepsilon_i + \theta\sigma_v^2) / \sigma_v]} \quad (3.5)$$

Stevenson (1980) has argued that the assumption of zero mean in (3.5) is an unnecessary restriction. He introduced a truncated-normal model as opposed to a half-normal model. For the model with truncated distributed disturbance, the one-sided error term u_i is taken to be the variable obtained by truncating at zero the distribution of a variable with a possibly non-zero mean. The counterpart is obtained by replacing $\varepsilon_i \lambda / \sigma$ with

$$\mu_i^* = \frac{\varepsilon_i \lambda}{\sigma} + \frac{\mu}{\sigma \lambda} \quad (3.6)$$

$E(u_i | \varepsilon_i)$ is an unbiased but inconsistent estimator of u_i , since, regardless of N , the variance of the estimator remains non-zero. This model can be estimated using maximum likelihood techniques.

3.3.3 The Model Specification

Consistent with most of the bank X-efficiency literature, this study adopts a translog functional form rather than a more flexible form such as the Fourier-flexible (FF) specification⁵⁹. The choice was motivated by the fact that the FF specification requires more degrees of freedom. This is a problem in this thesis because the number of observations available is limited given the relatively small number and short history of these banks. In addition, although formal statistical tests indicate that the coefficients on the Fourier terms are jointly significant, Berger and Mester (1997) argue that the improvement obtained through the use of the FF specification is insignificant from an economic viewpoint. The average

⁵⁹ According to Berger and Humphrey (1997), Berger and Mester (1997), DeYoung and Hasan (1998), and Altunbas, Gardener, Molyneux, and Moore (2001c), the translog functional form is only a local approximation of the data, i.e., it provides a good fit for banking data that are close to the sample means but may provide a poor fit for banking data located far from the mean scale and product mix. The translog also forces the frontier average cost curve to have a symmetric U-shape in logs. Compared to the translog functional form, the Fourier-flexible (FF) functional form is more flexible and provides a global approximation of any cost function over the entire range of the banking data, because it is the linear combination of the sine and cosine function, which are mutually orthogonal over the $[0, 2\pi]$ interval and function space-spanning. Thus, in contrast to the translog function form, which constrains a bank's true cost function to a translog form, the FF functional form imposes no such constraint, allowing the data to reveal the true cost function through a large value of fitted parameters, thereby avoiding misspecification error.

improvement in goodness of fit is relatively small, meaning both functional forms yield basically the same average level and dispersion of measured efficiency, and both rank the individual banks in almost the same order.

Wheelock and Wilson (2001) also argue that the FF specification raises several unresolved statistical problems, including whether to augment the underlying translog function with trigonometric terms or orthogonal polynomials, and how many terms should be included for estimation. Furthermore, Altunbas and Chakravarty (2001a) indicate that the predictive ability of the FF form is worse than the translog form. Finally, several studies use the stochastic frontier approach for both the translog and the Fourier specification of the cost function and reach similar conclusions (Berger and Mester, 1997; Vander Venet, 2002).

A classical pooled data regression model is applied in this study, since there is not enough data for a panel data model. The translog cost function is specified as follows; in common with the published work in this area, time and bank subscripts are dropped for ease of exposition:

$$\begin{aligned} \ln \frac{C}{z * w_3} &= \alpha_0 + \sum_{p=1}^4 \beta_p \ln \frac{y_p}{z} + \sum_{m=1}^2 \delta_m \ln(w_m / w_3) \\ &+ \frac{1}{2} \sum_{p=1}^4 \sum_{q=1}^4 \beta_{pq} \ln \frac{y_p}{z} \ln \frac{y_q}{z} + \frac{1}{2} \sum_{m=1}^2 \sum_{n=1}^2 \delta_{mn} \ln \frac{w_m}{w_3} \ln \frac{w_n}{w_3} \\ &+ \sum_{p=1}^4 \sum_{m=1}^2 \gamma_{pm} \ln \frac{y_p}{z} \ln \frac{w_m}{w_3} + u + v \end{aligned} \quad (3.7)$$

where

C = total cost

z = total assets

y_p = p th output ($p = 1, 2, 3, 4$)

w_m = m th input price ($m = 1, 2, 3$).

Following common practice, the standard symmetry restrictions apply to this function (i.e., $\beta_{pq} = \beta_{qp}$, $\delta_{mn} = \delta_{nm}$). In addition, all of the cost and input price terms are normalized by the last input price, w_3 , which imposing linear homogeneity restrictions on the model.

Many studies normalize all of the cost and output quantities relative to the bank's financial capital to control for scale biases in estimation (e.g., Berger and Mester, 1997; DeYoung and Hasan, 1998; Altunbas, Liu, Molyneux, and Seth, 2000; Merterns and Urga, 2001). Since the costs of the largest banks are much larger than those of the smallest banks, large banks would have random errors with much larger variances without the normalization. Furthermore, the X-inefficiency term in cost functions is derived from the composite residuals, which might make the variance of the X-efficiencies dependent on bank size without normalization. Similarly, the normalization of the output quantities keep these variables from being very skewed for the large banks, so that all the variables are of nearly the same order of magnitude.

However, the capitalization and provisioning regulations in Chinese banks were tightened considerably during the sample period. In particular, the state-owned banks were severely undercapitalized in the earlier years, and, over time, were required to meet capitalization standards in line with international norms. Thus, normalizing by financial capital would conflate these institutional changes with changes in bank behaviour, and overstate their costs in the early years. For this reason, this thesis follows Hardy and Patti (2001) who normalized these variables using total assets rather than total equity. All the cost and output quantities are specified as ratios of the total assets, z , to control for scale biases in the estimation of the X-efficiency in China's banking sector.

For firms that try to minimize costs, Shephard's lemma⁶⁰ specifies cost share equations that can be jointly estimated with the total cost function to improve the efficiency of certain coefficient estimates. However, as Berger (1993) and Berger and Mester (1997) stated, inclusion of the share equations in an Iterative

⁶⁰ Shephard's Lemma was first introduced by Shephard, R.W. in 1953. The cost function C is differentiable with respect to the components of the input price vector, w . Then the solution S to the cost minimization problem is unique and

$$S_m = \partial C / \partial w_m, \quad m=1, \dots, N;$$

i.e., the cost minimizing demand for the m th input is equal to the partial derivative of the cost function with respect to the m th input price. This result is known as the derivative property of the cost function or Shephard's Lemma, since Shephard (1953) was the first to obtain the result (*New Palgrave Dictionary of Economics*, 1998, 4, p.692).

Seemingly Unrelated Regression (SUR) estimation may improve the precision of the estimates, but at a cost, i.e., it would impose the undesirable assumption of no allocative inefficiencies. Forcing the shares to be consistent with the overall cost equation (3.7) incorporates the arbitrary implicit assumption that all X-inefficiencies are technical in nature (involving the general overuse of inputs), rather than allocative (involving an incorrect input mix). That is, the cross-equation restrictions incorporate the assumption that the input mix responds correctly to changes in relative prices and output levels (Berger, 1993). Berger (1993) also found that X-efficiency estimates that do not use cost share equations, partially restricted share equations, and fully restricted share equations gave very similar X-efficiency results. Following common practice, factor share equations are not included in this model.

3.3.4 Data

As discussed in Chapter 2, this chapter focuses on the two major types of commercial banks in China – 4 state-owned commercial banks and 10 joint-stock commercial banks. The sample period was from 1985 to 2002, giving 187 observations in total. All of the data (except where mentioned specifically) used in this study were obtained from various editions of *the Almanac of China's Finance and Banking* issued by the China Finance Society⁶¹. Table 3.2 provides summary statistics of all the variables used in the cost function in Eq. (3.7).

In the literature, there are two main approaches to measure the flow of services provided by banks. Under the production approach, banks are treated as firms which employ capital and labour to produce services for both deposit and loan account holders. Outputs are measured by the number of deposit and loan transactions processed over a given time period. Total costs include operating expenses only. Output is treated as a flow, showing the given amount of output produced per unit of time. However, such detailed transaction flow data are not generally available, the numbers of deposit and loan account services are

⁶¹ All these data were translated from Chinese into English by the author.

sometimes used instead. In this event, output is treated as a stock, i.e., a given amount of output at one point in time.

Table 3.2 Variables Used to Estimate X-efficiency

Unit: million RMB

Variable	Description	Mean	Standard Deviation
<i>C</i>	Total costs	6317	11948.2
<i>Y1</i>	Total deposits	159056.8	231466.1
<i>Y2</i>	Total loans	143498.4	192872.1
<i>Y3</i>	Total investments	24637.9	53000.4
<i>Y4</i>	Non-interest income	1324.2	2668.2
<i>W1</i>	Price of funds	0.021	0.020
<i>W2</i>	Price of fixed assets	0.287	0.214
<i>W3</i>	Price of employees	0.004	0.002
<i>Z</i>	Total assets	254431.3	327102.2

Sources: *Almanac of China's Finance and Banking (1986-2003)*, *China Statistical Yearbook (2003)*.

Notes:

1. All financial variables measured in million's of constant 1985 RMB.
2. Total costs (*C*) refer to operating costs plus interest costs, including costs of funds, fixed assets, and labour.
3. Total assets (*z*) is defined as all assets listed on the left-hand side of the balance sheet.
4. Total deposits (*y₁*) include short-term deposits, short-term savings deposits, fiscal deposits, long-term deposits, and long-term savings deposits.
5. Total loans (*y₂*) include short-term loans, trade bills, bills discounted, medium and long-term loans, and impaired loans, but excludes loan loss reserves.
6. Total investments (*y₃*) include short-term investment, trading securities, securities held under Repo agreement, and long-term investment, while excluding investment loss reserves.
7. Non-interest income (*y₄*) include all the operating income excluding interest income.
8. The cost of funds (*w₁*) is defined as the ratio of total interest expenses on borrowed funds to total borrowed funds. Total interest expenses on borrowed funds include interest paid on total deposits plus interest paid on interbank borrowing. Total borrowed funds include total deposits, borrowing from central bank, deposits from banks, borrowing from banks, borrowing from non-bank financial institutions, deposits against other credit facilities, bonds issued, and long-term borrowing.
9. The cost of employees (*w₃*) is defined as a ratio of total expenses on employees to the number of employees. Since the total expenses on employees are unavailable, two categories of average wage are applied here. One is the (annual) average wage for employees in state-owned financial institutions. The other is the (annual) average wage for employees in other types of financial institutions, which includes those in the shareholding financial institutions. There are completed data on the number of employees for four state-owned and joint-stock commercial banks. However, for six joint-stock commercial banks, data are incomplete. Following Vennet, R.V. (2002), Rezvanian and Mehdian (2002), and Altunbas, et al. (2001), this thesis assumes that the growth rate of employee numbers is the same as that of the total assets for a given bank. This may cause biases in the results.
10. The cost of fixed assets (*w₂*) is defined as the ratio of total expenses on the fixed assets to total fixed assets. Total fixed assets is defined as the gross fixed assets less depreciation. Total expenses on the fixed assets equal operating expenses minus expenses on employees.

Under the intermediation approach, banks are treated as financial intermediaries between borrowers and depositors rather than producers of loan and deposit services. Outputs are measured by the value of loans and investments. Total costs include operating costs plus interest costs. Output is also treated as a stock. However, neither of these approaches completely captures the function performed by banking institutions (Heffernan, 1996).

Following Humphrey (1992) and Berger (1993), the intermediation approach is adopted in this study, with some modifications to capture the dual roles of banks as (1) providing transaction services and (2) intermediating funds from depositors to borrowers. As a result, bank deposits have been treated as inputs as well as outputs at the same time. Bank deposits not only have input characteristics, because they are paid for in part by interest payments and the funds raised provide the bank with the raw material of investible funds, but they also have output characteristics, since they are associated with a substantial amount of liquidity, safekeeping, and payments services provided to depositors (Berger and Humphrey, 1997).

Some recent studies augment outputs by adding off-balance-sheet (OBS) activities (e.g., Jagtiani, Nathan, and Sick, 1995; Stiroh, 2000; Altunbas et al. 2000; Altunbas et al. 2001c; Mertens and Urga, 2001; Vander Venet, 2002). These studies argue that bank output is seriously understated by focusing only on the balance-sheet activities, since significant portions of the banking business have moved beyond the traditional balance sheet. OBS activities, such as loan origination, sales, servicing, securitization, standby letters of credit, and derivative securities, are expanding rapidly. Non-interest income, which is generated as a result of OBS fee services, is the most common proxy for OBS activity in literature. This thesis includes non-interest income as one of the outputs, though the extent to which Chinese banks are actively pursuing OBS business (derivatives, securities) is probably low – this is true in the west – the large commercial universal banks dominate the derivatives and securities markets.

Several studies argue that differences in output quality should be controlled in efficiency models. Generally, the balance-sheet data do not fully capture the heterogeneity in bank output, but theoretically the comparison should be based on the same output quality. For example, banks with relatively more problem loans may incur higher labour expenses for extra monitoring and negotiating, and, in addition, may also have to pay higher rates for funds. These differences may be mismeasured as differences in X-inefficiency. The proxies used to measure the bank-level differences in output quality include (1) the volume of non-performing loans (Clark and Siems, 2002); (2) the provisions for loan losses (Drake and Hall, 2002); (3) the ratio of non-performing loans to total loans (Altunbas et al. 2000); (4) the risk-weighted assets (DeYoung and Nolle, 1996).

According to Berger and Humphrey (1997) and Berger and Mester (1997), whether or not non-performing loans (NPLs) should be included as an explanatory variable in efficiency models depends on the main explanation for the observed negative relationship between measured efficiency and NPLs. NPLs would be exogenous to the bank if they are generally caused by negative economic shocks (“bad luck”). Thus, they should be controlled for in efficiency models, otherwise the measured X-efficiency may be artificially low due to the expenses associated with dealing with these loans (e.g., extra monitoring, negotiating workout arrangements, etc.). Alternatively, NPLs are likely to be endogenous to the bank, either because management is inefficient in managing its portfolio (‘bad management’) or because it is trying to reduce short-run expenses by cutting back on loan origination and monitoring resources (‘skimping’). Therefore, they should not be controlled for in efficiency models.

Since it is hard to separate the exogeneity from the endogeneity of NPLs, Berger and Mester (1997) attempted to solve this problem by using the ratio of NPLs to total loans in the bank’s state⁶². Using data on 6,000 US commercial banks over the period 1990-1995, they reported that the X-efficiency of US banks was 0.868

⁶² Berger and DeYoung (1997) tested the bad luck, bad management, and skimping hypotheses and found mixed evidence on the exogeneity of NPLs.

(model only including state average NPL ratios), 0.866 (model only including bank's own NPL ratio), 0.866 (model including both ratios), and 0.869 (model excluding both ratios). They argued that the state average variable is almost entirely exogenous to any individual bank, but it does allow them to control for negative shocks that may affect the bank.

The key problem with this approach is to classify NPLs using methodology in view of the ambiguity over what is exogenous or endogenous. For example, if most banks' assets are concentrated in one sector (e.g. Asia) and that sector is affected by an unexpected downturn, is this "bad luck" or poor management, because past loan decisions by these banks have left them overly exposed in that sector? Incorporating average NPL ratios in this case might cause the overestimate of the X-efficiency of banks with higher levels of NPLs. Another problem is the lack of appropriate Chinese data for such an exercise. For these reasons, no attempt is made to classify NPLs.

3.4 Empirical Results

3.4.1 X-efficiency Estimates

The parameter estimates of the stochastic frontier regression, Eq. (3.7), are presented in Table 3.3. The inefficiency residual u of this regression is used to derive the X-efficiency estimates⁶³.

⁶³ Following convention practice, the individual parameter estimates are not interpreted because the colinearity inherent in the translog specification makes these estimates difficult to interpret (Hardy and Patti, 2001).

Table 3.3 Parameter Estimates of the Stochastic Frontier Model

Independent Variable	Description	Half-normal model	Exponential model	Truncated-normal model
		Coefficients [Standard errors] (<i>p</i> -values)	Coefficients [Standard errors] (<i>p</i> -values)	Coefficients [Standard errors] (<i>p</i> -values)
<i>Constant</i>		2.025 [0.721] (0.005)	2.118 [0.710] (0.003)	2.208 [0.766] (0.004)
<i>Lny1</i>	Total deposits	0.489 [0.516] (0.344)	0.550 [0.507] (0.278)	0.582 [0.520] (0.263)
<i>Lny2</i>	Total loans	0.577 [0.601] (0.338)	0.649 [0.602] (0.281)	0.778 [0.613] (0.204)
<i>Lny3</i>	Total investments	0.149 [0.072] (0.037)	0.152 [0.072] (0.034)	0.163 [0.074] (0.027)
<i>Lny4</i>	Non-interest income	0.109 [0.103] (0.291)	0.102 [0.101] (0.310)	0.103 [0.103] (0.318)
<i>Lnw1</i>	Price of funds	1.152 [0.154] (0.000)	1.170 [0.150] (0.000)	1.193 [0.154] (0.000)
<i>Lnw2</i>	Price of fixed assets	-0.447 [0.269] (0.097)	-0.465 [0.262] (0.076)	-0.493 [0.267] (0.064)
<i>Lny1lny1/2</i>	Total deposits * Total deposits/2	-0.974 [0.383] (0.011)	-0.971 [0.386] (0.012)	-0.990 [0.386] (0.010)
<i>Lny1lny2</i>	Total deposits * Total loans	0.270 [0.341] (0.428)	0.253 [0.339] (0.456)	0.309 [0.348] (0.375)
<i>Lny1lny3</i>	Total deposits * Total investments	-0.012 [0.091] (0.899)	-0.011 [0.092] (0.906)	-0.007 [0.098] (0.940)
<i>Lny1lny4</i>	Total deposits * Non-interest income	-0.021 [0.044] (0.630)	-0.023 [0.044] (0.602)	-0.022 [0.045] (0.625)
<i>Lny2lny2/2</i>	Total loans * Total loans/2	0.918 [0.473] (0.052)	0.913 [0.488] (0.062)	0.932 [0.507] (0.066)
<i>Lny2lny3</i>	Total loans * Total investments	0.032 [0.093] (0.733)	0.031 [0.098] (0.755)	0.034 [0.102] (0.738)
<i>Lny2lny4</i>	Total loans * Non-interest income	-0.035 [0.041] (0.389)	-0.030 [0.041] (0.473)	-0.030 [0.042] (0.471)
<i>Lny3lny3/2</i>	Total investments * Total investments/2	0.010 [0.006] (0.110)	0.010 [0.007] (0.131)	0.010 [0.007] (0.121)
<i>Lny3lny4</i>	Total investments * Non-interest income	-0.006 [0.008] (0.416)	-0.006 [0.007] (0.410)	-0.006 [0.007] (0.393)

(continued on next page)

Table 3.3 (continued)

<i>Lny4lny4/2</i>	Non-interest income * Non-interest income/2	0.010 [0.005] (0.064)	0.010 [0.005] (0.078)	0.010 [0.006] (0.081)
<i>Lnw1lnw1</i>	Price of funds * Price of funds/2	0.131 [0.028] (0.000)	0.134 [0.028] (0.000)	0.136 [0.029] (0.000)
<i>Lnw1lnw2</i>	Price of funds * Price of fixed assets	-0.087 [0.044] (0.047)	-0.092 [0.043] (0.032)	-0.094 [0.045] (0.035)
<i>Lnw2lnw2</i>	Price of fixed assets * Price of fixed assets/2	0.082 [0.073] (0.261)	0.085 [0.071] (0.231)	0.088 [0.073] (0.224)
<i>Lny1lnw1</i>	Total deposits * Price of funds	-0.099 [0.095] (0.301)	-0.092 [0.095] (0.335)	-0.096 [0.096] (0.319)
<i>Lny2lnw1</i>	Total loans * Price of funds	0.012 [0.107] (0.914)	0.015 [0.107] (0.889)	0.039 [0.109] (0.718)
<i>Lny3lnw1</i>	Total investments * Price of funds	0.008 [0.023] (0.738)	0.008 [0.023] (0.717)	0.010 [0.025] (0.687)
<i>Lny4lnw1</i>	Non-interest income * Price of funds	0.021 [0.015] (0.157)	0.020 [0.015] (0.170)	0.020 [0.015] (0.168)
<i>Lny1lnw2</i>	Total deposits * Price of fixed assets	-0.115 [0.146] (0.432)	-0.136 [0.143] (0.341)	-0.134 [0.147] (0.363)
<i>Lny2lnw2</i>	Total loans * Price of fixed assets	0.065 [0.140] (0.642)	0.051 [0.141] (0.717)	0.025 [0.143] (0.863)
<i>Lny3lnw2</i>	Total investments * Price of fixed assets	-0.020 [0.017] (0.231)	-0.021 [0.016] (0.197)	-0.023 [0.017] (0.182)
<i>Lny4lnw2</i>	Non-interest income * Price of fixed assets	-0.025 [0.024] (0.287)	-0.023 [0.023] (0.327)	-0.023 [0.024] (0.347)
Variance parameters for compound error				
$\lambda, \theta, \lambda^1$		1.399 [0.416] (0.001)	19.879 [8.856] (0.248)	0.978 [1.075] (0.363)
$\sigma, \sigma_v, \sigma^2$		0.141 [0.021] (0.000)	0.094 [0.012] (0.000)	0.128 [0.131] (0.329)
μ/σ_u				0.069 [10.213] (0.995)
Adjusted R ²		0.98	0.98	0.98
Log-likelihood		153.91	153.81	153.77
Iteration completed		38	39	36

Notes: 1. Half-normal model estimates λ , exponential model estimates θ , and truncated-normal model estimates λ again. 2. Half-normal model estimates σ , exponential model estimates σ_v , and truncated-normal model estimates σ again. 3. Results at 10% significant level are in bold. 4. Standard errors are in brackets, and p values are in parentheses.

The mean X-efficiencies for the sample banks from 1985 to 2002 are presented in Table 3.4. Under the half-normal assumption, the grand mean efficiency score for the 187 observations was 0.407 with a standard deviation of 0.191. The figure of 0.407 suggests that, given its particular output level, the average bank could reduce its costs by approximately 60% by using its inputs more efficiently. Moreover, the results show that banks in the first stage of reform have higher X-efficiency than those in the second reform stage. The results also indicate that the joint-stock banks are more X-efficient than the state banks.

Table 3.4 X-efficiency Estimates (1985-2002)

Period	1985-2002			1985-1992			1993-2002		
Model	<i>H</i>	<i>E</i>	<i>T</i>	<i>H</i>	<i>E</i>	<i>T</i>	<i>H</i>	<i>E</i>	<i>T</i>
All sample banks									
Mean	0.407	0.516	0.461	0.435	0.554	0.487	0.395	0.501	0.451
S.D.	0.191	0.191	0.175	0.172	0.155	0.157	0.198	0.202	0.181
State-owned commercial banks									
Mean	0.352	0.463	0.413	0.410	0.532	0.465	0.305	0.408	0.370
S.D.	0.157	0.167	0.148	0.144	0.134	0.132	0.153	0.172	0.148
Joint-stock commercial banks									
Mean	0.442	0.549	0.492	0.473	0.587	0.519	0.434	0.541	0.485
S.D.	0.203	0.198	0.184	0.204	0.179	0.186	0.203	0.202	0.184

Note: *H* denotes the half-normal model, *E* for the exponential model, and *T* for the truncated-normal model.

Generally, the finding suggests much lower levels of X-efficiencies among Chinese banks compared to the results reported in the literature, which mostly range from 70% to 90% (Berger and Humphrey, 1997). However, this result is consistent with the findings shown in Table 3.1, that is, X-efficiency estimates are much lower for developing countries (64% on average) than developed countries (84% on average). Differences in data, periods of estimation and banking structure, together with the fact that this is a relative measure, preclude comparisons with results found in studies of other countries. This measure indicates only the distance between the individual bank's costs and the cost frontier determined by the performance of all banks in the sample. Hence, this X-efficiency measure is taken relative to the peer group in question.

Under the exponential and truncated-normal assumption, the grand mean

efficiency scores were 0.516 and 0.461, respectively. The overall results suggest that the half-normal model gives the lowest X-efficiency score, while the exponential model gives the highest X-efficiency score. Although different assumptions produce different sample mean efficiencies, both Pearson's and Spearman's correlation coefficients between pairs of efficiency estimates for all sample observations are significant with high values (Table 3.5). This result provides support for Ritter and Simar (1997), who advocate the use of a relatively simple distribution, such as normal or exponential, rather than a more flexible distribution, such as truncated normal⁶⁴.

Table 3.5 Correlation between the X-efficiency Estimates

	Pearson's correlation coefficients (<i>p</i> -values)		Spearman's rank correlation coefficients (<i>p</i> -values)	
	Half-normal	Exponential	Half-normal	Exponential
Distribution assumption				
Exponential	0.987 (0.000)		0.999 (0.000)	
Truncated-normal	0.998 (0.000)	0.989 (0.000)	0.998 (0.000)	0.999 (0.000)

Moreover, both Pearson's and Spearman's correlation coefficients are calculated to examine the possible relationship between the simple financial ratios used as indicators of X-efficiency and the X-efficiency estimates obtained by the above SFA. Generally, two simple financial ratios, the ratio of total cost to total assets (TC/TA), and the ratio of total cost to total income (TC/TI), are often used as indicators of efficiency.

⁶⁴ Pearson's correlation coefficient, which is usually identified with the letter *r*, is the measure of correlation most often used. The formula for *r* is

$$r = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2} \sqrt{\sum_{i=1}^n (y_i - \bar{y})^2}}$$

The disadvantage of it is that it can be susceptible to the influence of outliers in the data set. Also, it assumes that a straight line relationship exists between the two variables. Spearman's rank correlation, which is always shown with the symbol *s*, is less susceptible to the influence of outliers and is better in detecting nonlinear relationships. As with many other nonparametric tests, one can replace observed values with their ranks and calculate the value of *s* on the ranks. The disadvantage of the Spearman correlation is that it is not as powerful as the Pearson correlation in detecting significant correlations in situations where the parametric assumptions are satisfied (Berk and Carey, 2000).

As indicated in Table 3.6, the Spearman correlation between the X-efficiencies and both of the raw data measures follow the expected pattern – X-efficiency under any assumption is negatively correlated with the cost to asset ratio and the cost to income ratio at the 1% significance level. The Pearson's correlation coefficients are negative and not statistically significant. In general, the findings suggest these X-efficiency measures are consistent.

Table 3.6 Correlation between the X-efficiency Estimates and Accounting Measures of Efficiency

	Pearson's correlation coefficients (<i>p</i> -values)		Spearman's rank correlation coefficients (<i>p</i> -values)	
	TC/TA	TC/TI	TC/TA	TC/TI
X-efficiency estimates				
Half-normal model	-0.065 (0.378)	-0.084 (0.256)	-0.125 (0.089)	-0.130 (0.075)
Exponential model	-0.061 (0.410)	-0.067 (0.364)	-0.128 (0.082)	-0.136 (0.063)
Truncated-normal model	-0.071 (0.336)	-0.090 (0.222)	-0.136 (0.063)	-0.139 (0.057)

Note: TC/TA: total cost divided by total assets. TC/TI: total cost divided by total income.

3.4.2 Potential Correlates of X-efficiency

Following common practice (e.g. Hasan and Marton, 2003; Mertens and Urga, 2001; DeYoung et al. 1998; Berger and Mester, 1997), a two-stage regression was performed to explore the relationship between the X-efficiency estimates and a set of economic and financial variables. Among other issues, of specific interest was seeing whether a different ownership structure and gradual reform strategy influence the X-efficiency estimates in a significant way.

However, such a two-stage procedure has limitations. As Berger and Mester (1997) point out, such analyses are suggestive but not necessarily conclusive, because the dependent variable, X-efficiency, in the regression is an estimate and the standard error of this estimate is not taken into account in the subsequent regression or correlation analysis. The results should be interpreted as only providing information on correlation rather than causality because the variables

used in the estimation also suffer from an endogeneity problem and thus bias the coefficient estimates.

The two-stage regression model is specified below:

$$X - EFF = \alpha + \beta_1 OWN + \beta_2 REFORM + \beta_3 PF/TA + \beta_4 TL/TA + \beta_5 TI/TA + \beta_6 NI/PR + \varepsilon \quad (3.8)$$

where

OWN = an ownership dummy, 0 for state-owned and 1 for joint-stock;
REFORM = a reform dummy, 0 for banks in the first reform stage (1985-1992),
and 1 for banks in the second reform stage (1993-2002);
PF/TA = purchased funds (non-deposit funds) over total assets;
TL/TA = total loans over total assets;
TI/TA = total investment over total assets;
NI/PR = non-interest income over pre-tax profits;

The independent variables are selected based on previous studies and on available data. *OWN* is included to capture the possible difference in efficiency between the state-owned commercial banks and the joint-stock commercial banks. *REFORM* is included to capture any effects of the 1993 second stage reform. *PF/TA* measures the reliance on purchased funds: it could also be related to X-efficiency, because the cost of purchased funds differs from that of core deposits over the business cycle. *TL/TA*, *TI/TA*, and *NI/PR* are included to measure the impacts of output mix on X-efficiency.

Table 3.7 presents summary statistics for the variables employed in the two-stage regression model. There are a total of 187 observations in this sample, of which 54 are from the first reform stage (28.9%), and 133 from the second reform stage (71.1%). Among them, there are 115 joint-stock commercial banks (61.5%), and 72 state-owned commercial banks (38.5%). The average ratio of non-deposit funds to total assets was 18.6%, the average ratio of total loans to total assets was 54%, the average ratio of total investment to total assets was 9.5%, and the average ratio of non-interest income to pre-tax profit was 154%.

The results of the two-stage regression are presented in Table 3.8. As can be seen from this table, the ownership dummy has a statistically significant impact on

bank X-efficiency no matter which distribution assumption is applied. The significantly positive coefficient sign indicates that the joint-stock commercial banks were more X-efficient than the state-owned commercial banks. This finding is backed up by the individual X-efficiency scores in Table 3.4.

Table 3.7 Variables Employed in the Two-stage Regression Model

Variable	Description	Mean	Std. Dev.
<i>X-EFF-H</i>	X-efficiency under half-normal distribution	0.407	0.191
<i>X-EFF-E</i>	X-efficiency under exponential distribution	0.516	0.191
<i>X-EFF-T</i>	X-efficiency under truncated-normal distribution	0.461	0.175
<i>OWN</i>	Ownership dummy, 0 for state-owned and 1 for joint-stock	0.615	0.488
<i>REFORM</i>	Reform dummy, 0 for the 1 st stage and 1 for the 2 nd stage	0.711	0.454
<i>PF/TA</i>	purchased funds (non-deposit funds) over total assets	0.186	0.098
<i>TL/TA</i>	total loans over total assets	0.540	0.126
<i>TI/TA</i>	total investment over total assets	0.095	0.072
<i>NI/PR</i>	non-interest income over pre-tax profits	1.544	3.168

Sources: *Almanac of China's Finance and Banking (1986-2003)*.

Note: X-efficiency scores are derived from previous regressions.

The coefficient for the reform dummy is significantly negative for all the models, which suggests that the first stage of banking reform is correlated with higher levels of X-efficiency than the second stage. The individual X-efficiency scores in Table 3.4 also backs up this result. This finding might be explained by the large-scale adoption of expensive fixed assets, such as computers and telecommunications, during the second reform stage. For example, in 2000, the Industrial and Commercial Bank of China (ICBC), the largest bank in China, accomplished overall transaction automation, network-based information processing with 32 computer centres, 10,016 ATMs, 58,646 POS terminals, 227 self-banks and 13 call centres (Jiang, 2001). Referring to all sample banks, the average expenditures on fixed assets increased from RMB0.54 bn in the first reform stage to RMB2.15 bn in the second stage, and the growth rate was about 301%.

Table 3.8. X-efficiency Correlates

Variable	Half-normal model			Exponential model			Truncated-normal model		
	Regression Coefficients [S.E.] (<i>p</i> -values)	Pearson's Correlation coefficients (<i>p</i> -values)	Spearman's Correlation coefficients (<i>p</i> -values)	Regression Coefficients (<i>p</i> -values)	Pearson's Correlation coefficients (<i>p</i> -values)	Spearman's Correlation coefficients (<i>p</i> -values)	Regression Coefficients [S.E.] (<i>p</i> -values)	Pearson's Correlation coefficients (<i>p</i> -values)	Spearman's Correlation coefficients (<i>p</i> -values)
<i>Constant</i>	0.519 [0.084] (0.000)			0.636 [0.083] (0.000)			0.567 [0.076] (0.000)		
<i>OWN</i>	0.078 [0.030] (0.009)	0.229 (0.002)	0.217 (0.003)	0.076 [0.029] (0.010)	0.221 (0.002)	0.216 (0.003)	0.068 [0.027] (0.014)	0.221 (0.002)	0.215 (0.003)
<i>REFORM</i>	-0.127 [0.036] (0.001)	-0.097 (0.188)	-0.136 (0.063)	-0.140 [0.036] (0.000)	-0.127 (0.823)	-0.132 (0.072)	-0.116 [0.033] (0.001)	-0.094 (0.199)	-0.129 (0.079)
<i>PF/TA</i>	-0.555 [0.145] (0.000)	-0.264 (0.000)	-0.230 (0.002)	-0.553 [0.144] (0.000)	-0.254 (0.000)	-0.238 (0.001)	-0.525 [0.132] (0.000)	-0.271 (0.000)	-0.242 (0.001)
<i>TL/TA</i>	0.007 [0.112] (0.951)	-0.005 (0.946)	-0.020 (0.782)	0.011 [0.111] (0.925)	0.003 (0.966)	-0.022 (0.770)	0.010 [0.102] (0.926)	-0.002 (0.979)	-0.020 (0.791)
<i>TI/TA</i>	0.299 [0.228] (0.191)	0.043 (0.555)	0.054 (0.467)	0.327 [0.226] (0.150)	0.032 (0.667)	0.055 (0.453)	0.276 [0.208] (0.187)	0.044 (0.550)	0.060 (0.413)
<i>NI/PR</i>	0.001 [0.004] (0.884)	-0.038 (0.601)	-0.222 (0.002)	-0.001 [0.004] (0.887)	-0.060 (0.412)	-0.218 (0.003)	0.001 [0.004] (0.824)	-0.031 (0.670)	0.201 (0.006)
<i>Adj. R²</i>	0.15			0.16			0.15		
<i>F-statistics</i>	5.48 (0.000)			5.82 (0.000)			5.48 (0.000)		

Note: 1. OWN = an ownership dummy, 0 for state-owned and 1 for joint-stock; REFORM = an reform dummy, 0 for banks in the period 1985-1992, and 1 for banks in the period 1993-2002; PF/TA = purchased funds (non-deposit funds) over total assets; TL/TA = total loans over total assets; TI/TA = total investment over total assets; NI/PR = non-interest income over pre-tax profits. 2. The F-statistic is from a test of the hypothesis that of the slope coefficients (excluding the intercept) in the regression jointly equal to zero. 3. Results at 10% significant level are in bold. 4. Standard errors are in brackets, and *p* values are in parentheses.

The fixed interest rate might be another contributor to this finding. The cost of raising funds is the majority cost in China's banking sector, and its average ratio to total costs was 87% between 1985 and 2002. However, the Chinese government set the levels of interest rates for both deposits and loans. Hence, banks did not have enough opportunities to control their costs. This issue became more critical in the second reform stage, since banks spent much more money to improve their equipment, and better-equipped banks would probably ask for lower deposit rates. The significantly negative coefficient for *PF/TA* under all the models suggests that a lower proportion of purchased funds (non-deposit funds) would increase X-efficiency. A possible explanation is that this type of funding is more costly than deposits. If correct, banks in China could improve their X-efficiency by increasing their share of deposits.

The results of both Pearson's and Spearman's correlation coefficients generally support the findings of the two-stage regression, except an insignificant coefficient for the *REFORM* dummy under the Pearson's correlation test, and a significantly negative coefficient for *NI/PR* under the Spearman's correlation test. Taken together, they suggest that the findings of the two-stage regression are suggestive of consistency.

3.5 Conclusions

Employing the stochastic frontier approach, this chapter investigated X-efficiency in China's banking sector over the period 1985-2002. Three disturbance distributions were applied: half-normal, exponential, and truncated-normal. The results obtained under these assumptions were similar. The grand mean X-efficiency in China's banking sector was found to be in the range of 40%-50%. Put another way, on average, all the sample banks would have increased their X-efficiency (through lower costs) by about 50%-60% had they been operating on the X-efficiency frontier.

A two-stage regression model was estimated to explore the potential correlates of X-efficiency. The results indicate that the joint-stock commercial banks were relatively more efficient than state-owned commercial banks. In addition, X-efficiency was found to be more pronounced in the early stage of banking reform, and banks with higher proportions of deposits were relatively more X-efficient.

Overall, the findings suggest that X-inefficiency is an important issue that should receive more attention from Chinese researchers, bank regulators and managers. Second, converting state-owned banks to joint-stock ownership should improve their X-efficiency. Third, relying on purchased funds to finance the portfolio apparently raises X-inefficiency. Finally, further reforms should focus on giving bank managers more opportunities to control their costs, such as interest rate liberalisation.

It is worth to note that the joint-stock banks are *relatively* more X-efficient than the state banks. It may be that all of these domestic banks are far less X-efficient than foreign banks. Though there is no evidence to suggest whether this is true or not, it will be a critical issue especially after interest rates and entry (WTO) are liberalised. However, the domestic banks will behave like real commercial banks (as their foreign counterparts) if they are subject to the full force of competition with no interference (or expectation of interference) from the state. That is, the state only largely owns these domestic banks but does not interfere with management in any way, so they are left to compete with foreign banks on a level playing field.

The major limitation of this chapter is that the X-efficiency is only a relative measure against the best practice bank within the sample. The best practice bank itself may be really efficient or not in the real economic sense. The latter could cause the mis-measurement of the real efficiency level of China's banking sector.

Chapter 4. Economies of Scale and Scope in China's Banking Sector

4.1 Introduction

The main purpose of this chapter is to employ the stochastic frontier approach and expansion path measures to estimate economies of scale and scope in China's banking sector during the period 1985-2002. The traditional non-frontier approach and standard measures are also applied for comparison and completeness. Economies of scale and scope between banks with different ownership types and/or in different reform stages are compared as well. This chapter unfolds as follows: Section 4.2 reviews previous studies, including a brief introduction to the theory of economies of scale and scope and a review of the relevant empirical literature. Section 4.3 discusses the methodology and data used: the translog cost functions under different approaches are introduced first; the various measures of economies of scale and scope are then illustrated. The parameter estimates of the translog cost functions are used to calculate the economies of scale and scope using different measures. Section 4.4 describes the empirical results. Section 4.5 summarizes the chapter and presents the conclusions.

4.2 Literature Review

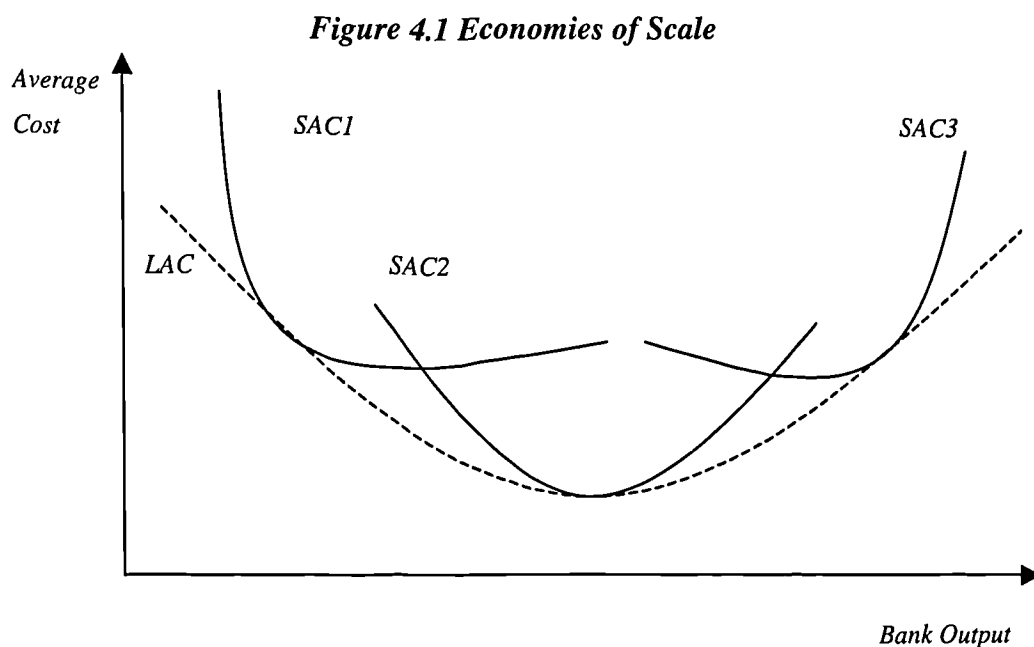
4.2.1 Theory of Economies of Scale and Scope

As indicated by Baumol, Panzar, and Willig (1982), two types of production economies may be achieved by any firm in any industry – economies of scale and scope. Economies of scale arise if average production costs decline as output rises. Conversely, diseconomies of scale exist if average production costs increase with output⁶⁵. Economies of scope exist if two or more products can be jointly

⁶⁵ Economies of scale is a long-run concept, applicable when all the factor inputs which contribute to a firm's production process can be varied (Heffernan, 1996).

produced with lower cost by one firm than is incurred in their independent production. Conversely, if the cost of joint production is higher than that of independent production, diseconomies of scope are present. Economies of scale are associated with firm size, while economies of scope are related to the joint production of two or more products.

Figure 4.1 shows a series of short-run average cost curves ($SAC1$, $SAC2$, $SAC3$) for three variously sized banks, each producing different levels of bank output. From the series of short-run average cost curves, an implied long-run average cost curve (LAC) can be traced out. A downward-sloping LAC indicates economies of scale, since lower average costs are incurred when more output is produced. An upward-sloping LAC reflects diseconomies of scale, because higher average costs are incurred when more output is produced. This description is based on an assumption that the appropriate LAC can be revealed by a cross-section of different sized banks at a point in time, and, a measure of economies of scale can be derived from it. Therefore, bank scale economies appear as the slope of an average cost curve indicating how costs change with output (Humphrey, 1990).

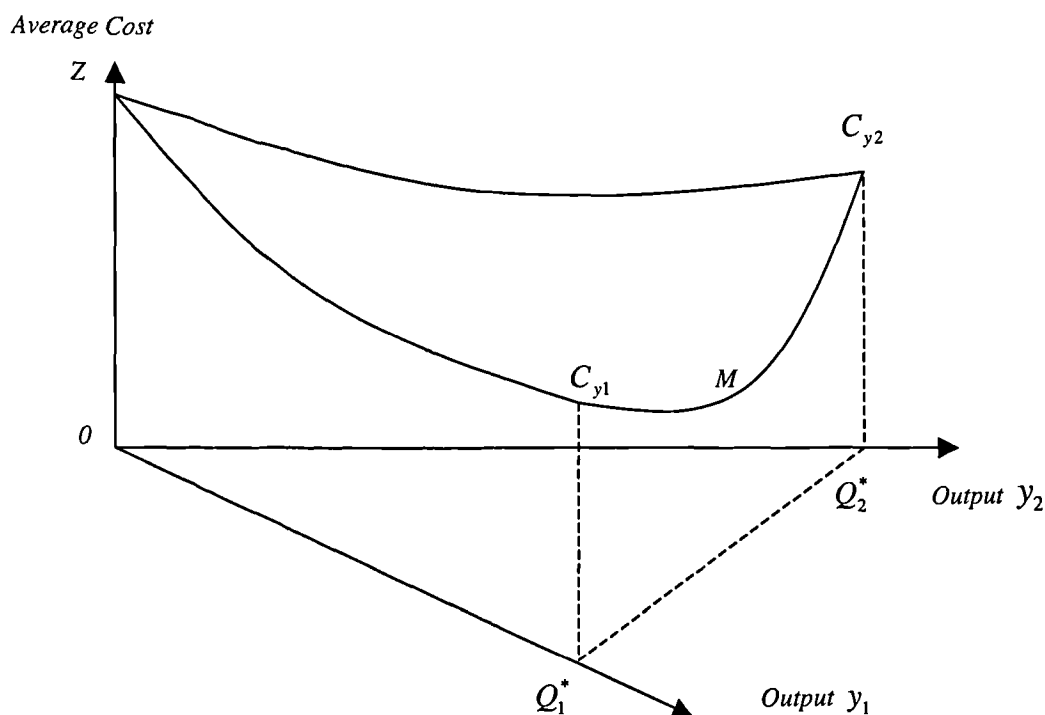


Source: Humphrey (1990, p.38)

Notes: SAC : short-run average cost curve; LAC : long-run average cost curve.

Figure 4.2 illustrates the economies of scope graphically for two products. The horizontal plane measures the output of two products, y_1 and y_2 . The vertical plane measures the average combined cost of production. The curved surface $ZC_{y_1}C_{y_2}$ indicates the average cost of producing different combinations of y_1 and y_2 . A vertical plane extended along the axis Oy_1 at $y_2 = 0$ traces the cost curve ZC_{y_1} , showing the product-specific average cost of different quantities of product y_1 without producing y_2 . Similarly, a vertical plane extended along the axis Oy_2 traces the comparable curve ZC_{y_2} for y_2 . Points on the cost surface between ZC_{y_1} and ZC_{y_2} show the combined cost of producing diverse combinations of y_1 and y_2 .

Figure 4.2 Economies of Scope



Source: Scherer and Ross (1990, p.101)

Supposing a third vertical plane is constructed to intersect axes Oy_1 and Oy_2 at 45-degree angles, it would cut the curved cost surface along line $C_{y_1}C_{y_2}$, tracing out the implications of producing different linear output combinations of y_1 and

y_2 . Its midpoint M pinpoints the average cost of producing half as much of product y_1 as quantity OQ_1^* in combination with half as much of product y_2 as quantity OQ_2^* . When $C_{y_1}C_{y_2}$ is convex downward, as shown in Figure 4.2, economies of scope exist, since it would be cheaper to produce y_1 and y_2 together rather than separately. Conversely, if $C_{y_1}C_{y_2}$ were concave downward, diseconomies of scope exist, because it would be more expensive to produce y_1 and y_2 together than separately (Scherer and Ross, 1990).

As indicated by Clark (1988), there are two potential sources of economies of scale and scope in banking. First, spreading fixed costs. If excess capacity exists, fixed or quasi-fixed branch costs, labour costs, or computer and telecommunications equipment costs may be spread over large levels of output and/or joint usage of these fixed resources. For example, employees at small banks are likely to be unspecialised. These unspecialised employees are then a fixed input that can be shared in the production of a number of products, with the potential to achieve economies of scope. As these small banks grow, they may be able to hire more specialised employees. Theoretically, greater specialisation will lead to reductions in per unit cost. Thus, in this example, increased size may result in production economies through substituting economies of scale for economies of scope.

In spite of the large set-up costs required, computer and telecommunications equipment can process a large number of transactions at a small additional cost per transaction. It is possible to reduce the per-unit cost of these banks if they increase the number of transactions that can be conducted by this equipment. Thus, economies of scale are realised. Moreover, if excess capacity of the equipment exists, its cost may be spread over an expanded product mix, thus realising economies of scope.

Information production is the second basis for both economies of scale and scope. For example, information collected from servicing a customer's deposits and

loans may be ‘reused’. Reuse may help reduce the incremental costs of extending additional services, since the cost of reusing information is usually less than the independent cost of its production. Hence, economies of scale will occur if the information is reused to produce more of the same type of service. Alternatively, economies of scope will occur if the information is reused to offer another type of service.

According to Berger, Hanweck, and Humphrey (1987), there are two more sources for economies of scope: risk reduction and customer cost economies. Theoretically, asset diversification and asset-liability maturity matching can reduce portfolio and interest rate risks. To reduce risk in their revenue streams, banks may be willing to incur extra operating and/or interest costs. In addition, when bank services are situated jointly, customer-incurred banking costs may be reduced due to transportation cost savings, ease of inter-account funds transfers, etc. Even if bank-incurred costs are increased, banks may respond to this joint demand to the extent that revenues are raised through higher fee income, larger balances, or increased market share.

4.2.2 Economies of Scale and Scope under Different Approaches and Measures

Generally, there are two types of approaches employed in the literature to estimate the economies of scale and scope. The traditional non-frontier models estimate an average practice cost function that relates bank cost to output levels and input prices. A two-sided error term is included in the cost function to capture measurement error or any unpredicted factor that affected a bank’s costs over the sample period. Thus, the non-frontier models are based on the assumption that there is no X-inefficiency⁶⁶ and the banks are using the same management and production technology (Mester, 1996).

⁶⁶ X-efficiency can be characterized as the superior management of resources, and shows how closely a firm approaches its highest operational capability. For details, please see Chapter 3.

However, Berger, Hunter, and Timme (1993) claim that the concepts of economies of scale and scope are strictly applicable only to the X-efficient frontier. Thus, the traditional non-frontier models of costs overlooking X-inefficiencies confound the scale and scope economy measures. Kumbhakar (1991, 1996) argues that, although neglecting technical inefficiency in a cost function may not affect the consistency property of the parameter estimates, except for the intercepts, exclusion of allocative inefficiency may result in inconsistent parameter estimates. This dissimilarity is due to the fact that allocative inefficiency is input price dependent whereas technical inefficiency is not.

Recent studies have reported another way to examine the economies of scale and scope of banks, which is abstracted from inefficiencies in production. The new measures are based on the estimated cost frontiers and so indicate whether a bank that is minimizing the cost of producing a particular output bundle could lower costs proportionately by choosing another level of output or by changing its output mix (Mester, 1996). The most common approach is the stochastic (translog) cost frontier approach. It is therefore the preferred method in this chapter.

Basically, there are two types of measures to calculate economies of scale and scope: the standard measures and the expansion path measures. The major standard measures determine if existing banks are competitive relative to banks with exactly the same product mix or banks that are specialised completely. The assumption of other standard measures is that banks should be able to increase one of their products, holding others at a constant level.

However, the standard measures may be of little use in evaluating competitive challenges between currently existing banks, because banks rarely, if ever, have the same product mix, are specialised completely, or increase one output while holding others constant. Berger et al. (1987) developed the expansion path measures, which capture the impact of changing scale and product mix

simultaneously. They are thus more general than the standard measures. For these reasons, they are used as the preferred measures in this chapter. The different approaches and measures will be explained in more detail in section 4.3. The following selective literature review focuses on the banking studies that employed various approaches and measures to estimate economies of scale and scope to some extent. Table 4.1 presents a summary of the relative studies reviewed.

Most studies on economies of scale and scope use the traditional non-frontier translog cost models with the standard measures. Usually, the results indicate overall economies of scale for small banks and overall economies of scope for all banks (Rezvanian and Mehdian, 2002; Mertens and Urga, 2001; etc.). Some studies use the stochastic frontier approach and the standard measures, and find mixed results. For example, Allen and Rai (1996) estimated economies of scale and scope for 194 banks in fifteen countries from 1988 to 1992. The results show that small banks in all countries exhibit significant economies of scale. In addition, there is no significant evidence of either economies or diseconomies of scope. Employing the same approach and similar measures, Mester (1996) estimated economies of scale and scope for 214 US banks in the Third Federal Reserve District for 1991-1992. The results indicate slight economies of scale and scope neutrality for these banks.

To determine whether the X-inefficiencies embedded in the traditional non-frontier approach significantly bias the measure of scale and scope economies, a few studies compare the differences between the stochastic frontier approach and the traditional non-frontier approach. The results are mixed. For example, applying both stochastic frontier and traditional non-frontier approaches, together with the standard measures, Mester (1993) investigated economies of scale and scope for 1,015 US savings and loans (S&Ls) in 1991. The estimation of the traditional non-frontier approach yields similar results to the stochastic frontier approach. Nearly constant returns to scale and economies of scope have been found for the entire sample of S&Ls.

Table 4.1 Summary of Selective Banking Studies on Economies of Scale and Scope

Authors	Approach	Measure	Sample	Scale	Scope	Additional Remarks
Rezvanian and Mehdiian (2002)	Non-frontier	Standard	10 Singaporean commercial banks from 1991 to 1997 (70 obs.)	- Overall economies of scale for small and medium sized banks; - Economies of scale specific to both loans and securities.	- Overall economies of scope for all groups of banks; - Economies of scope specific to all three types of outputs.	- Groups of banks: all sample, large, medium, and small. - Total assets of medium banks are between S\$10,107,000 and S\$13,868,000. - Outputs include loans, securities, and other earning assets. - All the values of scale and scope economies of banks for each year are not significant.
Mertens and Urga (2001)	Non-frontier	Standard	79 Ukrainian commercial banks in 1998	- Overall economies of scale for all sample banks & small banks; - Economies of scale specific to securities for large and medium banks; - Economies of scale specific to loans for all groups of banks.	Overall economies of scope for all groups of banks.	- Groups of banks: all sample, large and medium, and small. - Total assets of small banks are less than UAH 100m. - Outputs include interbank loans, securities, and loans.
Allen and Rai (1996)	Frontier	Standard	785 banks in 15 countries from 1988 to 1992	Overall economies of scale for small banks.	Scope neutrality for all banks.	Large and small: if asset size is above and below the median of all banks in the country, respectively.
Mester (1996)	Frontier	Standard	214 U.S. banks in the Third Federal Reserve District for 1991-1992.	Overall economies of scale for all groups of banks.	Within-sample economies of scope for all groups of banks.	- Groups of banks: all banks, banks with assets under \$72 million, between \$72 million and \$144 million, between \$144 million and \$280 million, and over \$280 million. - Outputs include real estate loans, industrial loans, and individual loans.
Berger and Humphrey (1991)	Frontier (thick frontier approach) and Non-frontier	Standard and Expansion Path	7,653 branching state banks in US in 1984	- Overall economies of scale for the smallest banks; - Slight overall scale diseconomies for the largest banks.	- Scope diseconomies under the frontier approach yields; - Scope economies under the traditional approach; - Scope neutrality presented under both approaches.	- Groups of banks in terms of asset size (unit: \$ millions): 0-10; 10-25; 25-50; 50-75; 75-100; 100-200; 200-300; 300-500; 500-1000; 1000-2000; 2000-5000; 5000-10,000; > 10,000. - Also estimates 6,298 unit state banks.

(continued on next page)

Table 4.1 (continued)

Mester (1993)	Non-frontier and Frontier	Standard	1,015 S&Ls in 1991	U.S.	1. Overall economies of scale under both approaches.	1. Within-sample economies of scope under both approaches.	1. Groups of S&Ls: mutual and stock. 2. The traditional approach yields larger degree of overall economies of scale (0.015 vs. 0.013). It yields larger degree of within-sample economies of scope (28.58 vs. 17.23 for mutual and 3.12 vs. 2.03 for stock).
Berger et al. (1987)	Non-frontier	Standard and Expansion -path	413 branching state banks		1. Constant returns to scale for all banks under both measures.	1. Modest scope economies for the smallest banks, and severe scope diseconomies for the largest under the standard measures; 2. Diseconomies of scope for small banks, and scope neutral for others under the expansion path measures.	1. Groups of banks in terms of deposit size (unit: \$ millions): 0-10; 10-25; 25-50; 50-75; 75-100; 100-200; 200-300; 300-500; 500-1000. 2. Both production and intermediation approaches are used. For comparison, the reports here are only from the results under intermediation approaches. 3. It also estimates the economies of scale and scope of 214 unit banking state, also the plan level economies. Since they are not consistent with other studies, they are not reported.
Rime and Siroh (2003)	Non-frontier	Standard and Expansion -path	289 banks from 1996 to 1999 (total 1,156 obs.)	Swiss	1. Economies of scale for banks with assets less than Sfr 1.5 billion in 1996 and 1998 under both measures; 2. For the same size banks in 1997 and 1999, economies of scale under the standard measure, and constant returns to scale under the expansion path measures; 3. No economies of scale for the large banks under both measures.	1. Expansion path subadditivity exists for banks in 1997 with assets less than Sfr 500 million. 2. There is scope neutrality for others.	1. Groups of banks: assets (A)<100, 100<A<200, 200<A<500, 500<A<1500, 1500<A<10,000, 10,000<A (unit: Sfr million). 2. Outputs include loans to banks, mortgage loans, loans to customers, securities and participations, traditional off-balance-sheet positions, trading activities, and brokerage and portfolio management.
Mitchell and Onvural (1996)	Non-frontier	Standard and Expansion -path	306 and 331 US branching state banks in 1986 and 1990, separately	US	1. Increasing returns to scale for small banks, and constant returns to scale for large banks under the standard measures; 2. Constant returns to scale for all banks under the expansion path measures.	1. Neither economies nor diseconomies of scope were found for all banks under the standard measures; 2. Under the expansion path measures, costs are subadditive in both years only along the expansion path between two smallest size bank groups. Costs are also subadditive in 1986 along the expansion path joining the two largest groups.	1. Bank groups in terms of total assets (unit: \$ billion): 0.5-1; 1-2; 2-5; 5-10; 10-100. 2. Both production and intermediation approaches are used. For comparison, the reports here are only from the results under intermediation approaches. 3. The Fourier Flexible functional form is used in this study.

Using the thick frontier approach⁶⁷ and the traditional non-frontier approach, Berger and Humphrey (1991) estimated both standard and expansion path (only expansion path subadditivity) economies of scale and scope for all US banks in 1984. The results show overall scale economies for the smallest banks and slight overall scale diseconomies for the largest banks. The large difference between the results estimated by different approaches is that the thick frontier approach yields scope diseconomies and the traditional approach yields scope economies (especially for the largest banks). Hence, there is evidence that the traditional non-frontier approach confounds the standard scope economy measures.

On the other hand, applying the traditional non-frontier approach, a few studies compare the differences between the standard measures and the expansion path measures. Different measures were always found to yield different results. Using this method, Berger et al. (1987) investigated the economies of scale and scope for US banks in 1983. The results of the standard measures show constant returns to scale for all banks; modest scope economies are found for the smallest banks, and severe scope diseconomies for the largest. The results of the expansion measures suggest that all banks face constant returns to scale as well, but show diseconomies of scope for small banks, and scope neutrality for others.

Employing the same method, Mitchell and Onvural (1996) estimated the economies of scale and scope for US banks in 1986 and 1990. The results from using the standard measures suggest that small banks enjoy increasing returns to scale while large banks generally face constant returns to scale. There was no evidence of either economies or diseconomies of scope. The results of the expansion path measures showed constant returns to scale for all banks. Costs are subadditive in both years only along the expansion path between the two smallest size bank groups. Costs are also subadditive in 1986 along the expansion path joining the two largest groups.

⁶⁷ Thick frontier approach is a parametric method to detect X-inefficiency. Please see Chapter 3 for details.

Employing the traditional non-frontier model, together with both standard (only for overall scale economies) and expansion path measures, Rime and Stiroh (2003) estimated economies of scale and scope for 289 Swiss banks that operated between 1996 and 1999. Both measures showed there are economies of scale for the small and mid-size banks in 1996 and 1998, but, for banks in 1997 and 1999, the standard measure indicates economies of scale while the expansion path measure implies constant returns to scale. Both measures suggest there are no economies of scale for the large banks in most cases. The results of the expansion path measure also suggest that there is limited evidence of economies of scope for the smaller banks in 1997, and scope neutrality for others.

4.3 Methodology and Data

4.3.1 Empirical Models

Banks are multi-product firms employing a vector of inputs to produce a vector of outputs. Under duality theory, the multi-product cost function dual to the production function can be defined as:

$$C = f(Y, W) \tag{4.1}$$

where

C : total cost,

Y : a vector of outputs,

W : a vector of input prices.

This study also uses a parametric approach with a translog specification, as discussed in Chapter 3. A classical pooled data regression model is applied in this study, given there is not enough data for a panel data model. In common with the published work in this area, time and bank subscripts are dropped for ease of exposition. The traditional non-frontier translog cost function takes the following form:

$$\begin{aligned}\ln C = & \alpha_0 + \sum_p \beta_p \ln y_p + \sum_m \delta_m \ln w_m + \frac{1}{2} \sum_p \sum_q \beta_{pq} \ln y_p \ln y_q \\ & + \frac{1}{2} \sum_m \sum_n \delta_{mn} \ln w_m \ln w_n + \sum_p \sum_m \gamma_{pm} \ln y_p \ln w_m + \varepsilon\end{aligned}\quad (4.2)$$

where

C : total cost,

y_p : p th output,

w_m : m th input price,

ε : a normally distributed random error term.

Both standard symmetry ($\beta_{pq} = \beta_{qp}$, $\delta_{mn} = \delta_{nm}$) and linear homogeneity restrictions ($\sum_m \delta_m = 1$, $\sum_m \delta_{mn} = 0$, $\sum_m \gamma_{pm} = 0$) are imposed during estimation.

Under the stochastic cost frontier approach, the translog cost function takes the following form:

$$\begin{aligned}\ln C = & \alpha_0 + \sum_p \beta_p \ln y_p + \sum_m \delta_m \ln w_m + \frac{1}{2} \sum_p \sum_q \beta_{pq} \ln y_p \ln y_q \\ & + \frac{1}{2} \sum_m \sum_n \delta_{mn} \ln w_m \ln w_n + \sum_p \sum_m \gamma_{pm} \ln y_p \ln w_m + u + v\end{aligned}\quad (4.3)$$

where

u : an X-inefficiency factor,

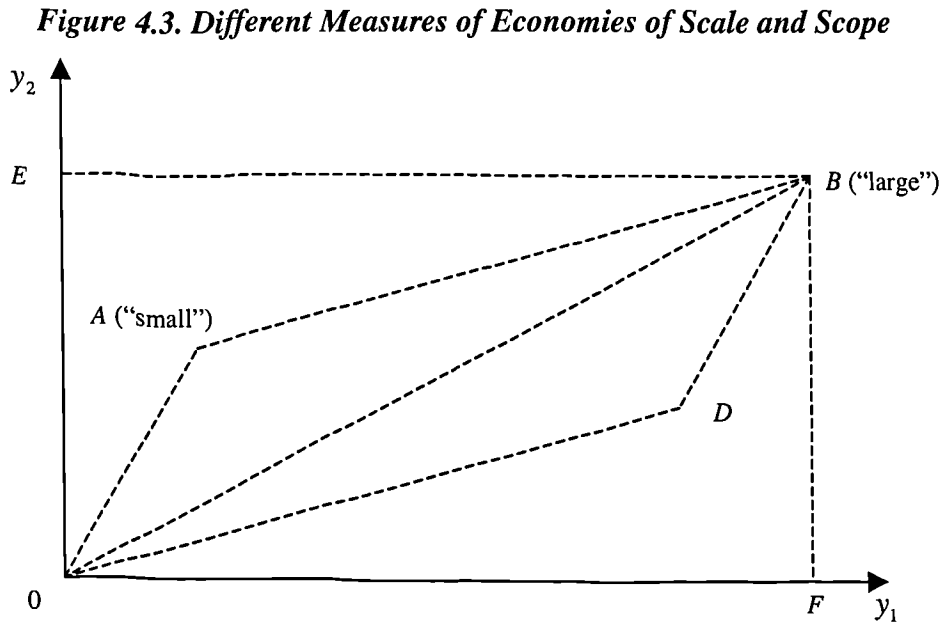
v : the random error.

The above-mentioned standard symmetry restrictions continue to apply. To impose linear homogeneity restrictions on the function, all of the cost and input price terms are normalized by the last input price, w_3 . As discussed in Chapter 3, Shephard's lemma is not applied for either approach, because it would impose the undesirable assumption that there were no allocative inefficiencies (Berger, 1993).

4.3.2 Measures of Economies of Scale and Scope

Basically, there are three standard measures of economies of scale – overall scale economies (*SCALE*), product-specific scale economies (*PSSE*), and within-sample product-specific scale economies (*WPSSE*). Moreover, economies of scope can be

assessed in four different ways under the standard measures – overall scope economies (*SCOPE*), within-sample overall scope economies (*WSCOPE*), product-specific scope economies (*PSCO*), and within-sample product-specific scope economies (*WPSCO*). Finally, there are two expansion path measures for economies of scale and scope - expansion path scale economies (*EPSCE*) and expansion path subadditivity (*EPSUB*). Following Berger et al. (1987), Figure 4.3 is employed to illustrate the measures of economies of scale and scope graphically. It shows an output plane with two sizes of banks *A* and *B* producing two outputs in quantities $Y^A = [y_1^A y_2^A]$ and $Y^B = [y_1^B y_2^B]$, respectively. Costs can be thought of as lying along a manifold above this output plane.



Source: Berger et al. (1987, p.505)

The overall scale economies (*SCALE*), also called ray scale economies, was developed by Baumol et al. in 1982. It is said to exist if an equi-proportionate increase in all outputs leads to a less than equi-proportionate increase in cost. *SCALE* is measured by the elasticity of cost with respect to output, taken along a ray tY that holds output mix constant:

$$SCALE(Y) \equiv \partial \ln C(tY) / \partial \ln t|_{t=1} = \sum_p \partial \ln C(Y) / \partial \ln y_p, \quad (4.4)$$

where

$C(Y)$: a multiple-output cost function,
 Y : a vector of outputs, $= [y_1 \dots y_p]'$,
 t : a scale adjustment factor,
 p : indexes of different products.

$SCALE$ is the multi-product analogue of marginal cost $[\partial C(tY)/\partial t]$ divided by average cost $[C(tY)/t]$ on a ray such as OB in Figure 4.3. $SCALE < 1$ implies economies of scale since costs increase proportionally less than outputs increase, while $SCALE > 1$ implies diseconomies of scale.

Benston, Hanweck, and Humphrey (1982) argued that the overall economies of scale could be divided into two types: the plant (branch)-level and the firm (bank)-level⁶⁸. The plant-level economies of scale refers to cost savings generated by only increasing the output of existing branches (not by adding new branches),

⁶⁸ As indicated by Benston et al. (1982) and Berger et al. (1987), to calculate both plant- and firm-level economies of scale, the cost function should be changed to

$$\begin{aligned}
 \ln C = & \alpha_0 + \sum_p \beta_p \ln y_p + \sum_m \delta_m \ln w_m + \frac{1}{2} \sum_p \sum_q \beta_{pq} \ln y_p \ln y_q \\
 & + \frac{1}{2} \sum_m \sum_n \delta_{mn} \ln w_m \ln w_n + \sum_p \sum_m \gamma_{pm} \ln y_p \ln w_m \\
 & + \rho_B \ln B + \frac{1}{2} \rho_{BB} (\ln B)^2 + \sum_p \rho_{Bp} \ln B \ln y_p + \varepsilon
 \end{aligned}$$

where B is the number of branch offices.

Assuming that output expands while holding the number of branch offices constant, the plant-level of economies of scale are derived using the partial elasticity with respect to y . It is calculated as follows:

$$SCALE_1(Y) = \partial \ln C(tY, B) / \partial \ln t \big|_{t=1} = \sum_p \partial \ln C(Y, B) / \partial \ln y_p$$

Alternatively, assuming that the number of branch offices varies with output, the firm-level economies of scale are derived from the total elasticity. It is computed as follows:

$$\begin{aligned}
 SCALE_2(Y) &= \partial \ln C[(tY, B(tY))] / \partial \ln t \big|_{t=1} \\
 &= SCALE_1(Y) + [\partial \ln C(Y, B) / \partial \ln B \times \sum_p \partial \ln B(Y) / \partial \ln y_p]
 \end{aligned}$$

where $\sum_p \partial \ln B(Y) / \partial \ln y_p$ is estimated by running an auxiliary regression of the form as follows:

$$\ln B = \theta_0 + \sum_p \theta_p \ln y_p + \varepsilon$$

while the firm-level economies of scale refers to cost savings generated by both output and branch expansions. Since the calculation of the two types of overall economies of scale requires the information of the number of branch offices, which is not available for China, so this measure is not used in this chapter.

SCALE does not allow for a change in output mix. Baumol et al. (1982) suggested an additional measure to illustrate how costs change when the output of one product changes with the quantities of all other products held constant. Product-specific scale economies (*PSSE*) are present if an increase in production of a specific product results in a decline in the average cost, holding the other outputs constant. *PSSE* for the k th output can be obtained by examining the relation between its incremental average cost and marginal cost:

$$PSSE(y_k) = [IC(y_k)/y_k] / MC(y_k) = [IC(y_k)/C(Y)] / [\partial \ln C(Y) / \partial \ln y_k] \quad (4.5)$$

where

$IC(y_k)$: the incremental cost of producing y_k ,

$$= [C(y_1, \dots, y_p) - C(y_1, \dots, y_{k-1}, 0, y_{k+1}, \dots, y_p)],$$

$IC(y_k)/y_k$: the average incremental cost of producing y_k ,

$MC(y_k)$: the marginal cost with respect to the k th output⁶⁹.

If the marginal cost is less (more) than average incremental cost at a given level of output, then the value of $PSSE(y_k) > 1$ ($PSSE(y_k) < 1$) implies economies (diseconomies) of scale in production of the k th output.

Empirically, in the framework of the translog cost function, the original version of *PSSE* cannot be calculated because it requires the assumption of zero output for at least one output. Previous studies usually suggest a revised version of *PSSE*, which substitutes the zero level of output with ad hoc values (such as 0.01 or 0.001) to avoid the non-finite representation of the translog cost function. However, Berger et al. (1987) argue that both the conventional and revised version of *PSSE* still require evaluation of the cost function at y_k near zero,

⁶⁹ The incremental cost of the k th product is defined as the difference in cost incurred by the firm when producing the given level of product k , as opposed to producing a zero level, while the quantities of all other products are held constant.

which is generally far outside the sample over which the cost function is estimated. Thus, both versions should be subject to substantial extrapolation error. In addition, the results of the revised measure are highly dependent on the closeness of the approximation. Thus, any findings of the revised *PSSE* could be inappropriate, since it could be reversed by making the approximation to zero output more precise.

To remedy the extrapolation error and the problem of inappropriateness, Mester (1992) defined a new measure of product-specific economies of scale, which is called the within-sample product-specific scale economies (*WPSSE*). The within-sample degree of economies of scale specific to output k :

$$WPSSE(y_k) = [IC(\tilde{y}_k) / C] / [\partial \ln C(Y) / \partial \ln y_k] \quad (4.6)$$

where

$$IC(\tilde{y}_k) = [C(y_1, \dots, y_p) - C(y_1, \dots, y_{k-1}, y_k^m, y_{k+1}, \dots, y_p)],$$

y_k^m = the sample minimum of y_k .

Thus, $WPSSE(y_k)$ is just $PSSE(y_k)$ with the sample minimum of y_k replacing zero⁷⁰. Like $PSSE(y_k)$, $WPSSE(y_k) > 1$ ($WPSSE(y_k) < 1$) implies economies (diseconomies) of scale in production of the k th output.

In principle, both *PSSE* and *WPSSE* for each product should be measured independently from the other products in the product mix (Clark, 1988). In practice, however, such a measurement is meaningless. Due to joint production, it is usually impossible to change the output of one specific product while holding the output of the other products constant. Berger et al. (1987) proposed an alternative measure of economies of scale called expansion path scale economies (*EPSCE*).

⁷⁰ For some bank groups, the minimum levels of bank investments and non-interest income are zero. Following Mester (1992), in this chapter the minimum values of these outputs are the same as the conventional measures (0.001).

EPSCE measures the proportional changes in costs as banks move along the observed expansion path from a small to a large bank. *EPSCE* avoids the unrealistic assumption of constant output mix assumed by *SCALE*, the extrapolation error and the problem of inappropriateness implied by *PSSE*, and the partial constant output mix assumed by both *PSSE* and *WPSSE*. The curve *OAB* in Figure 4.3 can be thought of as the expansion path that banks follow in choosing output bundle *B*, changing product mix as scale increases.

Hence, *EPSCE* is defined as the elasticity of incremental cost with respect to incremental output along the observed expansion path from the small bank *A* to the large bank *B*:

$$EPSCE(Y^A, Y^B) = \frac{\sum_p [(y_p^B - y_p^A) / y_p^B] [\partial \ln C(Y^B) / \partial \ln y_p]}{[C(Y^B) - C(Y^A)] / C(Y^B)} \quad (4.7)$$

where

y_p^A : the quantities of the *p*th output at bank *A*,

y_p^B : the quantities of the *p*th output at bank *B*,

$C(Y^A)$: total costs at bank *A*,

$C(Y^B)$: total costs at bank *B*.

The numerator is the percentage change in cost when each output changes in the same proportion as it does between bundles *A* and *B*. The denominator is the percentage difference in costs between banks *A* and *B* computed from the cost function. $EPSCE < 1$ implies economies of scale since costs increase proportionally less than outputs, while $EPSCE > 1$ implies diseconomies of scale.

Compared to the standard scale economy measures, *EPSCE* is more generalised, which accounts for observed (or more flexible) changes in the output mix between small and large banks. *SCALE* is a special case of *EPSCE*, where the smaller bank is at the origin in Figure 4.3, i.e., $SCALE(Y^A) = EPSCE(0, Y^A)$. Both *PSSE* and *WPSSE* are also special cases of *EPSCE*, where the smaller bank is either at point *E* or *F* or near point *E* or *F* in Figure 4.3.

Baumol et al. (1982) also developed overall scope economies (*SCOPE*). *SCOPE* are presented for a given product mix, if the total costs from the joint production of all products in the product mix are less than the sum of the costs of producing each product independently. That is, *SCOPE* measures the cost saving from joint versus specialised production. The set of all parallelograms that stretch from O to B in Figure 4.3 represents the combinations of two output bundles with various product mixes that sum to Y^B .

Under the assumption of *SCOPE*, the output among banks should be divided into two specialised banks - each produces only one of the two products, corresponding to the largest parallelogram $OEBF$. *SCOPE* at B are the proportional cost increases from dividing Y^B into $Y^E = (0, y_2^B)$ and $Y^F = (y_1^B, 0)$. In a general case with p outputs, *SCOPE* at B are calculated as:

$$SCOPE(Y^B) \equiv [C(y_1^B, 0, \dots, 0) + \dots + C(0, \dots, 0, y_p^B) - C(y_1^B, \dots, y_p^B)] / C(y_1^B, \dots, y_p^B), \quad (4.8)$$

$SCOPE > 0$, $SCOPE < 0$, and $SCOPE = 0$ suggest the presence of overall scope economies, scope diseconomies, and scope neutrality, respectively.

Another measure of economies of scope is product-specific scope economies (*PSCO*). *PSCO* exists if the cost of jointly producing one particular output with the existing output bundle is smaller than the sum of the cost of producing this output and the rest of the output bundle separately. Commonly, *PSCO* can be calculated as follows:

$$PSCO(y_k) = [C(y_1, \dots, y_{k-1}, 0, y_{k+1}, \dots, y_p) + C(0, \dots, 0, y_k, 0, \dots, 0) - C(y_1, \dots, y_p)] / C(y_1, \dots, y_p) \quad (4.9)$$

$PSCO > 0$, $PSCO < 0$, and $PSCO = 0$ indicate the presence of product-specific scope economies, scope diseconomies, and scope neutrality, respectively.

Previous studies have developed revised versions of these measures, which substitute the zero level of output in estimating both the *SCOPE* and *PSCO* with an arbitrary minimum value (such as 0.01 or 0.001), because the translog cost

function is undefined for a zero output level. However, as indicated by Berger et al. (1987), the problems of extrapolation and inappropriate measures still exist. To avoid the extrapolation inherent in the measures of *SCOPE* and *PSCO*, Mester (1992) suggested a new approach: substituting the minimum output within the sample for the zero level of output. Therefore, the within-sample scope economies (*WSCOPE*) is defined as follows:

$$\begin{aligned} WSCOPE(Y^B) \equiv & [C(y_1^B - 3y_1^m, y_2^m, y_3^m, y_4^m) + C(y_1^m, y_2^B - 3y_2^m, y_3^m, y_4^m) \\ & + C(y_1^m, y_2^m, y_3^B - 3y_3^m, y_4^m) + C(y_1^m, y_2^m, y_3^m, y_4^B - 3y_4^m) - C(y_1^B, y_2^B, y_3^B, y_4^B)] \\ & / C(y_1^B, y_2^B, y_3^B, y_4^B) \end{aligned} \quad (4.10)$$

where

y_p^m : the minimum value of y_p in the sample⁷¹.

WSCOPE measures the percentage increase in cost of dividing the outputs into relative specialised banks, but none more specialised than the most specialised bank in the sample. $WSCOPE > 0$, $WSCOPE < 0$, and $WSCOPE = 0$ suggest the presence of within-sample scope economies, scope diseconomies, and scope neutrality, respectively. In addition, the within-sample product-specific economies of scope (*WPSCO*) is developed and defined as:

$$\begin{aligned} WPSCO(y_k) = & [C(y_1, \dots, y_{k-1}, y_k^m, y_{k+1}, \dots, y_p) + C(y_1^m, \dots, y_{k-1}^m, y_k - y_k^m, y_{k+1}^m, \dots, y_p^m) \\ & - C(y_1, \dots, y_p)] / C(y_1, \dots, y_p) \end{aligned} \quad (4.11)$$

where

y_k^m : the minimum level of output k within the sample.

Therefore, $WPSCO(y_k)$ is just $PSCO(y_k)$ with the sample minimum of y_k replacing 0. *WPSCO* is said to exist in the production of y_k when

⁷¹ In this chapter, $(y_p^B - 3y_p^m)$ in Eq. (4.10) is substituted by $(y_p^B - y_p^m)$, because, for the output vector y_1 (deposits) and y_2 (loans), the value calculated by the former equation is negative, and hence cannot be used in the translog function to obtain costs. This may overestimate the costs of producing separately, or underestimate the costs of joint production. Hence, the results of *WSCOPE* should be interpreted with regard to this possible bias.

$WPSCO(y_k) > 0$, whereas $WPSCO(y_k) < 0$ indicates within-sample product-specific diseconomies of scope.

Baumol et al. (1982) also indicate that a sufficient condition for a multiproduct cost function to exhibit economies of scope is the cost complementarities between products. The cost complementarities imply that the marginal cost of producing any one product decreases with increases in the quantities of all other products. This condition may be expressed as:

$$\frac{\partial^2 C}{\partial y_p * \partial y_q} = \frac{C}{y_p * y_q} * \left(\frac{\partial^2 \ln C}{\partial \ln y_p * \partial \ln y_q} + \frac{\partial \ln C}{\partial \ln y_p} * \frac{\partial \ln C}{\partial \ln y_q} \right) < 0$$

However, as indicated by Berger et al. (1987), the test for cost complementarities is a local test at the mean data point. It is impossible to have cost complementarities at every data point in the case of translog cost functions. In addition, banking studies specifying more than two products find some complementarities and some non-complementarities, and give inconclusive economies of scope findings. Finally, the implementation of cost complementarity tests is sometimes inconsistent with economic theory.

In detail, theory requires non-negative marginal costs, which means that the latter two terms in the above condition equation must be positive and the first term in parentheses must be negative for cost complementarity or joint production to hold. Mester (1987) reported instances of negative marginal costs and negative average incremental costs. Kolari and Zardoohi (1987) reported positive estimates for the first term in parentheses, yet found evidence of economies of scope. Therefore, the cost complementarity estimates and tests reported by these authors may be of questionable validity⁷². For this reason, this thesis makes no attempt to estimate the cost complementarity.

Since banks in different size categories appear to “specialize” in different output

⁷² For details, please see Berger et al. (1987).

compositions, as shown in Figure 4.3, a more likely division of output bundle Y^B includes the representative bank at A along the expansion path OAB . D is a hypothetical bank, and $Y^A + Y^D = Y^B$, shown by parallelogram $OABD$. Accordingly, Berger et al. (1987) developed another measure called expansion path subadditivity (*EPSUB*), which gives the proportional cost increase from two-bank instead of one-bank production of Y^B , using the smaller bank on the expansion path:

$$EPSUB(Y^B) \equiv [C(Y^A) + C(Y^D) - C(Y^B)] / C(Y^B) \quad (4.12)$$

EPSUB measures the predicted cost differences if an observed bank were arbitrarily divided into two smaller banks that produced the same total output.

Following Berger et al. (1987) and Mitchell and Onvural (1996), *EPSUB* is estimated along the expansion path from the mean output level of one size class to the mean of the next size class. $EPSUB < 0$ implies that the two smaller banks could produce the same output at a lower total cost and output bundle B is not competitively viable. This is referred to as “superadditive” costs.

$EPSUB > 0$ implies that the larger bank incurs lower costs and the smaller banks have an incentive to expand since joint production can occur at lower costs. This is referred to as “subadditive” costs. As claimed by Berger et al. (1987), *EPSUB* is also a generalized version of *SCOPE*. In detail, *SCOPE* is a special case of *EPSUB*, where the smaller bank specializes at point E or F in Figure 4.3.

In the next section, both the traditional non-frontier and stochastic frontier estimates of equations (4.2) and (4.3), together with the original data set, are used to compute economies of scale and scope. These estimates are entered into equations:

- (4.4) to calculate overall economies of scale, *SCALE*;
- (4.6) to obtain within-sample product-specific economies of scale, *WPSSE*;
- (4.7) to compute expansion path economies of scale, *EPSCE*;
- (4.10) to obtain within-sample economies of scope, *WSCOPE*;

- (4.11) to calculate within-sample product-specific economies of scope, *WPSCO*;
- (4.12) to obtain expansion path subadditivity, *EPSUB*.

4.3.3 Data

As discussed in Chapter 2, this chapter concentrates on the two major types of commercial banks in China – four state-owned commercial banks and 10 joint-stock commercial banks - over the period 1985-2002. The dataset consists of 187 observations. All of the data (except where mentioned specifically) used in this study are obtained from various editions of the *Almanac of China's Finance and Banking* issued by the China Finance Society.

As discussed in Chapter 3, the modified intermediation approach is adopted in this study to measure bank outputs. Based on this approach, outputs include total deposits (y_1), total loans (y_2), total investments (y_3), and non-interest income (y_4), which is used to represent the off-balance-sheet (OBS) activities. Inputs include borrowed funds (x_1), fixed assets (x_2), and employees (x_3). The definition of each variable is consistent with those in Chapter 3. Table 4.2 illustrates the major changes in output mix of the 14 sample banks during the period 1985-2002. Table 4.3 reports the information related to the different categories of assets in the sample banks, together with the expansion paths for different categories of banks.

Many studies in the banking literature are concerned with the possible endogenous nature of the independent variables (especially bank outputs). Molyneux, Altunbas, and Gardener (1996) provided an excellent review of this issue. To solve this problem, Benston et al. (1982) included an independent variable, measuring average account size, to adjust the number of accounts for bank size. However, Kolari and Zardkoohi (1987) argued that the inclusion of account size in the model does not necessarily resolve the endogeneity problem. Instead, it is likely to create a multicollinearity situation, since the number and average size of accounts are highly correlated.

Table 4.2 Summary Statistics for Sample Banks (1985-2002)

Unit: million RMB

Bank groups	Periods	No. of observations	y1 (Total deposits)	y2 (Total loans)	y3 (Total investments)	y4 (Non-interest income)	w1 (Prices of funds)	w2 (Prices of fixed assets)	w3 (Prices of employees)
All banks	1985-2002	187	159057 (231466)	143498 (192872)	246378 (53000)	1324 (2668)	0.021 (0.020)	0.287 (0.214)	0.004 (0.002)
All state-owned Banks	1985-2002	72	373043 (252155)	341378 (178784)	55633 (75399)	2799 (3793)	0.031 (0.027)	0.206 (0.180)	0.003 (0.001)
All joint-stock banks	1987-2002	115	25083 (28081)	19608 (23934)	5232 (7476)	401 (649)	0.015 (0.010)	0.337 (0.218)	0.005 (0.002)
State-owned Banks (1)	1985-1992	32	187514 (100859)	226949 (124126)	10018 (15625)	1892 (4970)	0.042 (0.028)	0.211 (0.100)	0.001 (0.000)
State-owned Banks (2)	1993-2002	40	521466 (238378)	432922 (163109)	92125 (84158)	3526 (2311)	0.022 (0.023)	0.202 (0.226)	0.003 (0.001)
Joint-stock Banks (1)	1987-1992	22	5596 (10597)	5202 (7938)	561 (713)	39 (85)	0.027 (0.011)	0.358 (0.366)	0.004 (0.001)
Joint-stock Banks (2)	1993-2002	93	29693 (28969)	23016 (25181)	6337 (7917)	486 (694)	0.012 (0.007)	0.332 (0.169)	0.006 (0.002)

Sources: *Almanac of China's Finance and Banking (1986-2003)*; *China Statistical Yearbook (2003)*

Notes: 1. All the figures are based on the mean value of the relative year. Standard deviations are in parentheses.

2. All the figures are deflated by the CPI, with 1985 as the base year.

3. For the definition of these variables, please see Chapter 3.

Kim (1985) suggested a theoretical solution to this problem, in which the joint estimation of an equation system consisting of a translog cost function, a cost-share equation and a revenue-share equation, along with the proper parameter restrictions, was the solution for obtaining consistent estimates with endogenous outputs. But Kolari and Zardkoohi (1987) indicated that this procedure might not be completely necessary. On the one hand, the endogeneity problem is no more or less serious than cost estimations in other industries. On the other hand, this approach takes into account only the supply side of the market, without covering the demand side. Given these problems, no attempt is made to deal with this issue in this study.

Table 4.3 Total Assets of Sample Banks (1985-2002)

Unit: million RMB

Categories	Periods	Mean	Median	Min.	Max.	Asset Range in Expansion Path
All sample banks	1985-2002	254431	66317	386	1432002	(386-66317) -- (66317-1432002)
All State-owned Banks	1985-2002	600243	554222	168843	1432002	(168843-554222) -- (554222-1432002)
All Joint-stock Banks	1987-2002	37923	20561	386	231964	(386-20561) -- (20561-231964)
State-owned Banks (1)	1985-1992	390217	389397	168843	789022	(168843-389397) -- (389397-789022)
State-owned Banks (2)	1993-2002	768264	749361	406523	1432002	(406523-749361) -- (749361-1432002)
Joint-stock Banks (1)	1987-2002	9755	4336	386	85976	(386-4336) -- (4336-85976)
Joint-stock Banks (2)	1993-2002	44586	28233	2621	231964	(2621-28233) -- (28233-231964)

Sources: Almanac of China's Finance and Banking (1986-2003)

Notes: 1. Total assets are adjusted for inflation using the CPI, with 1985 as the base year. 2. To calculate the *EPSCE* and *EPSUB*, sample banks are divided into large banks and small banks by the median value of total assets in the relevant categories. 3. The expansion path is from "group of small banks" to "group of large banks".

4.4 Empirical Results

Before the traditional non-frontier (4.2) and the stochastic frontier (4.3) functions are estimated, two revised functions have been estimated to see if the costs of the sample banks would be changed under different ownership and regulatory

environments. Two dummy variables, an ownership dummy (zero for state-owned banks, and one for joint-stock banks) and a reform dummy (zero for the first reform stage, and one for the second reform stage), are added to functions (4.2) and (4.3) simultaneously.

The results of the revised non-frontier function show that the coefficient of the ownership dummy is significantly negative (-0.303) at the 1% level, and the coefficient of the reform dummy is 0.052 , which is insignificant at the 10% level. This suggests that, under the traditional non-frontier approach, it is important to test for differences in economies of scale and scope between the state-owned banks and the joint-stock banks, but not between the banks in different reform stages.

The results of the revised stochastic frontier function show that the coefficient of the ownership dummy is significantly negative (-0.334) at the 1% level, and the coefficient of the reform dummy is significantly positive (0.086) at the 5% level. This again indicates that it is important to test the differences in economies of scale and scope between different ownership banks and banks in different reform stages under the stochastic frontier approach.

The coefficients and p -values after estimating equations (4.2) and (4.3) are reported in Table 4.4⁷³. The result shows that, among 36 coefficients estimated by the traditional non-frontier cost function, only nine coefficients are found to be statistically significant at the 10% level.

Using the stochastic frontier model, just one of 28 coefficients is statistically significant at the 10% level. The findings are hard to explain, because the second-order terms of outputs and input price do not make much economic sense. The adjusted R-square is, for both models, 0.99 , indicating that 99% of the variation in total cost is explained by variation in independent variables.

⁷³ Given the coefficients estimated under the revised versions are similar to those under the original functions, the calculation of economies of scale and scope is based on the coefficients estimated by the original functions.

Table 4.4. Parameter Estimates of the Translog Cost Functions

Variable	Description	Stochastic Frontier Approach		Traditional Non-frontier Approach	
		Coefficients	p-values (S.E.)	Coefficients	p-values (S.E.)
<i>Constant</i>		0.966	0.432 (1.231)	1.546	0.068 (0.842)
<i>LN_{Y1}</i>	Total deposits	0.891	0.377 (1.008)	1.006	0.054 (0.519)
<i>LN_{Y2}</i>	Total loans	-0.111	0.898 (0.836)	-0.323	0.511 (0.490)
<i>LN_{Y3}</i>	Total investments	0.053	0.590 (0.099)	0.069	0.135 (0.046)
<i>LN_{Y4}</i>	Non-interest income	-0.012	0.945 (0.171)	0.011	0.894 (0.080)
<i>LN_{Y1}LN_{Y1}/2</i>	Total deposits * Total deposits/2	-0.092	0.842 (0.463)	-0.217	0.406 (0.260)
<i>LN_{Y1}LN_{Y2}</i>	Total deposits * Total loans	0.078	0.841 (0.387)	0.170	0.489 (0.245)
<i>LN_{Y1}LN_{Y3}</i>	Total deposits * Total investments	-0.052	0.506 (0.078)	-0.012	0.803 (0.049)
<i>LN_{Y1}LN_{Y4}</i>	Total deposits * Non-interest income	0.080	0.251 (0.070)	0.073	0.031 (0.034)
<i>LN_{Y2}LN_{Y2}/2</i>	Total loans * Total loans/2	-0.021	0.950 (0.339)	-0.067	0.780 (0.240)
<i>LN_{Y2}LN_{Y3}</i>	Total loans * Total investments	0.041	0.598 (0.078)	0.001	0.988 (0.048)
<i>LN_{Y2}LN_{Y4}</i>	Total loans * Non-interest income	-0.095	0.148 (0.066)	-0.091	0.011 (0.035)
<i>LN_{Y3}LN_{Y3}/2</i>	Total investments * Total investments/2	0.013	0.013 (0.005)	0.010	0.004 (0.003)
<i>LN_{Y3}LN_{Y4}</i>	Total investments * Non-interest income	0.003	0.667 (0.007)	0.005	0.114 (0.003)
<i>LN_{Y4}LN_{Y4}/2</i>	Non-interest income * Non-interest income/2	0.001	0.899 (0.009)	0.001	0.855 (0.004)
<i>LN_{W1}</i>	Price of funds	0.247	0.382 (0.282)	0.284	0.291 (0.268)
<i>LN_{W2}</i>	Price of fixed assets	0.491	0.212 (0.393)	0.462	0.124 (0.230)
<i>LN_{W3}</i>	Price of employees	NA	NA (NA)	0.253	0.146 (0.173)
<i>LN_{W1}LN_{W1}/2</i>	Price of funds * Price of funds/2	0.029	0.433 (0.037)	0.053	0.175 (0.039)
<i>LN_{W1}LN_{W2}</i>	Price of funds * Price of fixed assets	0.076	0.170 (0.055)	0.048	0.331 (0.049)
<i>LN_{W1}LN_{W3}</i>	Price of funds * Price of employees	NA	NA (NA)	-0.101	0.001 (0.025)
<i>LN_{W2}LN_{W2}/2</i>	Price of fixed assets * Price of fixed assets/2	-0.088	0.302 (0.085)	-0.058	0.376 (0.065)

(continued on next page)

Table 4.4 (continued)

<i>LNW2LNW3</i>	Price of fixed assets * price of employees	NA	NA (NA)	0.010	0.773 (0.035)
<i>LNW3LNW3/2</i>	Price of employees * Price of employees/2	NA	NA (NA)	0.091	0.001 (0.035)
<i>LNy1LNW1</i>	Total deposits * Price of funds	-0.012	0.909 (0.104)	0.041	0.614 (0.080)
<i>LNy1LNW2</i>	Total deposits * Price of fixed assets	-0.050	0.746 (0.155)	-0.086	0.424 (0.107)
<i>LNy1LNW3</i>	Total deposits * Price of employees	NA	NA (NA)	0.045	0.567 (0.079)
<i>LNy2LNW1</i>	Total loans * Price of funds	0.036	0.719 (0.100)	-0.013	0.865 (0.078)
<i>LNy2LNW2</i>	Total loans * Price of fixed assets	0.006	0.965 (0.136)	0.035	0.730 (0.102)
<i>LNy2LNW3</i>	Total loans * Price of employees	NA	NA (NA)	-0.022	0.773 (0.076)
<i>LNy3LNW1</i>	Total investments * Price of funds	-0.011	0.600 (0.022)	-0.009	0.401 (0.102)
<i>LNy3LNW2</i>	Total investments * Price of fixed assets	0.017	0.475 (0.023)	0.015	0.204 (0.120)
<i>LNy3LNW3</i>	Total investments * Price of employees	NA	NA (NA)	-0.007	0.406 (0.008)
<i>LNy4LNW1</i>	Non-interest income * Price of funds	0.018	0.426 (0.023)	0.015	0.262 (0.013)
<i>LNy4LNW2</i>	Non-interest income * Price of fixed assets	0.024	0.456 (0.033)	0.027	0.092 (0.016)
<i>LNy4LNW3</i>	Non-interest income * Price of employees	NA	NA (NA)	-0.042	0.037 (0.020)
$\bar{R}^2$		0.99		0.99	

Note: Bold typeface for values indicates significantly different from zero at the 10% level.

Using these estimated coefficients and the original data set, different measures of economies of scale and scope are calculated. The results are reported in Table 4.5. Table 4.5(a) summarises the results using the stochastic frontier approach; and Table 4.5(b) reports the results using the traditional non-frontier approach. In addition, in the discussion that follows, significance will mean at the 10% level, unless stated otherwise.

Table 4.5 Economies of Scale and Scope

(a) Stochastic frontier approach

	Types of scale and scope economies	Descriptions	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			All banks	All state-owned	All joint-stock	State-owned-1	State-owned-2	Joint-stock-1	Joint-stock-2
1	SCALE	Overall scale economies	1985-2002 0.973***	1985-2002 1.030***	1987-2002 0.937***	1985-1992 1.085***	1993-2002 0.986*	1987-1992 1.013	1993-2002 0.919***
2	EPSCE	Expansion path scale economies	1.003	1.893	1.024	2.205*	0.829	0.945	1.001
3	WSCOPE	Within-sample scope economies	-0.81***	1.064***	-0.70***	1.274***	0.690***	-0.216	-0.45***
4	EPSUB	Expansion path subadditivity	0.192***	0.204***	0.189***	0.252	0.177**	0.270**	0.181***
5	WPSSE(y ₁)	Within-sample scale economies specific to y ₁ (total deposits)	0.679***	0.354***	0.796***	0.024**	0.426***	0.797***	0.715***
6	WPSSE(y ₂)	Within-sample scale economies specific to y ₂ (total loans)	-2.79***	-1.32***	-2.53***	-1.16***	-0.75***	-2.60***	-2.13***
7	WPSSE(y ₃)	Within-sample scale economies specific to y ₃ (total investments)	2.709***	1.410	3.522***	0.458	1.854***	2.997**	2.251***
8	WPSSE(y ₄)	Within-sample scale economies specific to y ₄ (the OBS activities)	-2.56***	-3.52***	-1.34***	-1.02**	0.723	0.851	0.784
9	WPSCO(y ₁)	Within-sample scope economies specific to y ₁ (total deposits)	-0.87***	-0.26***	-0.84***	-0.04	0.011	-0.49***	-0.63***
10	WPSCO(y ₂)	Within-sample scope economies specific to y ₂ (total loans)	-0.68***	0.738***	-0.59***	0.818***	0.078**	-0.36***	-0.49***
11	WPSCO(y ₃)	Within-sample scope economies specific to y ₃ (total investments)	-0.19***	0.065*	-0.23***	0.158**	0.107***	-0.05	-0.25***
12	WPSCO(y ₄)	Within-sample scope economies specific to y ₄ (the OBS activities)	0.132***	0.558***	-0.01	0.507***	0.217***	-0.04	-0.01

(b) Tradition non-frontier approach

	Types of scale and scope economies	Descriptions	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			All banks	All state-owned	All joint-stock	State-owned-1	State-owned-2	Joint-stock-1	Joint-stock-2
			1985-2002	1985-2002	1987-2002	1985-1992	1993-2002	1987-1992	1993-2002
1	SCALE	Overall scale economies	0.933***	1.009	0.885***	1.081***	0.951***	0.989	0.860***
2	EPSCE	Expansion path scale economies	0.952***	2.028	0.928*	1.182**	1.361**	0.892***	0.950***
3	WSCOPE	Within-sample scope economies	-0.68***	3.288***	-0.52***	1.308***	3.088***	-0.99***	-0.99***
4	EPSUB	Expansion path subadditivity	0.238**	1.644***	0.758***	0.467*	1.613***	-0.15	0.595***
5	WPSSE(y1)	Within-sample scale economies specific to y ₁ (total deposits)	0.434***	0.299***	0.474***	0.218***	0.227***	0.454***	0.435***
6	WPSSE(y2)	Within-sample scale economies specific to y ₂ (total loans)	-0.89***	-0.23***	-0.89***	0.017	0.503**	-1.18***	-1.12***
7	WPSSE(y3)	Within-sample scale economies specific to y ₃ (total investments)	2.118**	1.553	2.454**	1.128***	0.758*	1.942*	1.359***
8	WPSSE(y4)	Within-sample scale economies specific to y ₄ (the OBS activities)	-0.441**	-2.856**	0.979*	-1.430*	-1.065	1.273*	1.896**
9	WPSCO(y1)	Within-sample scope economies specific to y ₁ (total deposits)	-0.93***	-0.42***	-0.90***	-0.53***	1.938***	-0.99***	-0.99***
10	WPSCO(y2)	Within-sample scope economies specific to y ₂ (total loans)	-0.63***	3.116***	-0.44***	1.203***	1.770***	-0.99***	-0.99***
11	WPSCO(y3)	Within-sample scope economies specific to y ₃ (total investments)	-0.31***	-0.03	-0.35***	-0.27***	1.878***	-0.99***	-0.98***
12	WPSCO(y4)	Within-sample scope economies specific to y ₄ (the OBS activities)	0.178***	0.701***	-0.04	0.205	2.272***	-0.99***	-0.96***

Note: 1. Values with ***, ** and * are (1) Statistically different from one for the measures of economies of scale (e.g. SCALE, EPSCE, and WPSSE). (2) Statistically significant from zero for the measures of economies of scope (e.g. WSCOPE, EPSUB, and WPSCO) at the 1%, 5%, and 10% levels of significance, respectively. 2. Bold typeface for values indicates significant economies of scale and scope at the 10% level.

4.4.1 Econometric Results: Stochastic Frontier Approach

As mentioned in section 4.2, the stochastic frontier approach and the expansion path measures are the preferred methods in this chapter. Estimated expansion path scale economies (*EPSCE*) indicate that, in general, the values are not significantly different from one for all groups. This implies that most banks face constant returns to scale taking account of changes in output composition as these banks change their scales along their expansion path. It generally reveals no gains from changing the scale of production for these banks.

Estimated expansion path subadditivity (*EPSUB*) generally indicates that costs are subadditive along the expansion path, given that most values are significantly more than zero. This finding suggests that most banks could save on costs by joint production as they grow. It might also imply that most banks are able to meet customers' joint demands or efficiently reduce risk through product diversification.

For both expansion path measures, the one exception to the aforementioned general results is that the state-owned banks in the first reform stage (column 4) face decreasing returns to scale and scope neutrality, but that they enjoy constant returns to scale and scope economies in the second reform stage (column 5). This might suggest that the second stage of banking reform improved the cost structure of the state banks by reducing their scale to an optimal level. However, the forbiddance of universal banking might reduce their opportunity to save on costs by joint production.

The results of the major standard measures (i.e., *SCALE* and *WSCOPE*) tell a different story. They show that, on average, all the sample banks have significant overall economies of scale and diseconomies of scope. This finding suggests that these banks are operating on the falling part of their respective average cost (*AC*) curves and could reduce costs by increasing outputs. In addition, having specialised banks would lower costs.

Comparing the results of state-owned banks in column (2) with joint-stock banks in column (3), state banks exhibit diseconomies of scale, but economies of scope. On the contrary, joint-stock banks have economies of scale, but diseconomies of scope. This finding suggests that state-owned banks have greater potential to take advantage of joint production, whereas joint-stock banks are likely to be faced with the necessity of increasing scale to remain cost competitive. The result on economies of scale is consistent with those reported in the majority of bank cost structure studies, which report the existence of economies of scale usually at small size banks.

The results in columns (4) and (5) indicate that state-owned banks in the first reform stage face decreasing returns to scale, but in the second reform stage enjoy increasing returns to scale. This finding partly reflects the effects of the streamlining of state banks in the second reform stage. It suggests that the second stage of banking reform optimised the cost structure of state banks. In addition, state banks enjoy economies of scope regardless of the reform stages. This finding indicates that these state banks could always reduce costs by joint production.

For joint-stock banks, the results in columns (6) and (7) indicate that there are significant economies of scale and diseconomies of scope during the second reform stage, while both figures are insignificant for the first reform stage. Thus there are cost savings to be had through scale expansion of joint-stock banks in the second reform stage. The finding of diseconomies of scope in the second reform stage might be explained by the fact that banks in the second stage bought more computer and telecommunications equipment, which requires large set-up costs. It would be too difficult for them to achieve a lower level of additional cost per transaction, unless the volume of transactions rose substantially.

Comparing the results of the expansion path and standard measures, the findings are similar to those of previous studies (i.e., Berger et al. 1987; Mitchell and Onvural, 1996; Rime and Stiroh, 2003). That is, different measures of economies of scale and scope generally result in inconsistent results. This might be due to the

fact that the expansion path measures capture the impacts of changing scale and product mix simultaneously but the standard measures do not. According to Wheelock and Wilson (2001), the expansion path measures are composite measures of standard economies of scale and scope. *EPSCE* is closer in spirit to a measure of economies of scale than *EPSUB* because *EPSCE* measures the incremental cost of incremental output along the expansion path between two different-sized banks. *EPSUB*, on the other hand, compares the cost of production at a given bank *B* with the cost of producing an identical level of output in two separate banks with different output mixes. Therefore, the findings imply that the standard measures are inadequate to determine the level of economies of scale and scope for the sample banks in this study.

The results of within-sample product-specific economies of scale (*WPSSE*) indicate that there are significant diseconomies of scale for deposits, loans, and off-balance sheet (OBS) activities for all banks. A proportionate increase in any of these three outputs (with the others held constant) will raise costs by a great proportion. In contrast, the sign for y_3 , bank investments is significantly positive, suggesting costs will fall with a proportionate increase in investments, holding constant deposits, loans, and OBS activities. The results of other bank groups are similar to this one, except several values become insignificant.

The results of within-sample product-specific economies of scope (*WPSCO*) indicate significantly negative values found with respect to deposits, loans, and investments for all banks. This means that there is no cost advantage from the joint production of these respective products. The coefficient on OBS activities is significantly positive, suggesting costs fall if OBS activities are jointly produced with the other three outputs. The joint-stock banks tell a similar story, but the results of the groups of state-owned banks suggest that, in addition to joint production of the OBS activities, there is cost advantage from the joint production of loans and investments.

However, the results of both within-sample product-specific economies of scale (*WPSSE*) and scope (*WPSCO*) should be interpreted with caution because they include a usually impossible assumption that banks can change the output of one specific product while holding the output of the other products constant. In this paper, 3 of the 4 “outputs” come from both the assets and the liabilities sides of the balance sheet. For example, bank loans (y_2) and investments (y_3) are from the assets side, while bank deposits (y_1) are from the liabilities side. From an accounting standpoint, assets and liabilities must balance. Thus, it will cut the balance sheet if increasing bank loans while holding bank deposits and investments constant.

4.4.2 Econometric Results: Traditional Non-frontier Approach

Comparing the values estimated under the stochastic frontier and traditional non-frontier approaches, the results present a similar picture. However, the differences appear when one looks into the degrees of economies of scale and scope for each bank group. If the first four rows of Table 4.5(a) with 4.5(b) are compared, the degree of economies of scale and scope is generally larger under the traditional non-frontier approach than those estimated by the stochastic frontier approach. For example, the degree of overall scale economies (*SCALE*) for all banks under the stochastic frontier approach is 2.7% ($=|0.973-1|$), whereas the same estimate under the traditional non-frontier approach is 6.7% ($=|0.933-1|$). Hence, the traditional non-frontier approach overestimates the degree of overall scale economies for all banks by 4% ($=6.7\%-2.7\%$).

The degrees of diseconomies of scale and scope are usually smaller under the traditional non-frontier approach than those estimated by the stochastic frontier approach. For example, the degree of within-sample scope diseconomies (*WSCOPE*) for all banks under the stochastic frontier approach is 81% ($=|-0.81-0|$), while the same estimate under the traditional non-frontier approach is 68% ($=|-0.68-0|$). Thus, the traditional non-frontier approach underestimates the degree of within-sample scope diseconomies for all banks by 13% ($=81\%-68\%$). In short,

the results suggest that using the traditional non-frontier model would confound the degrees of scale and scope economies with X-inefficiencies. This result is consistent with the finding in Berger and Humphrey (1991).

4.5 Conclusions

Employing both the stochastic frontier approach and expansion path measures, this is the first empirical study estimating economies of scale and scope in China's banking sector during the period 1985-2002. The traditional non-frontier approach and the standard measures of scale and scope economies are also applied for comparison and completeness. In addition, the economies of scale and scope of banks with different ownership types and/or in different reform stages are compared as well.

Before calculating the measures of scale and scope economies, two revised functions with an ownership dummy and a reform dummy were estimated. The results generally show that it is meaningful to estimate the differences of economies of scale and scope between the banks with different ownership and the banks in different reform stages, especially under the stochastic frontier approach.

Several conclusions emerge from this study. First, the results of the preferred measures, the expansion path measures, indicate that, in general, there were constant returns to scale and significant economies of scope in China's banking sector during the last two decades independent of their ownership and reform stages. This finding suggests that these major banks in China were at their optimal levels of scale; increasing or decreasing their outputs along the expansion path would not affect their cost efficiency. However, they could reduce their costs by diversifying their products along the expansion path. This implies that allowing these banks to conduct universal banking operations could enhance their cost competitiveness.

Second, the state-owned banks in the first reform stage faced decreasing returns to scale and scope neutrality, but, in the second reform stage, they enjoyed constant returns to scale and scope economies. As explained in Chapter 2, organisational and product restructuring was one of the major reforms taken by the state-owned banks in the second reform stage. Thus, this finding suggests that the restructuring improved the cost structure of the state-owned banks.

Third, the results of the standard measures present a different picture. They indicate that, on average, there were significant overall scale economies and scope diseconomies in China's banking sector during the last two decades. State-owned commercial banks exhibited diseconomies of scale and economies of scope, whereas joint-stock commercial banks had economies of scale and diseconomies of scope. The findings suggest that banks could reduce costs by increasing outputs while holding the output mix unchanged. In addition, having specialised banks would lower costs. Joint-stock commercial banks have greater potential to take advantage of expansion in scale, while state-owned commercial banks can increase their cost competitiveness by joint production.

Fourth, the results of standard measures also indicate that state-owned commercial banks in the first reform stage faced decreasing returns to scale, but in the second reform stage enjoyed increasing returns to scale. They enjoyed economies of scope regardless of the reform stages. This suggests that the second stage of banking reform optimised the cost structure of state-owned commercial banks, which is consistent with the results of the expansion path measures. For joint-stock commercial banks, the results indicate that there were significant economies of scale and diseconomies of scope during the second reform stage, while both figures are insignificant for the first reform stage. The findings suggest that there were cost savings through expansion of joint-stock commercial banks in the second reform stage.

Fifth, the difference between the results of the two types of measures might be explained by the composite characteristic of the expansion path measures. In

addition, it might imply that the standard measures are inadequate to determine the level of economies of scale and scope for the Chinese banks.

Sixth, the results indicate that there are significant economies of scale specific to investments and significant economies of scope specific to the off-balance-sheet activities. These findings suggest that banks could save costs by proportionately increasing investments while holding other outputs at their current levels. In addition, jointly producing the off-balance-sheet activities with other products is a good way to reduce costs.

Finally, there is evidence that using the traditional non-frontier model overlooking X-inefficiencies would confound most of the measures of economies of scale and scope. This suggests that the stochastic frontier approach is superior to the traditional non-frontier approach.

However, Berger et al. (1987) indicates that cost functions only capture the cost- or supply-side benefits to banks from joint production, as in the first two resources of economies of scope, but ignore the revenue- or demand-side benefits, as in the last two resources. Therefore, the total economies from joint production may be understated in the empirical estimates here and in other studies.

Chapter 5. Competition in China's Banking Sector

5.1 Introduction

This chapter examines the relationship between market structure and profitability within China's banking sector over the period 1985-2002. Emphasis has been placed on investigating the influences of the gradual reform strategy on competitive structure. In addition, the issue of whether the four state-owned banks enjoy a "quiet life" or not is also tested. The next section reviews the relevant theory of competition, and previous attempts to test the market structure-profitability relationship in banking. Section 5.3 discusses the methodology and the data used. The random effects panel data model, which incorporates measures of concentration, market share, X-efficiency, and scale efficiency directly to the regression, is employed to test both market-power and efficient-structure hypotheses. Following Goldberg and Rai (1996), measures of both types of efficiencies are obtained using the stochastic cost frontier, which assumes the X-inefficiency factors are distributed half-normally. These estimates can be derived from Chapters 3 and 4 directly. The classic pooled data regression model is also estimated as a robust check. Section 5.4 presents the results of the tests. Section 5.5 summarizes and presents the implications of the results for China's banking sector in its new regulatory environment.

5.2 Literature Review

5.2.1 Theory of Competition

In economic analysis, there are two broad concepts of competition: one emphasises the conduct of sellers and buyers, while the other focuses on market structure. Adam Smith's comments dealing with both features dominated the strain of economic thought during the eighteenth and nineteenth centuries⁷⁴. On

⁷⁴ For reviews of the development of economic thought on the nature of competition, see Stigler (1957) and McNulty (1967, 1968).

the conduct side, Smith considered the essence of competition to be an independent striving for the patronage of the different sellers in a market. The short-run structural prerequisites for competitive conduct were left indefinite. On the structure side, the absence of barriers to resource transfers was considered as the essence of competition. Given that the resources were usually fairly fixed in the short run, Smith and his followers concluded that the full benefit of competitive market processes might be realised only in the long run (Scherer and Ross, 1990).

A different, essentially structural concept of competition emerged during the nineteenth century. The pioneers were Jevons (1871), Marshall (1890, 1919), Edgeworth (1881), Clark (1899), and Knight (1921), who contributed to the development of the current model of perfect competition and monopoly⁷⁵. In this modern economic theory, a market is said to be purely competitive if it has a large number of firms selling a homogeneous commodity, and the market share of each individual firm is so small that no individual firm finds itself able to influence appreciably the commodity's price by changing the quantity of output it sells. To make competition in economic theory not only "pure" but also "perfect", several additional structural conditions are added: free entry and exit, perfect information, and no transaction costs⁷⁶ (Scherer and Ross, 1990).

Violations of the major structure preconditions for pure competition lead to a rich variety of (seller's) market structure types. Table 5.1 presents six major types of market structure, using the two-way classification based on the number of sellers and the nature of the product. The difference between homogeneity and differentiation in this classification implies the degree of substitutability among competing sellers' products. In contrast to the pure competition concept, the monopoly concept assumes a market with only one seller with complete control over price.

⁷⁵ See Hay and Morris (1991) for a review.

⁷⁶ When firms can enter a market and then exit easily, the market is said to be contestable even if the conditions for pure competition are not met (Baumol, Panzar, and Willig, 1982).

However, most markets are neither purely competitive nor monopolistic but fall somewhere in between. Chamberlin (1933) made a very important theoretical advance by developing new theories of monopolistic competition and oligopoly⁷⁷. The concept of monopolistic competition is characterised by a large number of sellers (and buyers), easy entry, and a differentiated product. The oligopoly theory assumes a market structure where a relatively small number of sellers control the market.

Table 5.1 Major Types of Market Structure

	Number of sellers		
	One	A few	Many
Homogeneous Products	Pure monopoly	Homogeneous oligopoly	Pure competition
Differentiated Products	Pure multiproduct monopoly	Differentiated oligopoly	Monopolistic competition

Source: Scherer and Ross (1990, p.17)

Under the theory of monopolistic competition, although a large number of sellers may supply a single market, each firm's product has some unique characteristics, which allow the firm some discretion over price and the ability to pursue a policy at least somewhat different from their competitors. Under the oligopoly theory, firms realise that their actions are interdependent because of the fewness of firms in the market. The nature of competition under oligopoly ranges from active price competition to implicit or explicit forms of collusion⁷⁸ (Goddard, Molyneux, and Wilson, 2001).

Pure monopolists, oligopolists, and monopolistic competitors share a common feature, that is, under given demand conditions, each can increase the quantity of

⁷⁷ In fact, Chamberlin's (1933) work on oligopoly was very brief, and 'ended up totally indeterminate'. However, he did succeed in drawing attention to it. The recent studies stemmed from the attempts by Cournot (1838) and Bertrand (1883) systematically analyze behaviour under oligopoly (Hay and Morris, 1991). In Cournot's model, each firm makes decisions about its own output assuming that the output levels of others will remain constant. In Bertrand's model, there is a similar pattern of behaviour with respect to price (Goddard et al. 2001).

⁷⁸ Implicit collusion includes models of dominant firm. Explicit collusion may take the form of cartel agreement. In the most extreme case it might allow the firms to operate at the point of joint profit maximization. That is, the firms collectively produce and set prices as would a single monopolist, which enable the industry profit to be maximized. The maximized profit is then divided among the participants (Goddard et al. 2001).

output it sells only by reducing its price. Therefore, all three types of market structure possess some degree of power over price, which is called monopoly power or market power (Scherer and Ross, 1990).

Chamberlin's monopolistic competition and oligopoly models provided the basis on which economists, in particular Mason (1939, 1949) and Bain (1951), could generate empirically testable hypotheses about the market structure-performance relationship that are at the heart of recent industrial economics. Basically, there are two approaches to study this relationship: the structure-conduct-performance (SCP) and the Chicago School approaches. In general, the SCP approach originally was primarily empirical in its orientation, whereas the Chicago School approach focused on the use of price theory (Waldman and Jensen, 2001).

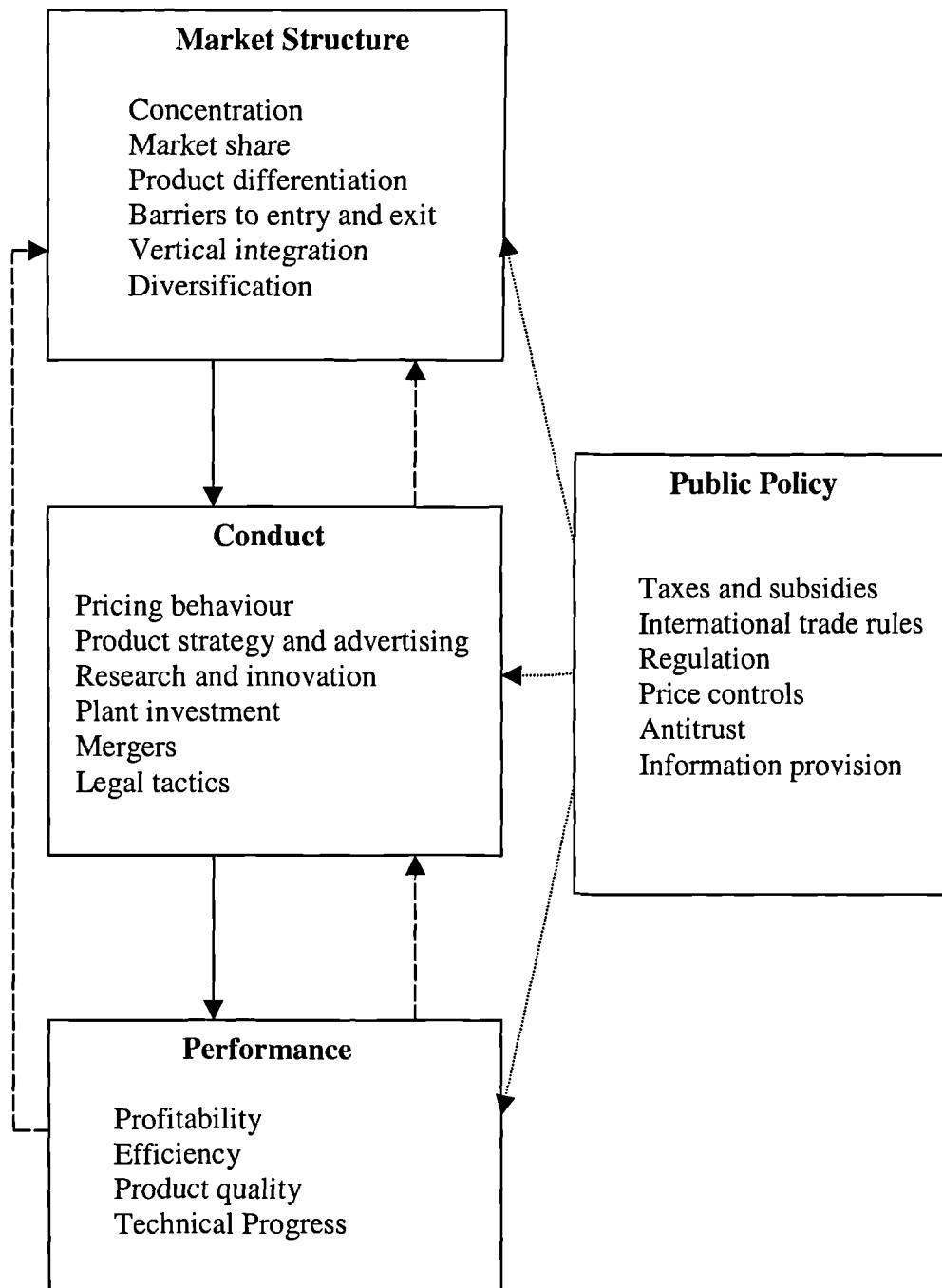
The Structure-Conduct-Performance Paradigm

To describe the relationship between market structure and the performance of firms, Mason (1939, 1949) and Bain (1951) developed a basic paradigm, which is called the structure-conduct-performance (SCP) paradigm, and was elaborated by numerous scholars. The assumption of the SCP paradigm is that there is a direct relationship between market structure, market conduct, and market performance. For example, a perfectly competitive market structure leads to efficient economic performance with price equal to marginal cost, inefficient firms driven from the market, and long-run economic profits equal to zero. In contrast, a monopolistic market structure results in poor economic performance with price exceeding marginal cost, inefficient firms surviving in the long run, and economic profits greater than zero.

The SCP paradigm extends the structure-conduct-performance relationship to oligopoly and monopolistic competition. This paradigm is illustrated in Figure 5.1. The solid arrows show the primary relationships in this paradigm: market structure determines conduct, and conduct determines performance. The dashed arrows depict the feedback effects of performance on conduct and structure, and

of conduct on structure as well. Also, government policies have a direct influence on structure, conduct, and performance, which are shown by the dotted arrows.

Figure 5.1 The Structure-Conduct-Performance Paradigm



Source: modification of Waldman and Jensen (2001, p.7); Goddard, Molyneux, and Wilson (2001, p.35)

In detail, the structure of the relevant market affects the conduct of the firms in the market. Market structure is characterised by the degree of concentration, the market share, the degree of differentiation of products, the presence or absence of barriers to either the entry of new firms or the exit of old firms, etc. The conduct of sellers and buyers determines performance in particular markets or industries. Conduct is featured through pricing policies and practices, product strategy and advertising strategies, research and development commitments, investment in production facilities, legal tactics (e.g. in enforcing patent rights), etc. Relevant performance measures embody at least the following goals: profitability, efficiency, product quality, and technical progress (Waldman and Jensen, 2001; Goddard, Molyneux, and Wilson, 2001). Proponents of the SCP paradigm view most existing markets as imperfect in terms of their competitive structure, which needs some form of regulation to check the abuse of market power.

Under this approach, the finding of a positive relationship between firm profitability and the market structure elements is attributed to two major market-power (MP) hypotheses: the traditional structure-conduct-performance (SCP) and the relative-market-power (RMP) hypotheses. The traditional SCP hypothesis proposes that banks are able to extract monopolistic rents in more concentrated markets by their ability to offer lower deposit rates and charge higher loan rates due to competitive imperfections in these markets. The RMP hypothesis asserts that only firms with large market shares and well-differentiated products are able to exercise market power in pricing these products and earn supernormal profits (Shepherd, 1982)⁷⁹. The difference between SCP and RMP is that the latter need not occur in concentrated markets. Generally, the MP hypotheses suggest that antitrust or regulatory action may be productive.

The Chicago School Approach

The Chicago School of Economics refers to a school of industrial organization economists who prefer to use price theory models to make predictions about

⁷⁹ Smirlock (1985) regards it as the product differentiation hypothesis.

expected conduct and performance and to design empirical tests of their theories⁸⁰. In its most general form, price theory is characterised by three elements. The first element is demand conditions. These conditions depend on whether the product is homogeneous or heterogeneous, and the conjectural variation that firms adopt⁸¹. The latter will partly reflect the number and size of firms in the market. The second element is cost conditions. These conditions are usually portrayed by the average cost curve of the firm, which may be downward-sloping, horizontal, or upward-sloping, but which can be drawn as U-shaped to cover all possibilities. The third element is the assumption of profit maximisation (Hay and Morris, 1991).

Generally, Chicago School economists, represented by academics including Stigler (1968) and Demsetz (1973, 1974), argue that government interference tends to lead to less competition rather than more. They questioned many of the main empirical findings concluded by followers of the SCP approach in the 1960s and 1970s. One of the key debates is about the rationale of the observed positive relationship between concentration and profits in many empirical studies. Chicago School economists argued that concentration is not a random event but rather the results of the superior efficiency of the leading firms. Firms possessing a comparative advantage in production become large and obtain a high market share. Consequently, the market becomes more concentrated, and such efficient firms earn Ricardian rents (Demsetz, 1973).

Theoretically, in competitive markets, the least efficient firm in the market determines the price: the marginal cost of the last unit (highest cost) supplied equals the price. Firms with lower costs earn Ricardian rents. These rents are returns on their superior factors of production instead of economic profits. The market value of these superior factors would include these capitalized rents, and a decision to use them rather than sell them requires an imputation of their opportunity cost (market value). The firm's economic profits become zero in

⁸⁰ For details, see Stigler (1968), Posner (1979), and Reder (1982).

⁸¹ The conjectural variation captures the beliefs of one firm about how all the other firms respond to an increase in its output (Hay and Morris, 1991).

doing so. Therefore, the apparent economic profits of the firm arise from the scarcity and superiority of the factor of production, not from anything done by the firm.

An efficient firm may possess market power only if the scale of production at which the cost advantage is sustained is large enough that the firm can act as a price maker. In addition, monopoly profits could be capitalized from the absolute cost advantage to the market value of the superior factor of production - thereby eliminating it – which would disguise the fact that the source of the firm’s market power is its control of that factor (Church and Ware, 2000). Therefore, proponents of the Chicago school approach are instinctively suspicious of any suggestion that government intervention may be at all helpful in enabling markets to reach competitive outcomes. They suggest that the best option for governments is to stand back and allow market forces to run their course (Posner, 1979).

Following the Chicago school approach, two major efficient-structure (ES) hypotheses have been generated: the X-efficiency version of the efficient-structure (ESX) hypothesis and the scale-efficiency version of the efficient-structure (ESS) hypothesis. Under the ESX hypothesis, banks with superior management and production technologies operate at lower costs and subsequently achieve higher profits⁸². The X-efficient banks are also assumed to gain large market shares, which may lead to higher levels of market concentration. Thus, the positive relationship between market structure and profitability is “spurious” rather than of “direct origin” under the ESX hypothesis, because X-efficiency drives both profits and market structure (Demsetz, 1973, 1974; Peltzman, 1977).

Under the ESS hypothesis, banks are assumed to have similar management and production technology but operate at different levels of economies of scale⁸³. Banks operating at optimal economies of scale will have lower costs and the

⁸² Banks with superior skill in minimizing the costs of producing any given output bundle may achieve the greater X-efficiency.

⁸³ Banks producing at output levels closer to the minimum average cost point may achieve the greater scale efficiency.

resulting higher profits may also lead to a larger market share and/or higher levels of market concentration. Thus, the positive relationship between market structure and profitability is also “spurious” (Lambson, 1987).

In short, the efficient-structure hypotheses suggest that the market-power hypotheses might not be supported even if the significantly positive relationship between market structure and profitability exists. Instead, they hypothesise that both market concentration and/or large market share are the results of banks with superior efficiency. Thus, the efficient-structure hypotheses have a different policy implication – antitrust or regulatory actions are likely to be counterproductive.

5.2.2 Review of Empirical Work

The empirical literature on the relationship between market structure and bank performance goes back at least to the 1960’s. Basically, three methods have been developed to test the market-power and the efficient-structure hypotheses. Table 5.2 briefly summarises the relative studies reviewed.

First Method

The first method is broadly characterized by testing the traditional SCP hypothesis by only regressing a measure of bank performance on a measure of market concentration. There is no attempt to review these studies one by one. Instead, the review is based on an excellent survey paper by Gilbert (1984), which reviewed 44 previous studies, from 1964 to 1982, that used this method to test the SCP hypothesis, and summarised the influence of a change in market concentration on bank performance measures. The results showed that, among 126 regressions used to test the SCP hypothesis, only 60 produced a positive relationship; the other 66 regressions were negative⁸⁴.

⁸⁴ See Gilbert (1984) for details.

Table 5.2 Summary of Banking Studies on the Structure-Performance Relationship

Author(s)	Sample	Data	Results of tests for					Remarks
			SCP	ES	RMP	X-EFF	S-EFF	
Smirlock (1985)	US	Over 2,700 unit state banks operating in the seven-state area under the jurisdiction of the Federal Reserve Bank of Kansas City for the years 1973 and 1978.	NO	YES	NA	NA	NA	
Evanoff and Fortier (1988)	US	6,300 unit banks located in the 30 states that permit either unit banking only or state wide branching in 1984	YES*	YES	NA	NA	NA	* Only valid for banks in markets with higher entry barriers.
Lloyd-Williams et al. (1994)	Spain	92 banks in 1988, and 56 banks in 1986 and 1987, total 204 observations.	YES	NO	NA	NA	NA	
Molyneux and Forbes (1995)	18 European countries	756 banks in 1986, 1217 banks in 1987, 1538 banks in 1988, and 1265 banks in 1989, total 4,776 observations.	YES	NO	NA	NA	NA	
Berger (1995)	US	For unit banking states, the number of banks is 1,538 in 1980, 1,551 for 1981-1989. For limited branching states, the number is 1,925 in 1980, and 1,928 for 1981-1989. For statewide branching states, the number is 1,324 in 1980, and 1,354 for 1981-1989.	NO	NA	YES	YES	NO	
Goldberg and Rai (1996)	11 European countries	Large commercial and savings banks over the period 1988-1991, total 303 observations.	NO	NA	YES	YES*	NO	* Only for the banks located in low concentration countries.
Berger and Hannan (1997)	US	240 banks in 1985	NO	NA	NO	NO	NO	The 'quiet life' hypothesis was also tested, and was supported by the findings.
Maudos (1998)	Spain	Commercial banks totalling 353 observations: 72 in 1990, 94 in 1991, 94 in 1992, and 93 in 1993.	NO	NA	YES	YES	NA	
Goddard, et al. (2001)	15 European countries	Banks, 1989-1996. Total 16,820 observations.	YES	NA	NO	YES	YES	
Mendes and Rebelo (2003)	Portugal	Banks, 1990-1999. Total 197 observations.	YES*	NA	YES**	YES	NA	* Only valid for banks in the first half of the nineties. ** Only valid for banks in the second half of the nineties.

Note: 1. SCP: the structure-conduct-performance hypothesis; ES: the spurious efficient-structure hypothesis; RMP: the relative market-power hypothesis; X-EFF: the X-efficiency version of the efficient-structure hypothesis; S-EFF: the scale-efficiency version of the efficient-structure hypothesis. 2. For studies using the first method, please see Gilbert (1984), which gives an excellent survey. 3. NA means the relevant hypothesis was not tested in that paper.

Second Method

Given that mixed results had been found in previous banking studies testing the SCP hypothesis, and also the development of the efficient-structure (ES) hypothesis, the innovation of the second method is to add one more independent variable, market share, to estimate the structure-performance relationship. Most studies in this category take market share as a proxy of efficiency. They argue that the efficiency is reflected in high market share, since the most efficient firms have lower costs and will consequently gain market share. Thus, the results of a significantly positive coefficient on market share and an insignificant coefficient on concentration support the ES hypothesis.

For example, taking market share as a proxy for efficiency, Smirlock (1985) modelled bank profitability as a function of market share, concentration, an interaction term between market share and concentration, and several control variables for over 2,700 unit state banks in the US between 1973 and 1978. The results show that market share is positively related to profitability and that, once this is controlled for, there is no relationship between concentration and profitability. They argue that the finding supports the ES hypothesis.

Following Smirlock (1985), Evanoff and Fortier (1988) employed a similar method (excluding the interaction term) to test more than 6,300 unit banks located in 30 states of the US in 1984. They argue that the results provide categorical support for the ES hypothesis, and limited support for the traditional SCP hypothesis. However, Lloyd-Williams and Molyneux (1994) and Molyneux and Forbes (1995) used the same method to investigate the relationship in Spanish banking and European banking, respectively. Employing the pooled and annual data for the period 1986-1988 and 1986-1989, separately, both papers found evidence in favour of the traditional SCP paradigm.

Shepherd (1986) suggested these conclusions could be problematic since larger market shares might also reflect higher market power. In fact, firms may obtain

market power from at least three elements of their market positions. One is the firm's own market share, which embodies direct control over market transactions. The second is concentration, because oligopoly collusion can give a diluted degree of market control. Thus, concentration should consistently show a weaker association with profitability than should market share. The third is entry barriers, which also convey a degree of market power and improved profitability. Whatever the origins of market dominance may be, once these elements exist, they can raise prices and profits.

Thus, the market-power and efficient-structure hypotheses cannot be distinguished by only adding market share as an independent variable. The model used by Smirlock (1985) and its followers only indicates whether market share is more important than concentration. The coefficient on market share is much more significant than that on concentration, which means that it is the firm's own market position that matters the most, rather than the firm being in a concentrated market. These results, it is argued, provide a "spurious" support for the ES hypothesis⁸⁵.

Third Method

To take the effects of efficiency directly into account, more recent studies have regressed the profitability on concentration, market share, X-efficiency, and scale-efficiency variables to distinguish among these four major theories. For example, Berger (1995) developed a series of tests to incorporate the direct measures of both market structure and efficiency into the model. Four hypotheses were specified, including the SCP, RMP, ESX, and ESS hypotheses. They were represented by different variables, so that any or all of them may be found to be consistent with the data. To measure both X-efficiency and scale efficiency, the

⁸⁵ The support was "spurious" because they used a spurious proxy for efficiency, i.e., market share. It is worth noting that this result cannot be said to support the RMP hypothesis, since RMP could be supported only when both concentration and efficiency are properly controlled for. These studies did not control for efficiency, so that market share may capture both market power and efficiency effects.

distribution-free method was employed⁸⁶. Concentration and market share were also regressed against the efficiency variables to test the necessary condition of the ES hypotheses that efficiency affects market structure.

The tests were applied to thirty separate US banking datasets with between 1,300 and 2,000 observations each, covering a decade (the 1980s) and three different competitive environments, unit banking, limited branching, and state-wide branching states. The use of so many separate samples allows for a relatively comprehensive treatment of the industry and for evaluation of the stability of the results. The main results of Berger (1995) give limited support for two of the four hypotheses: ESX and RMP. The data do not support the ESS and SCP hypotheses. Despite this limited support for two of the hypotheses, none of the hypotheses appear to explain bank profits. The efficiency and market power variables, with low R^2 value, explain relatively little of the variance of profitability, and the coefficients of the profitability equations suggest that very large increases in efficiency and market share would be needed to raise expected profits significantly⁸⁷.

Applying a similar method, Goldberg and Rai (1996) tested the four hypotheses for banks across 11 European countries over the period 1988-1991. Unlike Berger (1995), who used deviations from the average cost frontier to represent measures of inefficiency (under the distribution-free approach), this paper applied a stochastic cost frontier to derive measures of X-inefficiency and scale inefficiency. In addition to testing the necessary condition of the efficient-structure hypotheses (like Berger, 1995), the efficiency variables were also regressed against concentration and market share to test the 'necessary condition' of the market-power hypotheses⁸⁸, that is, larger market shares or concentrations

⁸⁶ For details of the distribution-free method, please see Chapter 3.

⁸⁷ Berger (1995) indicated that if a bank were simultaneously to increase its market share, X-efficiency, and scale-efficiency by 10 percentage points, respectively, only about a 14 percent (ROA) to 19 percent (ROE) increase in expected profitability.

⁸⁸ In fact, Goldberg and Rai (1996) indicated that the regressions were used to test Hicks' (1935) 'quiet life' hypothesis (p.751, 765). However, they treated them as the necessary condition of the MP hypothesis in explaining the empirical results, and did not comment on the 'quiet life' hypothesis (p.765).

should result in greater X- and scale inefficiencies. Goldberg and Rai (1996) find the results support the RMP hypothesis for all banks and the ESX hypothesis for banks located in countries with a low concentration of banks. When both 'necessary conditions' are complied with, the results only support the ESX hypothesis.

However, the 'necessary condition' for the market-power hypotheses developed in this paper was inappropriate. The structural model in Berger (1995, p.408) shows that there is no such requirement that larger market shares or concentrations should lead to greater X- and scale inefficiencies under the market-power hypotheses. Berger and Hannan (1997, p.11) indicate explicitly that this condition is not a necessary part of the market-power paradigm: it is only offered as an adjunct or supplement to this paradigm (p.22). Accordingly, the results of Goldberg and Rai (1996) also support the RMP hypothesis when all banks are considered.

Berger and Hannan (1997) computed direct measures of bank efficiency to distinguish among alternative explanations of the structure-performance relationship in US banking in 1985. As in Berger (1995), the major four hypotheses were specified, and the necessary condition of the efficient-structure hypotheses was also tested. In addition to the profit data, survey price data on bank deposits and loan rates were also used to investigate the structure-price relationship⁸⁹. The results show more support for the SCP hypothesis than for the RMP and efficient-structure hypotheses, although the results are not fully consistent with any of these theories⁹⁰.

Furthermore, Berger and Hannan (1997) tested the 'quiet life' (QL) hypothesis. As Hicks (1935) observed, "The best of all monopoly profits is a quiet life (Hicks,

⁸⁹ Berger and Hannan (1997) argue that the common dependent variable, profitability, contains a significant amount of noise that is not related to the variables of interest. Some of this noise comes from the difficulties in using accounting data, and some from a number of other factors (e.g., loan loss provisions), which are largely unrelated to either market power or cost efficiency.

⁹⁰ The SCP hypothesis is only supported by the price data, but not the profit data. Also, since the concentration variable has significant influence on the efficiency variable, which might cause a multicollinearity problem, the above result could be biased.

1935, p.8)”. The hypothesis proposes that firms with greater market power may take part of the gains from non-competitive pricing not as profits, but as a more relaxed environment in which less effort is put into the rigours of maximising cost efficiency. That is, banks with greater market power are inefficient because a relaxed environment enables slack management.

Based on Berger and Hannan (1998) and Rhoades and Rutz (1982), the ‘quiet life’ effects might include two aspects: one is X-inefficiencies caused by the absence of incentive to put full effort into choosing the optimal scale and/or mix of inputs to produce any given output bundle, for example, the expansion of staff or other physical inputs beyond levels justified by cost minimization, extra expenses in obtaining and maintaining market power, etc. The other is scale-inefficiencies caused by not putting full effort into operating at the optimal scale level. For example, only choosing “safer” portfolios to trade off some of their monopoly profit for a reduction in risk. The results of Berger and Hannan (1997) provide support for Hicks’ quiet-life hypothesis, which implies that banks with market power adhere less rigorously to X-efficiency maximization.

Maudos (1998) estimated the relationship between market structure and performance within the Spanish banking sector. There were 353 observations over the period 1990-93. Three different stochastic measures of X-efficiency were used, whereas the measure of scale efficiency was not included. The necessary condition of the ES hypotheses was tested. The results support both the ESX and RMP hypotheses.

Using a similar approach to Berger (1995), Goddard, Molyneux, and Wilson (2001) investigated the structure-performance relationship of banks from 15 European countries covering the period 1989-1996. A Fourier-flexible stochastic cost frontier was used to obtain the estimates of bank-specific efficiency and scale economies. The results support the SCP, ESX, and ESS hypotheses. However, the explanatory power of the model is weak, as adjusted R^2 equals 0.05. Thus, they

agree with Berger's (1995) concerns about the capability of such models to explain variations in bank profitability.

Mendes and Rebelo (2003) studied the structure-performance relationship in the Portuguese banking industry during the nineties. The hypotheses of SCP, RMP, and ESX were tested using a direct measure of X-efficiency (both cost and profit efficiency). The results support both the SCP and the ESX hypotheses in the first half of the nineties. However, after 1994, there is more evidence to support the RMP and ESX hypotheses. The deregulation process has apparently helped to increase the degree of competition within the Portuguese banking industry, and banks with superior efficiency exhibit better performance, although there remains some market power via product differentiation.⁹¹

5.3 Methodology and Data

5.3.1 Methodology

According to Berger (1995) and Goldberg and Rai (1996), the following equation is used to test which of the four hypotheses is valid:

$$P_{i,t} = \alpha_0 + \beta_1 CONC_t + \beta_2 MS_{i,t} + \beta_3 XEFF_{i,t} + \beta_4 SEFF_{i,t} + \beta_5 AIP_t + \beta_6 OWN_i + \beta_7 TT_t + e_{i,t} \quad (5.1)$$

where

$P_{i,t}$ = a measure of profitability, such as return on equity (ROE) or return on assets (ROA), of bank i at time t ;

$CONC_t$ = a measure of market concentration, such as four-bank concentration ratio (CR4) or Herfindahl-Hirschman index (HERF), of concentration at time t ;

$MS_{i,t}$ = market share (in terms of deposits) of bank i at time t ;

$XEFF_{i,t}$ = a measure of X-efficiency, reflecting the ability of banks to produce a given bundle of output at minimum cost through superior management and/or technology;

$SEFF_{i,t}$ = a measure of scale-efficiency, reflecting the ability of banks to produce at optimal output levels (economies of scale), given similar

⁹¹ However, the conclusion of supporting the ESX hypothesis is suspicious, since its necessary condition is not tested.

production and management technology;
 AIP_t = average income per person at time t ;
 OWN_i = dummy variable for different ownership, equal to 0 if it is state-owned, 1 for joint stock;
 TT_t = time trend variable, equals to 0 to 17 for years 1985 to 2002, respectively.
 $e_{i,t}$ = an error variable for each bank i at time t .

Under the efficient-structure hypotheses, causation is assumed to run from efficiency to profits, and to market structure. Therefore, the expected signs of the coefficients on $XEFF$ and $SEFF$ in the estimation of Equation (5.1) are as follows: $\beta_3 > 0, \beta_4 > 0$. More efficient banks should have higher profits, so the signs of the coefficients on $XEFF$ and $SEFF$ should be significantly positive. Under the market-power hypotheses, the appropriate market structure variable, $CONC$ or MS should have a significantly positive coefficient, that is, β_1 should be positive if the structure-conduct-performance hypothesis holds, and β_2 should be positive if the relative-market-power hypothesis holds.

As indicated by Berger (1995), $CONC$ and MS , although endogenous under the ES hypotheses, may be included as irrelevant independent variables, since they are correlated with profitability only because they reflect the influences of $XEFF$ and/or $SEFF$ and the control variables, which are controlled for in Eq. (5.1)⁹². Moreover, theoretically, such endogeneity only exists under free entry with fixed costs. However, no free entry condition has existed in China's banking sector during the last two decades (Xie and Jiao, 2002). Hence, such formal entry barriers could help to overcome some of the problems in this study.

To explain the relationship between profitability and market structure spuriously, not only profits but also the market structure variables must be positively related to efficiency. Thus, a necessary condition for the efficient-structure hypotheses to

⁹² The prerequisite of this argument is that the model is block-recursive – that other factors affecting market structure do not affect profitability. That is, the error terms in the recursive structural model are mutually uncorrelated (Berger, 1995; Berger and Hannan, 1997).

hold is that efficiency has positive effects on market structure. To ensure that the necessary conditions hold, the following two equations are also tested:

$$CONC_t = \alpha + \beta_1 XEFF_{i,t} + \beta_2 SEFF_{i,t} + \beta_3 AIP_t + \beta_4 OWN_i + \beta_5 TT_t + e_{i,t} \quad (5.2)$$

$$MS_{i,t} = \alpha + \beta_1 XEFF_{i,t} + \beta_2 SEFF_{i,t} + \beta_3 AIP_t + \beta_4 OWN_i + \beta_5 TT_t + e_{i,t} \quad (5.3)$$

The expected signs of the coefficients on *XEFF* and *SEFF* should be significantly positive in Eqs. (5.2) and (5.3). Therefore, the efficient-market hypotheses are strictly valid if they can establish that more efficient banks are more profitable, and more efficient banks have larger market shares and/or lead to a higher level of market concentration.

As suggested by Berger and Hannan (1997), Eqs. (5.4) and (5.5) are used to test Hicks' (1935) 'quiet-life' hypothesis. In addition, failure to account for the possibility of 'reverse causation' may result in biased coefficients in testing the necessary condition of the ES hypotheses, as in equations (5.2) and (5.3).

$$XEFF_{i,t} = \alpha + \beta_1 CONC_t + \beta_2 MS_{i,t} + \beta_3 AIP_t + \beta_4 OWN_i + \beta_5 TT_t + e_{i,t} \quad (5.4)$$

$$SEFF_{i,t} = \alpha + \beta_1 CONC_t + \beta_2 MS_{i,t} + \beta_3 AIP_t + \beta_4 OWN_i + \beta_5 TT_t + e_{i,t} \quad (5.5)$$

Under the 'quiet-life' hypothesis, the expected signs of the coefficients on *CONC* and/or *MS* should be significantly negative in equations (5.4) and (5.5). It means that banks with greater market power are less efficient due to a relaxed environment which enabling slack management.

Eqs. (5.2) and (5.3) are quite different from Eqs. (5.4) and (5.5), since they have the reversed causal ordering between efficiency and market structure. This suggests that simultaneous equations biases would result from OLS estimation if both sets of relations were true (Berger and Hannan, 1997).

All the equations are first estimated using the random effects panel data approach. As indicated by Greene (2000), the fundamental advantage of a panel data set over a cross section and/or a time-series is that it will allow the researcher far

greater flexibility in modelling differences in behaviour across individuals and/or time periods.

The random effects model is preferred over the fixed effects model because the fixed effects estimator requires within group variation in all variables for at least some groups. However, the Chinese banking data have some time invariant regressors, such as the ownership dummy. Thus, the fixed effects estimator cannot be computed. Moreover, a fixed effects model would lead to a substantial loss of degrees of freedom (Baltagi, 1995). The pooled OLS estimators are computed later for comparison.

5.3.2 Data

Most of the data used in this study came from various editions of *the Almanac of China's Finance and Banking*, which contains annual information on the balance sheet and income statements of all banks operating in China. The number of employees, the average wages of employees, and the average income per person are obtained from *China Statistical Yearbook (2003)*. Data are collected on the four state-owned commercial banks and the ten joint-stock commercial banks. The full sample covers the period from 1985 through 2002 with 187 observations. In addition, the data are split to obtain the first stage reform sub-sample (1985-1992), and the second stage reform sub-sample (1993-2002). A complete description of the variables not explained in earlier chapters is provided below.

Two popular measures of profitability, *ROA* and *ROE*, are employed here. *ROA* is defined as the ratio of pre-tax net income to total assets, and *ROE* is defined as the ratio of pre-tax net income to total equity⁹³. In addition, two common measures of concentration, the four-bank concentration ratio, *CR4*, and the Herfindahl-Hirschman Index (*HERF*), are used.

⁹³ Pre-tax net income is used to calculate *ROA* and *ROE* instead of after-tax net income because of missing corporate tax figures. Total equity (net worth) of the four state-owned banks refers to the paid-in capital, which corresponds closely to Tier 1 capital in the Basel Accord, plus retained profits and other surpluses to paid-in capital. Thus, it is roughly comparable to the sum of Tier 1 and Tier 2 capital (Lardy, 1999).

CR4 is defined as the ratio of the total deposits of the four largest banks to the total deposits of all the banks in a given year. *CR4* should be close to 0 for a perfectly competitive market and 100 for a monopoly. However, *CR4* also has some limitations. First, it is not affected by changes in the market share outside of the four largest banks, and therefore does not ensure consistent rankings of the degree of competition within an industry. Second, it takes no direct account of the number of firms in the industry. Two industries could both have ten-firm ratios of 60 per cent, but one could have 30 smaller firms and the other 300 smaller firms, and they would not be distinguished. If industry performance is determined mainly by the ten largest firms, this may not matter, but if the number of firms included in the ratio does not correspond with the number that determines industry performance, this would be a problem (Hay and Morris, 1991).

HERF is defined as the sum of squared market shares of deposits of the sample of banks in a given year. *HERF* is slightly greater than 0 for a perfectly competitive market and 100 for a monopoly⁹⁴. *HERF* takes into account both the number of banks and the inequality of market shares. Generally, the more banks there are in a market, the lower is the value of *HERF*, ceteris paribus. Moreover, *HERF* increases as the market shares of a given number of banks become less equal (Waldman and Jensen, 2001). However, *HERF* has been found to have one drawback: because the *HERF* may be written as $H = n\sigma^2 + 1/n$ where σ^2 is the variance of firms' market shares and n is the number of firms. It thus embodies a particular weighting between the inequality of the firms' market shares and the number of firms (Hay and Morris, 1991, p.250). Since any measure of concentration is arbitrary to some extent, the two variables are included separately in the regressions. In addition, the national market is used because there is no local market share. Market share is defined as the ratio of an individual bank's total deposits to the total deposits of all banks in a given year.

⁹⁴ Some antitrust practitioners prefer to move the decimal point two places to the right, using percentages of the market instead. Thus, *HERF* then equals 10,000 for a monopoly under this practice (Waldman and Jensen, 2001).

X-efficiency provides a measure of how effectively banks are employing their inputs to produce a given bundle of outputs. The estimates for X-inefficiency (*XINEFF*) are obtained directly from Chapter 3. Following Goldberg and Rai (1996), this empirical test substitutes *XINEFF* for the X-efficiency variables (*XEFF*), defined in Eqs. (5.1), (5.2), (5.3), and (5.4). The estimate of *XINEFF* represents an inefficiency measure for each bank in the sample. Accordingly, the coefficients on *XINEFF* in the series of equations will have the opposite sign to *XEFF* specified in the same sets of equations.

Scale efficiency indicates whether banks with similar management and production technology are operating at optimal economies of scale. Overall scale economies (*SCALE*) are said to exist if an equi-proportionate increase in all outputs leads to a less than equi-proportionate increase in cost. The estimates of *SCALE* are obtained directly from Chapter 4⁹⁵. Given that both *SCALE* > 1 and *SCALE* < 1 imply scale inefficiencies⁹⁶, following Goldberg and Rai (1996), the method to estimate scale inefficiency is described below:

$$\begin{aligned} SINEFF &= SCALE - 1 && \text{if } SCALE > 1 \\ SINEFF &= 1 - SCALE && \text{if } SCALE < 1 \end{aligned}$$

A bank is at the scale efficiency point if its *SCALE* = 1, thus *SINEFF* = 0. As in the case of *XINEFF*, the sign of the coefficient will be opposite to that estimated in Eqs. (5.1), (5.2), (5.3), and (5.5). For example, the predicted relationship between *ROA* (*ROE*) and *SINEFF* is negative, i.e., the further a bank is from efficient scale, the lower the profitability.

Average income per person (*AIP*) is included to control for factors affecting the supply of funds to banks. Its coefficient may have either sign in a non-competitive market, because it may reflect either a greater or lesser elasticity of deposit

⁹⁵ As mentioned in Chapter 4, overall scale economies requires an unrealistic assumption - does not allow for a change in output mix. Hence, the results of this chapter should be interpreted with regards to this possible biasedness.

⁹⁶ *SCALE* > 1 means that banks are operating below optimal scale levels and have the ability to lower costs by increasing output further. *SCALE* < 1 means that banks are operating over optimal scale levels and are required to downsize in order to achieve optimal input combinations.

supply. An ownership dummy variable (*OWN*) is included to capture the possible difference in profitability between the state-owned banks and the joint-stock banks. The time trend variable (*TT*) is included to investigate the possible influences of the gradual reform strategy on bank *ROA* and *ROE*⁹⁷. Table 5.3 presents summary data for all the variables used in the analysis.

Table 5.3 Variables Used to Estimate the Structure-Performance Relationship

Variable	1985-2002	1985-1992	1993-2002
<i>ROA</i>	0.010 (0.008)	0.011 (0.008)	0.009 (0.008)
<i>ROE</i>	0.155 (0.108)	0.139 (0.086)	0.162 (0.116)
<i>CR4</i>	0.916 (0.047)	0.981 (0.021)	0.889 (0.023)
<i>HERF</i>	0.236 (0.034)	0.284 (0.018)	0.217 (0.013)
<i>MS</i>	0.096 (0.122)	0.148 (0.145)	0.075 (0.104)
<i>X-INEFF</i>	0.091 (0.046)	0.077 (0.025)	0.097 (0.051)
<i>S-INEFF</i>	0.068 (0.040)	0.067 (0.053)	0.068 (0.033)
<i>AIP (1000's)</i>	0.855 (0.266)	0.546 (0.043)	0.981 (0.210)
Number of observations	187	54	133

Sources: *Almanac of China's Finance and Banking (1986-2003)*; *China Statistical Yearbook (2003)*.

Notes: 1. All the figures are based on the mean value of the relative sample period. Standard deviations are in parentheses. 2. All the original data are deflated by the CPI, with 1985 as the base year.

5.4 Empirical Results

The empirical analysis focuses on estimating 5 equations, (5.1) to (5.5). The results estimated by the random effects panel data approach are shown first. Table 5.4 presents the results of Eq. (5.1) using *ROA* and *ROE* as the dependent variables, and *CR4* as the measure of concentration. Table 5.5 reports the results of the same estimation except the concentration measure is changed to *HERF*. Table 5.6 presents the results of estimating Eqs. (5.2) and (5.3) employing *CONC* and *MS* as the dependent variables, respectively. Table 5.7 provides the results of estimating Eqs. (5.4) and (5.5) using *CR4* as the measure of concentration, while Table 5.8 gives the results of estimating the same equations but using *HERF* as the measure of concentration.

⁹⁷ The time trend variable could also pick up trends in omitted variables.

Before analysing the empirical results, Chow's Breakpoint Test is undertaken to test for data poolability. The result shows that there was a structural change in 1993 (test statistics is 3.069, and p value is 0.003). Therefore, the empirical analysis focuses on the two sub-samples.

Table 5.4 Regression results of ROA and ROE on the CR4, MS, XINEFF, SINEFF, and other control variables

	Dependent variable = ROA			Dependent variable = ROE		
	All	1 st Stage	2 nd Stage	All	1 st Stage	2 nd Stage
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.099 [0.024] (0.000)	-0.075 [0.063] (0.234)	0.085 [0.043] (0.045)	1.809 [0.362] (0.000)	0.081 [0.837] (0.923)	1.634 [0.655] (0.013)
<i>CR4</i>	-0.086 [0.024] (0.000)	0.051 [0.050] (0.313)	-0.065 [0.039] (0.092)	-1.760 [0.354] (0.000)	-0.311 [0.664] (0.640)	-1.522 [0.590] (0.010)
<i>MS</i>	0.036 [0.011] (0.002)	0.049 [0.019] (0.010)	-0.014 [0.016] (0.390)	0.825 [0.178] (0.000)	0.620 [0.192] (0.001)	0.157 [0.285] (0.582)
<i>XINEFF</i>	-0.027 [0.009] (0.003)	-0.019 [0.020] (0.336)	-0.029 [0.010] (0.004)	-0.241 [0.134] (0.073)	-0.024 [0.256] (0.924)	-0.326 [0.156] (0.036)
<i>SINEFF</i>	0.018 [0.012] (0.145)	0.031 [0.015] (0.031)	-0.003 [0.022] (0.878)	0.245 [0.184] (0.182)	0.092 [0.185] (0.617)	0.0963 [0.345] (0.788)
<i>AIP</i>	-0.028 [0.006] (0.000)	0.040 [0.032] (0.212)	-0.017 [0.017] (0.324)	-0.285 [0.093] (0.002)	0.401 [0.421] (0.341)	-0.180 [0.259] (0.486)
<i>OWN</i>	0.016 [0.003] (0.000)	0.020 [0.006] (0.000)	0.006 [0.004] (0.106)	0.283 [0.048] (0.000)	0.164 [0.055] (0.003)	0.175 [0.070] (0.012)
<i>TT</i>	0.0001 [0.0004] (0.860)	-0.0002 [0.0004] (0.620)	-0.001 [0.001] (0.574)	-0.004 [0.006] (0.470)	-0.003 [0.006] (0.535)	-0.011 [0.017] (0.529)
<i>LM-statistic</i>	28.99 (0.000)	33.24 (0.000)	20.29 (0.000)	26.83 (0.000)	4.86 (0.028)	43.15 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), ROA = return on assets, ROE = return on equity, INT = intercept, CR4 = four-bank concentration ratio, MS = market share, XINEFF = X-inefficiency, SINEFF = scale inefficiency, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. To provide correct estimates of the coefficient covariances in the presence of heteroscedasticity of unknown form, White (1980) derived a heteroscedasticity consistent covariance matrix estimator. 3. p -values are in parentheses. 4. Coefficients in 10% significance level are in bold type. 5. LM (Lagrange multiplier test) is devised by Breusch and Pagan (1980), and used to test for the random effects model based on the OLS residuals. Under the null hypothesis, LM is distributed as chi-squared with one degree of freedom. The null hypothesis is that the classical regression model with a single constant term is appropriate. The alternative hypothesis is that the panel data model is appropriate.

Table 5.5 Regression results of ROA and ROE on the HERF, MS, XINEFF, SINEFF, and other control variables

	Dependent variable = ROA			Dependent variable = ROE		
	All	1 st Stage	2 nd Stage	All	1 st Stage	2 nd Stage
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.054 [0.011] (0.000)	-0.027 [0.026] (0.297)	0.075 [0.025] (0.003)	0.871 [0.168] (0.000)	-0.146 [0.339] (0.667)	1.386 [0.376] (0.000)
<i>HERF</i>	-0.140 [0.037] (0.000)	0.031 [0.049] (0.529)	-0.204 [0.079] (0.010)	-2.874 [0.541] (0.000)	-0.338 [0.648] (0.602)	-4.781 [1.183] (0.000)
<i>MS</i>	0.036 [0.011] (0.002)	0.049 [0.019] (0.010)	-0.014 [0.016] (0.394)	0.833 [0.177] (0.000)	0.621 [0.192] (0.001)	0.179 [0.279] (0.522)
<i>XINEFF</i>	-0.029 [0.009] (0.001)	-0.018 [0.020] (0.378)	-0.029 [0.010] (0.003)	-0.282 [0.133] (0.035)	-0.039 [0.258] (0.880)	-0.337 [0.150] (0.025)
<i>SINEFF</i>	0.018 [0.012] (0.153)	0.031 [0.015] (0.034)	-0.003 [0.022] (0.900)	0.236 [0.182] (0.194)	-0.094 [0.185] (0.611)	0.112 [0.333] (0.737)
<i>AIP</i>	-0.023 [0.006] (0.000)	0.026 [0.026] (0.333)	-0.018 [0.015] (0.231)	-0.168 [0.094] (0.074)	0.438 [0.348] (0.208)	-0.219 [0.229] (0.338)
<i>OWN</i>	0.016 [0.003] (0.000)	0.020 [0.006] (0.000)	0.006 [0.004] (0.105)	0.284 [0.047] (0.000)	0.164 [0.055] (0.003)	0.178 [0.069] (0.010)
<i>TT</i>	-0.0003 [0.0005] (0.446)	-0.0001 [0.0004] (0.732)	-0.001 [0.001] (0.364)	-0.013 [0.007] (0.058)	-0.004 [0.006] (0.475)	-0.018 [0.015] (0.247)
<i>LM-statistic</i>	29.53 (0.000)	32.62 (0.000)	21.93 (0.000)	27.28 (0.000)	4.82 (0.028)	49.51 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), ROA = return on assets, ROE = return on equity, INT = intercept, HERF = Herfindahl-Hirschman index, MS = market share, XINEFF = X-inefficiency, SINEFF = scale inefficiency, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. To provide correct estimates of the coefficient covariances in the presence of heteroscedasticity of unknown form, White (1980) derived a heteroscedasticity consistent covariance matrix estimator. 3. p-values are in parentheses. 4. Coefficients in 10% significance level are in bold type. 5. LM (Lagrange multiplier test) is devised by Breusch and Pagan (1980), and used to test for the random effects model based on the OLS residuals. Under the null hypothesis, LM is distributed as chi-squared with one degree of freedom. The null hypothesis is that the classical regression model with a single constant term is appropriate. The alternative hypothesis is that the panel data model is appropriate.

Table 5.6 Regression results of CR4, HERF, and MS on the XINEFF, SINEFF, and other control variables

	Dependent variable = CR4			Dependent variable = HERF			Dependent variable = MS		
	All	1 st Stage	2 nd Stage	All	1 st Stage	2 nd Stage	All	1 st Stage	2 nd Stage
<i>N</i>	187	54	133	187	54	133	187	54	133
<i>INT</i>	1.012 [0.006] (0.000)	1.246 [0.027] (0.000)	1.081 [0.020] (0.000)	0.294 [0.004] (0.000)	0.479 [0.028] (0.000)	0.293 [0.009] (0.000)	0.225 [0.026] (0.000)	0.240 [0.072] (0.001)	0.210 [0.036] (0.000)
<i>XINEFF</i>	0.009 [0.026] (0.723)	-0.011 [0.049] (0.825)	0.017 [0.019] (0.373)	-0.007 [0.017] (0.673)	-0.040 [0.050] (0.427)	0.003 [0.009] (0.710)	0.016 [0.049] (0.735)	0.115 [0.109] (0.293)	0.028 [0.038] (0.462)
<i>SINEFF</i>	0.031 [0.034] (0.374)	-0.007 [0.027] (0.789)	-0.001 [0.044] (0.978)	0.015 [0.022] (0.496)	-0.007 [0.028] (0.804)	-0.0002 [0.021] (0.991)	0.127 [0.061] (0.036)	0.061 [0.083] (0.460)	-0.015 [0.083] (0.855)
<i>AIP</i>	-0.003 [0.019] (0.858)	-0.488 [0.054] (0.000)	-0.256 [0.030] (0.000)	0.039 [0.012] (0.001)	-0.344 [0.056] (0.000)	-0.089 [0.015] (0.000)	0.005 [0.030] (0.877)	-0.016 [0.115] (0.890)	0.016 [0.049] (0.735)
<i>OWN</i>	-0.001 [0.003] (0.622)	-0.0003 [0.003] (0.904)	0.0001 [0.003] (0.996)	-0.001 [0.002] (0.620)	-0.0001 [0.003] (0.975)	-0.0002 [0.001] (0.891)	-0.220 [0.029] (0.000)	-0.233 [0.054] (0.000)	-0.210 [0.020] (0.000)
<i>TT</i>	-0.009 [0.001] (0.000)	0.001 [0.001] (0.485)	0.012 [0.002] (0.000)	-0.009 [0.001] (0.000)	-0.001 [0.001] (0.437)	0.002 [0.001] (0.025)	-0.001 [0.002] (0.403)	0.0001 [0.002] (0.965)	0.001 [0.004] (0.715)
<i>LM-statistic</i>	4.58 (0.032)	4.44 (0.035)	6.71 (0.010)	3.63 (0.057)	4.31 (0.038)	6.92 (0.009)	1160.55 (0.000)	211.89 (0.000)	357.51 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), INT = intercept, CR4 = four-bank concentration ratio, HERF = Herfindahl-Hirschman index, MS = market share, XINEFF = X-inefficiency, SINEFF = scale inefficiency, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. To provide correct estimates of the coefficient covariances in the presence of heteroscedasticity of unknown form, White (1980) derived a heteroscedasticity consistent covariance matrix estimator. 3. p-values are in parentheses. 4. Coefficients in 10% significance level are in bold type. 5. LM (Lagrange multiplier test) is devised by Breusch and Pagan (1980), and used to test for the random effects model based on the OLS residuals. Under the null hypothesis, LM is distributed as chi-squared with one degree of freedom. The null hypothesis is that the classical regression model with a single constant term is appropriate. The alternative hypothesis is that the panel data model is appropriate.

Table 5.7 Regression results of XINEFF and SINEFF on the CR4, MS, and other control variables

	<i>Dependent variable = XINEFF</i>			<i>Dependent variable = SINEFF</i>		
	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.043 [0.199] (0.828)	0.265 [0.503] (0.598)	-0.105 [0.396] (0.792)	-0.205 [0.145] (0.158)	0.291 [0.670] (0.664)	-0.103 [0.181] (0.570)
<i>CR4</i>	0.043 [0.195] (0.826)	-0.070 [0.400] (0.860)	0.369 [0.356] (0.301)	0.144 [0.142] (0.310)	-0.153 [0.533] (0.774)	0.034 [0.163] (0.835)
<i>MS</i>	0.045 [0.090] (0.616)	0.024 [0.044] (0.591)	-0.120 [0.163] (0.463)	0.130 [0.088] (0.143)	0.085 [0.145] (0.557)	0.041 [0.068] (0.548)
<i>AIP</i>	-0.048 [0.042] (0.257)	-0.228 [0.252] (0.365)	-0.143 [0.153] (0.352)	0.279 [0.031] (0.000)	-0.081 [0.336] (0.808)	0.119 [0.070] (0.090)
<i>OWN</i>	-0.014 [0.023] (0.540)	0.004 [0.013] (0.787)	-0.056 [0.028] (0.043)	0.052 [0.018] (0.005)	-0.005 [0.042] (0.895)	0.052 [0.016] (0.001)
<i>TT</i>	0.005 [0.003] (0.087)	0.0001 [0.003] (0.971)	0.013 [0.010] (0.195)	-0.014 [0.002] (0.000)	-0.009 [0.004] (0.025)	-0.003 [0.005] (0.540)
<i>LM-statistic</i>	14.69 (0.000)	0.24 (0.627)	30.38 (0.000)	44.06 (0.000)	55.35 (0.000)	9.00 (0.003)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), INT = intercept, CR4 = four-bank concentration ratio, MS = market share, XINEFF = X-inefficiency, SINEFF = scale inefficiency, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. To provide correct estimates of the coefficient covariances in the presence of heteroscedasticity of unknown form, White (1980) derived a heteroscedasticity consistent covariance matrix estimator. 3. p-values are in parentheses. 4. Coefficients in 10% significance level are in bold type. 5. LM (Lagrange multiplier test) is devised by Breusch and Pagan (1980), and used to test for the random effects model based on the OLS residuals. Under the null hypothesis, LM is distributed as chi-squared with one degree of freedom. The null hypothesis is that the classical regression model with a single constant term is appropriate. The alternative hypothesis is that the panel data model is appropriate.

Table 5.8 Regression results of XINEFF and SINEFF on the HERF, MS, and other control variables

	<i>Dependent variable = XINEFF</i>			<i>Dependent variable = SINEFF</i>		
	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.136 [0.092] (0.136)	0.308 [0.197] (0.118)	0.188 [0.236] (0.424)	-0.111 [0.067] (0.099)	0.125 [0.265] (0.637)	-0.086 [0.107] (0.423)
<i>HERF</i>	-0.173 [0.300] (0.564)	-0.277 [0.385] (0.472)	0.364 [0.747] (0.626)	0.179 [0.220] (0.416)	-0.051 [0.517] (0.921)	0.068 [0.341] (0.843)
<i>MS</i>	-0.049 [0.091] (0.590)	0.024 [0.044] (0.589)	-0.119 [0.163] (0.466)	0.130 [0.087] (0.141)	0.085 [0.145] (0.560)	0.041 [0.068] (0.548)
<i>AIP</i>	-0.041 [0.044] (0.360)	-0.287 [0.205] (0.162)	-0.206 [0.140] (0.141)	0.271 [0.032] (0.000)	-0.024 [0.275] (0.929)	0.116 [0.064] (0.068)
<i>OWN</i>	-0.014 [0.023] (0.559)	0.004 [0.013] (0.783)	-0.056 [0.028] (0.043)	0.052 [0.018] (0.005)	-0.006 [0.042] (0.894)	0.050 [0.016] (0.001)
<i>TT</i>	0.003 [0.004] (0.364)	-0.0002 [0.003] (0.956)	0.017 [0.009] (0.071)	-0.01 [0.003] (0.000)	-0.010 [0.004] (0.023)	-0.003 [0.004] (0.543)
<i>LM-statistic</i>	15.19 (0.000)	0.21 (0.646)	30.05 (0.000)	43.87 (0.000)	55.24 (0.000)	8.98 (0.003)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002). INT = intercept, HERF = Herfindahl-Hirschman index, MS = market share, XINEFF = X-inefficiency, SINEFF = scale inefficiency, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. To provide correct estimates of the coefficient covariances in the presence of heteroscedasticity of unknown form, White (1980) derived a heteroscedasticity consistent covariance matrix estimator. 3. p-values are in parentheses. 4. Coefficients in 10% significance level are in bold type. 5. LM (Lagrange multiplier test) is devised by Breusch and Pagan (1980), and used to test for the random effects model based on the OLS residuals. Under the null hypothesis, LM is distributed as chi-squared with one degree of freedom. The null hypothesis is that the classical regression model with a single constant term is appropriate. The alternative hypothesis is that the panel data model is appropriate.

For banks in the first reform stage, when *ROA* is the dependent variable and *CR4* is the measure of concentration, the results in Table 5.4 show that the coefficient of *MS* is positive and significant, supporting the relative-market-power (RMP) hypothesis. The results in Table 5.7 and 5.8 indicate that the big four banks in China did not enjoy a ‘quiet life’ during this period, since neither of the structure variables (*CONC* and *MS*) has significant influence on the efficiency variables (*XINEFF* and *SINEFF*).

In addition, the coefficients on the ownership dummy variable show that the joint-stock banks have greater profits, but a smaller market share and lower scale efficiency. The coefficients on the time trend variables suggest that there is no significant change in performance, but banks became more scale efficient over time. The coefficients on the average income per person variables indicate that the higher the income per person, the lower the concentration levels. The results hardly change when employing *HERF* as the measure of concentration instead of *CR4*, and/or replacing *ROA* with *ROE* as the dependent variable.

Turning to the banks that existed during the second stage of banking reform, with *ROA* as the dependent variable and *CR4* as the measure of concentration, the results (in Table 5.4) support the X-efficiency version of the efficient-structure (ESX) hypothesis. However, it is shown to be invalid after its necessary condition is tested. Table 5.6 shows that when *MS* is the dependent variable (as in Eq. (5.3)), the coefficient of *XINEFF* is insignificant, which invalidates the ESX hypothesis.

Furthermore, the results in Table 5.7 and 5.8 also indicate that the big four banks in China did not enjoy a ‘quiet life’ during the second reform stage, because neither of the structural variables (*CONC* and *MS*) had a significant effect on the efficiency variables (*XINEFF* and *SINEFF*). Finally, the coefficients on *OWN* show that the joint-stock banks have a lower market share and less scale efficiency, but have higher X-efficiency and enjoy higher *ROE*. Similar results are obtained if *ROE* is taken as the dependent variable and/or *HERF* is the concentration measure.

On the other hand, as indicated by Goldberg and Rai (1996), Eq. (5.1) might be subject to multicollinearity problems if there are significant relationships between the market structure and efficiency variables. In addition, given that both concentration and market share measures are based on the ratio of bank's deposits to total deposits in a given year, there might be multicollinearity arising from them. Consequently, correlation coefficients are calculated to examine the possible relationship between different concentration, market share, and efficiency measures. As indicated in Table 5.9, the correlation coefficients range from -0.14 to 0.30. These values are not high enough for concerns of multicollinearity.

Table 5.9 Correlation between the Major Independent Variables

	<i>CR4</i>	<i>HERF</i>	<i>MS</i>	<i>SINEFF</i>
<i>MS</i>	0.29	0.30		
<i>SINEFF</i>	-0.09	-0.05	-0.09	
<i>XINEFF</i>	-0.12	-0.14	0.10	-0.02

Notes: *CR4* = four-bank concentration ratio, *HERF* = Herfindahl-Hirschman index, *MS* = market share, *XINEFF* = X-inefficiency, *SINEFF* = scale inefficiency.

Nevertheless, following the suggestion of Goldberg and Rai (1996), a test of robustness was undertaken. Eq. (5.1) was tested in four components in order to remove the effects of possible multicollinearity⁹⁸. The test also applied the random effects panel data approach and was constructed as follows:

$$P_{i,t} = \alpha + \beta_1 XEFF_{i,t} + \beta_2 SEFF_{i,t} + \beta_3 AIP_t + \beta_4 OWN_i + \beta_5 TT_t + e_{i,t} \quad (5.1a)$$

$$P_{i,t} = \alpha + \beta_1 CONC_t + \beta_2 MS_{i,t} + \beta_3 AIP_t + \beta_4 OWN_i + \beta_5 TT_t + e_{i,t} \quad (5.1b)$$

$$P_{i,t} = \alpha + \beta_1 CONC_t + \beta_2 XEFF_{i,t} + \beta_3 SEFF_{i,t} + \beta_4 AIP_t + \beta_5 OWN_i + \beta_6 TT_t + e_{i,t} \quad (5.1c)$$

$$P_{i,t} = \alpha + \beta_1 MS_{i,t} + \beta_2 XEFF_{i,t} + \beta_3 SEFF_{i,t} + \beta_4 AIP_t + \beta_5 OWN_i + \beta_6 TT_t + e_{i,t} \quad (5.1d)$$

The results of Eqs. (5.1a) and (5.1b) are presented in Tables 5.10 - 5.12, while the results of Eqs. (5.1c) and (5.1d) are reported in Tables 5.13 – 5.15. For all three

⁹⁸ To drop variables suspected of causing the problem from the regression is the most frequently used method to deal with multicollinearity (Greene, 2000, p.258).

samples, the results of Eqs. (5.1a), (5.1b), (5.1c), and (5.1d) are similar to those of Eq. (5.1) no matter which measure is used for profitability or concentration.

When taking all the results estimated by the random effects panel data approach together, there is conclusive evidence of the relevant market-power hypothesis for the banks in the first reform stage. On the other hand, the X-efficiency version of the efficient-structure hypothesis is only supported by the initial test for the second reform stage sample, but is invalidated by the test of its necessary condition (see Table 5.6). This result is largely consistent with the available literature on the topic (e.g. Berger and Hannan, 1997).

This finding suggests that the larger banks were able to exercise market power by providing differentiated products during the first reform stage. Neither concentration nor efficiency significantly influenced the level of profitability at that time. The result is consistent with the fact that the big four banks were actually the state-owned specialized banks, and were subsidized by the government to make loans to designated sectors/firms up to 1993. The second stage banking reform removed these subsidies and tried to transform state banks into commercial banks. During this stage, the effects associated with relative market power faded away, and banks with higher X-efficiency earned profits. This implies that the gradual reform strategy did improve the sector's competitive structure. However, the improvement is not enough for these more efficient banks to gain larger market share.

Given that the joint-stock banks are more X-efficient but scale inefficient than the state-owned banks, the policy implication therefore is to provide more opportunities for the joint-stock banks. However, any policy suggestion must be made with caution. None of these theories are completely consistent with the observed relationship between profits, market structure, and efficiency for banks in the second reform stage, further research is needed along these lines.

Furthermore, there is no evidence for the ‘quiet life’ hypothesis in either stage. This implies that large banks in China (mainly referring to the big four banks) did not enjoy a ‘quiet life’ by sacrificing their monopoly profits with cost inefficiency. This finding is not surprising, and might be explained by the fact that there was very limited opportunity for larger banks to obtain monopoly profits even in the highly concentrated market, since the interest rates of deposits and loans were controlled by the government. This restriction almost isolated the link between a higher concentration market/larger market share and higher profits, and hence lower cost efficiency, since there were fewer market-power benefits (i.e., subnormal profits) that they could enjoy by less rigorous adherence to cost minimization.

However, as noted in Chapter 2, the process of interest rate liberalization has been initiated in China, which is likely to enable such a link. Thus, ‘quiet life’ effects will be a crucial question for future research on banking regulation. The policy implication is that the liberalization of the interest rates should be accompanied by reforms which improve the competitive structure, otherwise ‘quiet life’ effects may emerge, and the market-power effects may be significant, if banks operate in a highly concentrated market with no restriction on interest rate. Alternatively, inefficiency may be hard to reduce, if banks operate in a competitive market with strong restrictions on interest rates.

To compare the results of other studies which used the classic regression model with a pooled data set, the pooled OLS estimators for all the equations are presented in Appendix 5.1. In addition to supporting the RMP hypothesis for banks in the first reform stage, the pooled results also support the ESX hypothesis for banks in the second reform stage. This finding is consistent with other studies (Goldberg and Rai, 1996; Maudos, 1998). However, almost all of the Lagrange Multiplier (LM) tests indicate that the random effects panel data model is superior over the classic regression model for these data. This finding suggests that applying the classic model to the pooled data set could yield misleading results.

Table 5.10 Regression results of ROA and ROE on the XINEFF, SINEFF, and other control variables

	Dependent variable = ROA			Dependent variable = ROE		
	All	1 st Stage	2 nd Stage	All	1 st Stage	2 nd Stage
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.021 [0.003] (0.000)	-0.001 [0.011] (0.962)	0.012 [0.009] (0.186)	0.219 [0.039] (0.000)	-0.148 [0.141] (0.296)	0.028 [0.144] (0.844)
<i>XINEFF</i>	-0.026 [0.010] (0.006)	-0.012 [0.020] (0.549)	-0.029 [0.010] (0.003)	-0.235 [0.150] (0.119)	0.059 [0.252] (0.814)	-0.369 [0.158] (0.020)
<i>SINEFF</i>	0.020 [0.013] (0.124)	0.033 [0.015] (0.027)	-0.005 [0.022] (0.836)	0.293 [0.203] (0.150)	0.159 [0.188] (0.398)	0.113 [0.353] (0.748)
<i>AIP</i>	-0.028 [0.007] (0.000)	0.015 [0.021] (0.496)	-0.0002 [0.014] (0.991)	-0.275 [0.105] (0.008)	0.515 [0.268] (0.054)	0.205 [0.217] (0.344)
<i>OWN</i>	0.008 [0.002] (0.000)	0.009 [0.004] (0.042)	0.010 [0.002] (0.000)	0.104 [0.027] (0.000)	0.024 [0.052] (0.652)	0.140 [0.033] (0.000)
<i>TT</i>	0.001 [0.0003] (0.029)	-0.0002 [0.0004] (0.681)	-0.001 [0.001] (0.160)	0.011 [0.006] (0.068)	-0.003 [0.005] (0.569)	-0.029 [0.016] (0.067)
<i>LM-statistic</i>	37.93 (0.000)	76.04 (0.000)	23.31 (0.000)	21.94 (0.000)	92.89 (0.000)	45.21 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), ROA = return on assets, ROE = return on equity, INT = intercept, XINEFF = X-inefficiency, SINEFF = scale inefficiency, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as, from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. To provide correct estimates of the coefficient covariances in the presence of heteroscedasticity of unknown form, White (1980) derived a heteroscedasticity consistent covariance matrix estimator. 3. p-values are in parentheses. 4. Coefficients in 10% significance level are in bold type. 5. LM (Lagrange multiplier test) is devised by Breusch and Pagan (1980), and used to test for the random effects model based on the OLS residuals. Under the null hypothesis, LM is distributed as chi-squared with one degree of freedom. The null hypothesis is that the classical regression model with a single constant term is appropriate. The alternative hypothesis is that the panel data model is appropriate.

Table 5.11 Regression results of ROA and ROE on the CR4, MS, and other control variables

	Dependent variable = ROA			Dependent variable = ROE		
	All	1 st Stage	2 nd Stage	All	1 st Stage	2 nd Stage
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.095 [0.025] (0.000)	-0.069 [0.065] (0.287)	0.088 [0.044] (0.043)	1.744 [0.363] (0.000)	0.103 [0.819] (0.900)	1.653 [0.659] (0.012)
<i>CR4</i>	-0.084 [0.025] (0.001)	0.046 [0.052] (0.371)	-0.075 [0.039] (0.056)	-1.732 [0.356] (0.000)	-0.321 [0.651] (0.622)	-1.636 [0.592] (0.006)
<i>MS</i>	0.037 [0.012] (0.002)	0.051 [0.019] (0.008)	-0.010 [0.017] (0.566)	0.853 [0.180] (0.000)	0.617 [0.193] (0.001)	0.205 [0.293] (0.485)
<i>AIP</i>	-0.022 [0.005] (0.000)	0.040 [0.033] (0.221)	-0.013 [0.017] (0.447)	-0.205 [0.077] (0.008)	0.395 [0.410] (0.336)	-0.122 [0.255] (0.634)
<i>OWN</i>	0.017 [0.003] (0.000)	0.020 [0.006] (0.001)	0.008 [0.004] (0.038)	0.301 [0.048] (0.000)	0.162 [0.056] (0.004)	0.199 [0.069] (0.004)
<i>TT</i>	-0.0003 [0.0004] (0.415)	-0.0005 [0.0004] (0.224)	-0.001 [0.001] (0.378)	-0.009 [0.006] (0.107)	-0.004 [0.005] (0.407)	-0.015 [0.017] (0.364)
<i>LM statistic</i>	27.69 (0.000)	26.40 (0.000)	22.95 (0.000)	39.37 (0.000)	17.29 (0.000)	57.97 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), ROA = return on assets, ROE = return on equity, INT = intercept, CR4 = four-bank concentration ratio, MS = market share, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. To provide correct estimates of the coefficient covariances in the presence of heteroscedasticity of unknown form, White (1980) derived a heteroscedasticity consistent covariance matrix estimator. 3. p-values are in parentheses. 4. Coefficients in 10% significance level are in bold type. 5. LM (Lagrange multiplier test) is devised by Breusch and Pagan (1980), and used to test for the random effects model based on the OLS residuals. Under the null hypothesis, LM is distributed as chi-squared with one degree of freedom. The null hypothesis is that the classical regression model with a single constant term is appropriate. The alternative hypothesis is that the panel data model is appropriate.

Table 5.12 Regression results of ROA and ROE on the HERF, MS, and other control variables

	<i>Dependent variable = ROA</i>			<i>Dependent variable = ROE</i>		
	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.048 [0.012] (0.000)	-0.028 [0.026] (0.279)	0.070 [0.026] (0.007)	0.805 [0.168] (0.000)	-0.143 [0.324] (0.659)	1.312 [0.378] (0.001)
<i>HERF</i>	-0.132 [0.078] (0.001)	0.035 [0.050] (0.488)	-0.214 [0.081] (0.008)	-2.780 [0.546] (0.000)	-0.327 [0.632] (0.605)	-4.893 [1.194] (0.000)
<i>MS</i>	0.036 [0.012] (0.002)	0.051 [0.019] (0.008)	-0.010 [0.017] (0.571)	0.855 [0.180] (0.000)	0.617 [0.193] (0.001)	0.223 [0.288] (0.438)
<i>AIP</i>	-0.017 [0.006] (0.003)	0.029 [0.027] (0.277)	-0.013 [0.015] (0.410)	-0.093 [0.080] (0.249)	0.443 [0.336] (0.187)	-0.136 [0.223] (0.543)
<i>OWN</i>	0.017 [0.003] (0.000)	0.020 [0.006] (0.001)	0.008 [0.004] (0.037)	0.301 [0.048] (0.000)	0.161 [0.056] (0.004)	0.202 [0.068] (0.003)
<i>TT</i>	-0.001 [0.0005] (0.130)	-0.0004 [0.0004] (0.295)	-0.001 [0.001] (0.170)	-0.017 [0.007] (0.009)	-0.005 [0.005] (0.350)	-0.024 [0.015] (0.116)
<i>LM statistic</i>	27.54 (0.000)	26.10 (0.000)	24.70 (0.000)	40.87 (0.000)	17.29 (0.000)	65.72 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), ROA = return on assets, ROE = return on equity, INT = intercept, HERF = Herfindahl-Hirschman index, MS = market share, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. To provide correct estimates of the coefficient covariances in the presence of heteroscedasticity of unknown form, White (1980) derived a heteroscedasticity consistent covariance matrix estimator. 3. p-values are in parentheses. 4. Coefficients in 10% significance level are in bold type. 5. LM (Lagrange multiplier test) is devised by Breusch and Pagan (1980), and used to test for the random effects model based on the OLS residuals. Under the null hypothesis, LM is distributed as chi-squared with one degree of freedom. The null hypothesis is that the classical regression model with a single constant term is appropriate. The alternative hypothesis is that the panel data model is appropriate.

Table 5.13 Regression results of ROA and ROE on the CR4, XINEFF, SINEFF, and other control variables

	<i>Dependent variable = ROA</i>			<i>Dependent variable = ROE</i>		
	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.107 [0.025] (0.000)	-0.069 [0.065] (0.293)	0.083 [0.042] (0.051)	1.978 [0.385] (0.000)	0.124 [0.830] (0.881)	1.665 [0.655] (0.011)
<i>CR4</i>	-0.085 [0.025] (0.001)	0.055 [0.052] (0.289)	-0.065 [0.038] (0.088)	-1.738 [0.379] (0.000)	-0.219 [0.658] (0.739)	-1.517 [0.593] (0.011)
<i>XINEFF</i>	-0.026 [0.009] (0.006)	-0.012 [0.020] (0.549)	-0.028 [0.010] (0.005)	-0.218 [0.143] (0.127)	0.060 [0.255] (0.816)	-0.333 [0.156] (0.033)
<i>SINEFF</i>	0.023 [0.013] (0.066)	0.034 [0.015] (0.024)	-0.005 [0.022] (0.823)	0.360 [0.194] (0.063)	0.157 [0.191] (0.412)	0.104 [0.345] (0.764)
<i>AIP</i>	-0.028 [0.006] (0.000)	0.041 [0.033] (0.212)	-0.017 [0.017] (0.326)	-0.286 [0.099] (0.004)	0.410 [0.416] (0.325)	-0.180 [0.260] (0.488)
<i>OWN</i>	0.008 [0.002] (0.000)	0.009 [0.004] (0.042)	0.010 [0.002] (0.000)	0.100 [0.026] (0.000)	0.023 [0.053] (0.659)	0.141 [0.034] (0.000)
<i>TT</i>	0.0001 [0.0004] (0.906)	-0.0002 [0.0004] (0.621)	-0.001 [0.001] (0.572)	-0.005 [0.007] (0.446)	-0.003 [0.005] (0.593)	-0.011 [0.017] (0.528)
<i>LM statistic</i>	42.15 (0.000)	77.01 (0.000)	23.60 (0.000)	28.72 (0.000)	93.15 (0.000)	48.15 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), ROA = return on assets, ROE = return on equity, INT = intercept, CR4 = four-bank concentration ratio, XINEFF = X-inefficiency, SINEFF = scale inefficiency, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. To provide correct estimates of the coefficient covariances in the presence of heteroscedasticity of unknown form, White (1980) derived a heteroscedasticity consistent covariance matrix estimator. 3. p-values are in parentheses. 4. Coefficients in 10% significance level are in bold type. 5. LM (Lagrange multiplier test) is devised by Breusch and Pagan (1980), and used to test for the random effects model based on the OLS residuals. Under the null hypothesis, LM is distributed as chi-squared with one degree of freedom. The null hypothesis is that the classical regression model with a single constant term is appropriate. The alternative hypothesis is that the panel data model is appropriate.

Table 5.14 Regression results of ROA and ROE on the HERF, XINEFF, SINEFF, and other control variables

	<i>Dependent variable = ROA</i>			<i>Dependent variable = ROE</i>		
	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.062 [0.011] (0.000)	-0.018 [0.027] (0.500)	0.072 [0.025] (0.004)	1.053 [0.175] (0.000)	-0.038 [0.335] (0.909)	1.423 [0.374] (0.000)
<i>HERF</i>	-0.138 [0.038] (0.000)	0.037 [0.051] (0.469)	-0.205 [0.079] (0.009)	-2.835 [0.580] (0.000)	-0.232 [0.642] (0.717)	-4.770 [1.190] (0.000)
<i>XINEFF</i>	-0.028 [0.009] (0.003)	-0.010 [0.020] (0.611)	-0.028 [0.010] (0.003)	-0.258 [0.142] (0.070)	0.049 [0.257] (0.849)	-0.343 [0.150] (0.022)
<i>SINEFF</i>	0.023 [0.013] (0.070)	0.033 [0.015] (0.027)	-0.004 [0.022] (0.848)	0.352 [0.192] (0.067)	0.158 [0.191] (0.407)	0.123 [0.334] (0.712)
<i>AIP</i>	-0.023 [0.007] (0.001)	0.028 [0.027] (0.327)	-0.018 [0.015] (0.233)	-0.171 [0.101] (0.089)	0.438 [0.344] (0.203)	-0.219 [0.230] (0.340)
<i>OWN</i>	0.008 [0.002] (0.000)	0.009 [0.004] (0.042)	0.009 [0.002] (0.000)	0.100 [0.026] (0.000)	0.023 [0.053] (0.660)	0.139 [0.033] (0.000)
<i>TT</i>	-0.0003 [0.001] (0.438)	-0.0001 [0.0004] (0.744)	-0.001 [0.001] (0.360)	-0.014 [0.008] (0.067)	-0.003 [0.006] (0.549)	-0.018 [0.015] (0.248)
<i>LM statistic</i>	42.35 (0.000)	76.19 (0.000)	25.45 (0.000)	28.64 (0.000)	93.23 (0.000)	55.10 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), ROA = return on assets, ROE = return on equity, INT = intercept, HERF = Herfindahl-Hirschman index, XINEFF = X-inefficiency, SINEFF = scale inefficiency, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. To provide correct estimates of the coefficient covariances in the presence of heteroscedasticity of unknown form, White (1980) derived a heteroscedasticity consistent covariance matrix estimator. 3. p-values are in parentheses. 4. Coefficients in 10% significance level are in bold type. 5. LM (Lagrange multiplier test) is devised by Breusch and Pagan (1980), and used to test for the random effects model based on the OLS residuals. Under the null hypothesis, LM is distributed as chi-squared with one degree of freedom. The null hypothesis is that the classical regression model with a single constant term is appropriate. The alternative hypothesis is that the panel data model is appropriate.

Table 5.15 Regression results of ROA and ROE on the MS, XINEFF, SINEFF, and other control variables

	<i>Dependent variable = ROA</i>			<i>Dependent variable = ROE</i>		
	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.013 [0.004] (0.000)	-0.012 [0.012] (0.284)	0.016 [0.010] (0.117)	0.037 [0.057] (0.521)	-0.305 [0.145] (0.035)	-0.003 [0.158] (0.984)
<i>MS</i>	0.035 [0.012] (0.003)	0.050 [0.019] (0.008)	-0.015 [0.016] (0.372)	0.785 [0.184] (0.000)	0.617 [0.191] (0.001)	0.134 [0.288] (0.641)
<i>XINEFF</i>	-0.027 [0.009] (0.003)	-0.019 [0.020] (0.332)	-0.030 [0.010] (0.002)	-0.253 [0.143] (0.077)	-0.023 [0.253] (0.928)	-0.364 [0.158] (0.022)
<i>SINEFF</i>	0.015 [0.013] (0.243)	0.031 [0.014] (0.034)	-0.003 [0.022] (0.893)	0.180 [0.195] (0.357)	0.097 [0.183] (0.596)	0.103 [0.352] (0.769)
<i>AIP</i>	-0.028 [0.006] (0.000)	0.015 [0.021] (0.458)	-0.0001 [0.014] (0.993)	-0.272 [0.099] (0.006)	0.550 [0.269] (0.041)	0.206 [0.216] (0.340)
<i>OWN</i>	0.016 [0.003] (0.000)	0.020 [0.006] (0.000)	0.006 [0.004] (0.117)	0.277 [0.049] (0.000)	0.164 [0.055] (0.003)	0.169 [0.071] (0.017)
<i>TT</i>	0.001 [0.0004] (0.020)	-0.0002 [0.0004] (0.677)	-0.001 [0.001] (0.164)	0.012 [0.006] (0.042)	-0.004 [0.005] (0.505)	-0.029 [0.016] (0.065)
<i>LM statistic</i>	25.77 (0.000)	32.53 (0.000)	19.92 (0.000)	19.64 (0.000)	4.86 (0.000)	40.13 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), ROA = return on assets, ROE = return on equity, INT = intercept, MS = market share, XINEFF = X-inefficiency, SINEFF = scale inefficiency, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. To provide correct estimates of the coefficient covariances in the presence of heteroscedasticity of unknown form, White (1980) derived a heteroscedasticity consistent covariance matrix estimator. 3. p-values are in parentheses. 4. Coefficients in 10% significance level are in bold type. 5. LM (Lagrange multiplier test) is devised by Breusch and Pagan (1980), and used to test for the random effects model based on the OLS residuals. Under the null hypothesis, LM is distributed as chi-squared with one degree of freedom. The null hypothesis is that the classical regression model with a single constant term is appropriate. The alternative hypothesis is that the panel data model is appropriate.

5.5 Conclusions

This chapter conducts the first empirical study of the relationship between market structure and profitability within China's banking sector. Emphasis has been placed on investigating the effects of a gradual reform strategy on competitive structure. In addition, the issue of whether the big four banks enjoy the "quiet life" is also tested.

Following Berger (1995) and Goldberg and Rai (1996), four hypotheses are specified, including the structure-conduct-performance hypothesis, the relative-market-power hypothesis, the X-efficiency version of efficient-structure hypothesis, and the scale-efficiency version of efficient-structure hypothesis. The first two are related to the market power paradigm; the latter two to the efficient-structure paradigm. These hypotheses were tested by regressing profits against measures of concentration, market share, X-efficiency, and scale efficiency. Concentration and market share were regressed against the efficiency variables to test for the presence of the necessary conditions of the efficiency-structure hypotheses.

In addition, following Berger and Hannan (1997), X-efficiency and scale efficiency were regressed against concentration and market share. This is used to test for reverse causality in estimating the necessary condition mentioned above, and to test for 'quiet life' effects, i.e., whether banks with market-power sacrifice some profits by less rigorous adherence to cost minimization. For example, X-inefficiencies caused by the absence of incentive to put full effort into minimizing the costs of producing any given output bundle, and scale-inefficiencies caused by not putting full effort into operating at the optimal scale level.

The random effects panel data model was chosen as the preferred approach, and the classic regression model is estimated for comparison. The empirical results of the preferred model suggest that:

- (1) Although using the standard OLS regression model yielded similar findings compared to other bank studies, the random effects panel data model is more appropriate for this study according to the results of the Lagrange Multiplier test.
- (2) The relative-market-power hypothesis is valid for banks in the first reform stage. For banks in the second reform stage, the X-efficiency version of the efficient-structure hypothesis is supported by the initial test but invalidated by the further test of necessary condition.
- (3) The results of the ownership dummy show that the joint-stock banks have a small market share and lower scale efficiency, but are more X-efficient, and earn more profits.
- (4) No significantly negative relationship between concentration and efficiency was found for the four state-owned banks.
- (5) The results are insensitive to different measures of profitability and concentration.

Overall, the findings indicate that the gradual reform strategy did improve the competitive structure of China's banking sector. For example, the subsidies to the state-owned banks were removed, and the more efficient banks gained higher profits. However, the improvement was not sufficient, because the more efficient banks could not gain a larger market share. Given that the joint-stock banks are more efficient than the state-owned banks in this sample, the policy implication is to provide more opportunities for the joint-stock banks (e.g. encouraging the expansion of these banks), which would, in turn improve competitive structure.

There was no evidence to suggest the big four banks enjoyed a 'quiet life' over the period, possibly due to the strict controls on interest rates. As "prices", interest rates provide the potential link between higher concentration level, higher monopolistic profits, and lower efficiency. The strict controls on interest rates could isolate such a link. However, the 'quiet life' scenario could become a problem, if in future banks operate in a highly concentrated market with no restriction on interest rates. For the same reason, the market-power effects on

bank profitability could become more significant. Thus, while interest rate liberalization could help to improve bank efficiency, policy makers must be wary of negative effects from too much market power, quiet life, etc. In other words, the deregulation of the interest rates should be accompanied by reforms which improve competitive structure.

Finally, further research is needed along these lines, since none of the theories are completely consistent with the observed relationships between profits, market structure, and efficiency for banks in the second reform stage. On the other hand, given that the acceleration of the interest rate liberalization and the full implementation of the WTO commitments in the coming years will greatly change the operational environment of the banks in China, the structure-performance issues will remain highly topical research questions in future years.

Appendix 5.1

Pooled OLS Estimates

Table 1. Regression results of ROA and ROE on the CR4, MS, XINEFF, SINEFF, and other control variables

	Dependent variable = ROA			Dependent variable = ROE		
	All	1 st Stage	2 nd Stage	All	1 st Stage	2 nd Stage
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.103 [0.029] (0.001)	-0.078 [0.137] (0.571)	0.092 [0.049] (0.061)	1.898 [0.373] (0.000)	0.213 [1.205] (0.861)	1.833 [0.678] (0.008)
<i>CR4</i>	-0.087 [0.029] (0.003)	0.050 [0.113] (0.660)	-0.070 [0.043] (0.112)	-1.762 [0.360] (0.000)	-0.439 [0.992] (0.660)	-1.595 [0.600] (0.009)
<i>MS</i>	0.027 [0.007] (0.000)	0.048 [0.006] (0.000)	-0.017 [0.009] (0.073)	0.484 [0.091] (0.000)	0.760 [0.054] (0.000)	-0.164 [0.114] (0.154)
<i>XINEFF</i>	-0.025 [0.010] (0.012)	-0.028 [0.035] (0.432)	-0.030 [0.010] (0.003)	-0.374 [0.144] (0.010)	-0.153 [0.349] (0.663)	-0.463 [0.150] (0.003)
<i>SINEFF</i>	0.022 [0.013] (0.087)	0.028 [0.016] (0.087)	-0.0004 [0.023] (0.985)	0.238 [0.196] (0.228)	-0.309 [0.198] (0.125)	0.181 [0.344] (0.599)
<i>AIP</i>	-0.029 [0.006] (0.000)	0.048 [0.055] (0.388)	-0.019 [0.089] (0.300)	-0.266 [0.109] (0.016)	0.440 [0.569] (0.443)	-0.253 [0.282] (0.370)
<i>OWN</i>	0.014 [0.002] (0.000)	0.018 [0.002] (0.000)	0.006 [0.003] (0.055)	0.204 [0.020] (0.000)	0.176 [0.023] (0.000)	0.099 [0.035] (0.005)
<i>TT</i>	0.0001 [0.0004] (0.777)	-0.0001 [0.001] (0.834)	-0.0004 [0.001] (0.697)	-0.005 [0.007] (0.431)	-0.008 [0.008] (0.318)	-0.006 [0.018] (0.736)
$\bar{R}^2$	0.51	0.38	0.61	0.41	0.52	0.50
<i>F-statistic</i>	28.44 (0.000)	5.62 (0.000)	29.91 (0.000)	19.28 (0.000)	9.07 (0.000)	19.97 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), ROA = return on assets, ROE = return on equity, INT = intercept, CR4 = four-bank concentration ratio, MS = market share, XINEFF = X-inefficiency, SINEFF = scale inefficiency, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. 3. p-values are in parentheses. 4. The F-statistic is from a test of the hypothesis that of the slope coefficients (excluding the intercept) in the regression jointly equal to zero. 5. Coefficients in 10% significance level are in bold type.

Table 2. Regression results of ROA and ROE on the HERF, MS, XINEFF, SINEFF, and other control variables

	Dependent variable = ROA			Dependent variable = ROE		
	All	1 st Stage	2 nd Stage	All	1 st Stage	2 nd Stage
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.057 [0.014] (0.000)	-0.019 [0.048] (0.699)	0.079 [0.030] (0.010)	0.960 [0.188] (0.000)	-0.084 [0.435] (0.847)	1.535 [0.447] (0.001)
<i>HERF</i>	-0.142 [0.046] (0.002)	0.006 [0.101] (0.951)	-0.210 [0.096] (0.031)	-2.872 [0.589] (0.000)	-0.522 [0.890] (0.560)	-4.869 [1.436] (0.001)
<i>MS</i>	0.026 [0.007] (0.000)	0.048 [0.006] (0.000)	-0.017 [0.009] (0.062)	0.481 [0.094] (0.000)	0.761 [0.053] (0.000)	-0.163 [0.105] (0.123)
<i>XINEFF</i>	-0.026 [0.010] (0.008)	-0.028 [0.037] (0.447)	-0.031 [0.010] (0.003)	-0.408 [0.144] (0.005)	-0.169 [0.357] (0.638)	-0.473 [0.155] (0.003)
<i>SINEFF</i>	0.021 [0.012] (0.089)	0.028 [0.016] (0.086)	-0.001 [0.023] (0.985)	0.226 [0.198] (0.254)	-0.310 [0.198] (0.124)	0.181 [0.354] (0.611)
<i>AIP</i>	-0.023 [0.006] (0.000)	0.026 [0.042] (0.540)	-0.020 [0.017] (0.233)	-0.148 [0.106] (0.163)	0.474 [0.473] (0.321)	-0.277 [0.257] (0.283)
<i>OWN</i>	0.014 [0.002] (0.000)	0.018 [0.002] (0.000)	0.006 [0.003] (0.045)	0.203 [0.020] (0.000)	0.176 [0.023] (0.000)	0.098 [0.031] (0.002)
<i>TT</i>	-0.0003 [0.0004] (0.499)	-9.87E-05 [0.001] (0.890)	-0.001 [0.001] (0.448)	-0.014 [0.007] (0.056)	-0.009 [0.008] (0.263)	-0.014 [0.017] (0.402)
$\bar{R}^2$	0.51	0.38	0.61	0.42	0.52	0.52
<i>F</i> -statistic	28.83 (0.000)	5.55 (0.000)	31.05 (0.000)	19.88 (0.000)	9.11 (0.000)	21.83 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), ROA = return on assets, ROE = return on equity, INT = intercept, HERF = Herfindahl-Hirschman index, MS = market share, XINEFF = X-inefficiency, SINEFF = scale inefficiency, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. 3. p-values are in parentheses. 4. The F-statistic is from a test of the hypothesis that of the slope coefficients (excluding the intercept) in the regression jointly equal to zero. 5. Coefficients in 10% significance level are in bold type.

Table 3. Regression results of CR4, HERF, and MS on the XINEFF, SINEFF, and other control variables

	Dependent variable = CR4			Dependent variable = HERF			Dependent variable = MS		
	All	1 st Stage	2 nd Stage	All	1 st Stage	2 nd Stage	All	1 st Stage	2 nd Stage
<i>N</i>	187	54	133	187	54	133	187	54	133
<i>INT</i>	1.012 [0.006] (0.000)	1.246 [0.036] (0.000)	1.081 [0.016] (0.000)	0.294 [0.004] (0.000)	0.479 [0.039] (0.000)	0.293 [0.006] (0.000)	0.253 [0.025] (0.000)	0.164 [0.304] (0.591)	0.283 [0.069] (0.000)
<i>XINEFF</i>	0.010 [0.025] (0.694)	-0.011 [0.054] (0.836)	0.016 [0.019] (0.389)	-0.006 [0.016] (0.719)	-0.039 [0.054] (0.474)	0.003 [0.009] (0.726)	-0.152 [0.075] (0.044)	0.326 [0.566] (0.567)	-0.199 [0.071] (0.006)
<i>SINEFF</i>	0.028 [0.031] (0.374)	-0.007 [0.020] (0.738)	-0.001 [0.054] (0.985)	0.013 [0.025] (0.597)	-0.007 [0.023] (0.774)	-0.001 [0.024] (0.987)	0.226 [0.131] (0.088)	0.193 [0.215] (0.373)	0.278 [0.199] (0.164)
<i>AIP</i>	-0.002 [0.015] (0.868)	-0.488 [0.070] (0.000)	-0.256 [0.026] (0.000)	0.040 [0.011] (0.001)	-0.344 [0.077] (0.000)	-0.089 [0.010] (0.000)	-0.039 [0.076] (0.613)	0.068 [0.568] (0.905)	-0.061 [0.102] (0.552)
<i>OWN</i>	-0.001 [0.003] (0.651)	-0.0002 [0.003] (0.919)	-7.73E-06 [0.003] (0.998)	-0.001 [0.002] (0.691)	2.97E-06 [0.003] (0.999)	-0.0001 [0.001] (0.898)	-0.227 [0.011] (0.000)	-0.233 [0.022] (0.000)	-0.228 [0.016] (0.000)
<i>TT</i>	-0.009 [0.001] (0.000)	0.001 [0.001] (0.525)	0.012 [0.002] (0.000)	-0.009 [0.001] (0.000)	-0.001 [0.001] (0.529)	0.002 [0.001] (0.004)	0.001 [0.005] (0.761)	0.001 [0.012] (0.940)	0.003 [0.008] (0.757)
$\overline{R}^2$	0.89	0.83	0.80	0.91	0.76	0.85	0.80	0.65	0.87
<i>F-statistic</i>	311.49 (0.000)	51.60 (0.000)	104.56 (0.000)	373.95 (0.000)	33.96 (0.000)	154.96 (0.000)	150.38 (0.000)	20.89 (0.000)	183.38 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), INT = intercept, CR4 = four-bank concentration ratio, HERF = Herfindahl-Hirschman index, MS = market share, XINEFF = X-inefficiency, SINEFF = scale inefficiency, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. 3. p-values are in parentheses. 4. The F-statistic is from a test of the hypothesis that of the slope coefficients (excluding the intercept) in the regression jointly equal to zero. 5. Coefficients in 10% significance level are in bold type.

Table 4. Regression results of XINEFF and SINEFF on the CR4, MS, and other control variables

	<i>Dependent variable = XINEFF</i>			<i>Dependent variable = SINEFF</i>		
	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.028 [0.215] (0.897)	0.272 [0.523] (0.605)	-0.077 [0.461] (0.867)	-0.186 [0.143] (0.196)	0.290 [0.670] (0.667)	-0.090 [0.238] (0.705)
<i>CR4</i>	0.091 [0.211] (0.666)	-0.074 [0.416] (0.860)	0.380 [0.429] (0.378)	0.132 [0.146] (0.366)	-0.161 [0.532] (0.764)	0.025 [0.212] (0.907)
<i>MS</i>	-0.095 [0.152] (0.521)	0.022 [0.046] (0.630)	-0.290 [0.308] (0.339)	0.081 [0.071] (0.249)	0.048 [0.052] (0.362)	0.055 [0.056] (0.325)
<i>AIP</i>	-0.045 [0.040] (0.263)	-0.234 [0.263] (0.379)	-0.143 [0.164] (0.388)	0.285 [0.044] (0.000)	-0.046 [0.353] (0.898)	0.105 [0.088] (0.232)
<i>OWN</i>	-0.042 [0.014] (0.002)	0.003 [0.015] (0.827)	-0.092 [0.025] (0.000)	0.037 [0.010] (0.001)	-0.018 [0.018] (0.307)	0.052 [0.013] (0.000)
<i>TT</i>	0.005 [0.003] (0.073)	0.0001 [0.003] (0.958)	0.013 [0.011] (0.223)	-0.014 [0.003] (0.000)	-0.010 [0.006] (0.105)	-0.002 [0.006] (0.779)
$\bar{R}^2$	0.07	0.04	0.12	0.29	0.25	0.60
<i>F-statistic</i>	3.60 (0.004)	1.39 (0.246)	4.45 (0.001)	16.42 (0.000)	4.50 (0.002)	40.38 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), INT = intercept, CR4 = four-bank concentration ratio, MS = market share, XINEFF = X-inefficiency, SINEFF = scale inefficiency, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. 3. p-values are in parentheses. 4. The F-statistic is from a test of the hypothesis that of the slope coefficients (excluding the intercept) in the regression jointly equal to zero. 5. Coefficients in 10% significance level are in bold type.

Table 5. Regression results of XINEFF and SINEFF on the HERF, MS, and other control variables

	<i>Dependent variable = XINEFF</i>			<i>Dependent variable = SINEFF</i>		
	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.150 [0.092] (0.106)	0.310 [0.206] (0.139)	0.232 [0.268] (0.387)	-0.093 [0.076] (0.223)	0.134 [0.300] (0.656)	-0.068 [0.132] (0.609)
<i>HERF</i>	-0.100 [0.302] (0.740)	-0.276 [0.397] (0.489)	0.349 [0.908] (0.701)	0.139 [0.272] (0.611)	-0.093 [0.623] (0.881)	-0.015 [0.415] (0.972)
<i>MS</i>	-0.095 [0.152] (0.533)	0.022 [0.045] (0.628)	-0.289 [0.208] (0.189)	0.081 [0.076] (0.274)	0.047 [0.052] (0.361)	0.055 [0.056] (0.323)
<i>AIP</i>	-0.040 [0.040] (0.320)	-0.291 [0.220] (0.191)	-0.210 [0.146] (0.154)	0.280 [0.048] (0.000)	0.001 [0.299] (0.998)	0.100 [0.074] (0.179)
<i>OWN</i>	-0.044 [0.014] (0.002)	0.003 [0.015] (0.823)	-0.092 [0.025] (0.000)	0.037 [0.010] (0.001)	-0.018 [0.018] (0.307)	0.052 [0.013] (0.000)
<i>TT</i>	0.004 [0.003] (0.294)	-0.0001 [0.003] (0.969)	0.017 [0.010] (0.090)	-0.014 [0.004] (0.001)	-0.010 [0.006] (0.098)	-0.001 [0.005] (0.782)
$\bar{R}^2$	0.06	0.04	0.11	0.29	0.25	0.60
<i>F statistic</i>	3.58 (0.004)	1.49 (0.210)	4.29 (0.001)	16.31 (0.000)	4.49 (0.002)	40.37 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002). INT = intercept, HERF = Herfindahl-Hirschman index, MS = market share, XINEFF = X-inefficiency, SINEFF = scale inefficiency, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. 3. p-values are in parentheses. 4. The F-statistic is from a test of the hypothesis that of the slope coefficients (excluding the intercept) in the regression jointly equal to zero. 5. Coefficients in 10% significance level are in bold type.

Table 6. Regression results of ROA and ROE on the XINEFF, SINEFF, and other control variables

	Dependent variable = ROA			Dependent variable = ROE		
	All	1 st Stage	2 nd Stage	All	1 st Stage	2 nd Stage
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.022 [0.002] (0.000)	-.008 [0.022] (0.726)	0.012 [0.009] (0.167)	0.237 [0.035] (0.000)	-0.209 [0.313] (0.506)	0.063 [0.144] (0.662)
<i>XINEFF</i>	-0.030 [0.009] (0.002)	-0.013 [0.042] (0.761)	-0.028 [0.009] (0.003)	-0.465 [0.140] (0.001)	0.100 [0.530] (0.852)	-0.457 [0.140] (0.001)
<i>SINEFF</i>	0.025 [0.014] (0.085)	0.037 [0.020] (0.070)	-0.005 [0.023] (0.827)	0.297 [0.225] (0.189)	-0.160 [0.268] (0.554)	0.137 [0.340] (0.688)
<i>AIP</i>	-0.030 [0.007] (0.000)	0.027 [0.044] (0.542)	-0.0004 [0.014] (0.975)	-0.281 [0.118] (0.018)	0.706 [0.619] (0.260)	0.164 [0.226] (0.469)
<i>OWN</i>	0.008 [0.001] (0.000)	0.007 [0.002] (0.002)	0.010 [0.001] (0.000)	0.096 [0.014] (0.000)	-0.002 [0.025] (0.944)	0.136 [0.018] (0.000)
<i>TT</i>	0.001 [0.000] (0.018)	-6.01E-05 [0.001] (0.946)	-0.001 [0.001] (0.190)	0.012 [0.007] (0.093)	-0.008 [0.013] (0.531)	-0.026 [0.017] (0.121)
$\bar{R}^2$	0.45	0.11	0.60	0.29	0.05	0.49
<i>F statistics</i>	31.41 (0.000)	2.28 (0.061)	40.00 (0.000)	16.31 (0.000)	0.56 (0.732)	25.96 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), ROA = return on assets, ROE = return on equity, INT = intercept, XINEFF = X-inefficiency, SINEFF = scale inefficiency, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. 3. p-values are in parentheses. 4. The F-statistic is from a test of the hypothesis that of the slope coefficients (excluding the intercept) in the regression jointly equal to zero. 5. Coefficients in 10% significance level are in bold type.

Table 7. Regression results of ROA and ROE on the CR4, MS, and other control variables

	Dependent variable = ROA			Dependent variable = ROE		
	All	1 st Stage	2 nd Stage	All	1 st Stage	2 nd Stage
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.099 [0.029] (0.0001)	-0.078 [0.140] (0.580)	0.095 [0.049] (0.055)	1.844 [0.381] (0.000)	0.082 [1.217] (0.947)	1.852 [0.677] (0.007)
<i>CR4</i>	-0.087 [0.029] (0.003)	0.048 [0.116] (0.681)	-0.081 [0.044] (0.065)	-1.765 [0.371] (0.000)	-0.378 [0.973] (0.699)	-1.766 [0.604] (0.004)
<i>MS</i>	0.031 [0.007] (0.000)	0.049 [0.006] (0.000)	-0.008 [0.010] (0.383)	0.539 [0.093] (0.000)	0.742 [0.057] (0.000)	-0.020 [0.097] (0.841)
<i>AIP</i>	-0.022 [0.005] (0.000)	0.054 [0.058] (0.360)	-0.015 [0.018] (0.403)	-0.182 [0.081] (0.026)	0.490 [0.625] (0.437)	-0.168 [0.273] (0.539)
<i>OWN</i>	0.016 [0.002] (0.000)	0.017 [0.002] (0.000)	0.008 [0.002] (0.000)	0.229 [0.019] (0.000)	0.181 [0.023] (0.000)	0.151 [0.023] (0.000)
<i>TT</i>	-0.0003 [0.0004] (0.409)	-0.0004 [0.001] (0.526)	-0.001 [0.001] (0.457)	-0.011 [0.006] (0.055)	-0.005 [0.008] (0.504)	-0.013 [0.018] (0.486)
$\bar{R}^2$	0.49	0.36	0.58	0.39	0.51	0.47
<i>F statistic</i>	36.25 (0.000)	7.05 (0.000)	37.17 (0.000)	24.44 (0.000)	11.99 (0.000)	24.84 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), ROA = return on assets, ROE = return on equity, INT = intercept, CR4 = four-bank concentration ratio, MS = market share, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. 3. p-values are in parentheses. 4. The F-statistic is from a test of the hypothesis that of the slope coefficients (excluding the intercept) in the regression jointly equal to zero. 5. Coefficients in 10% significance level are in bold type.

Table 8. Regression results of ROA and ROE on the HERF, MS, and other control variables

	Dependent variable = ROA			Dependent variable = ROE		
	All	1 st Stage	2 nd Stage	All	1 st Stage	2 nd Stage
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.051 [0.013] (0.000)	-0.024 [0.044] (0.534)	0.072 [0.032] (0.026)	0.877 [0.186] (0.000)	-0.178 [0.461] (0.701)	1.413 [0.468] (0.003)
<i>HERF</i>	-0.136 [0.046] (0.003)	0.011 [0.097] (0.906)	-0.221 [0.101] (0.031)	-2.800 [0.603] (0.000)	-0.446 [0.873] (0.612)	-5.031 [1.528] (0.001)
<i>MS</i>	0.031 [0.007] (0.000)	0.049 [0.006] (0.000)	-0.008 [0.009] (0.377)	0.538 [0.096] (0.000)	0.742 [0.056] (0.000)	-0.017 [0.092] (0.858)
<i>AIP</i>	-0.017 [0.005] (0.002)	0.034 [0.042] (0.423)	-0.014 [0.017] (0.407)	-0.068 [0.080] (0.394)	0.523 [0.524] (0.323)	-0.160 [0.252] (0.527)
<i>OWN</i>	0.016 [0.002] (0.000)	0.017 [0.002] (0.000)	0.008 [0.002] (0.000)	0.229 [0.019] (0.000)	0.181 [0.023] (0.000)	0.151 [0.021] (0.000)
<i>TT</i>	-0.001 [0.000] (0.132)	-0.0004 [0.001] (0.590)	-0.001 [0.001] (0.198)	-0.019 [0.007] (0.004)	-0.006 [0.008] (0.438)	-0.022 [0.016] (0.176)
$\bar{R}^2$	0.49	0.36	0.59	0.39	0.51	0.50
<i>F statistic</i>	36.50 (0.000)	6.98 (0.000)	38.36 (0.000)	24.82 (0.000)	12.03 (0.000)	26.96 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), ROA = return on assets, ROE = return on equity, INT = intercept, HERF = Herfindahl-Hirschman index, MS = market share, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. 3. p-values are in parentheses. 4. The F-statistic is from a test of the hypothesis that of the slope coefficients (excluding the intercept) in the regression jointly equal to zero. 5. Coefficients in 10% significance level are in bold type.

Table 9. Regression results of ROA and ROE on the CR4, XINEFF, SINEFF, and other control variables

	<i>Dependent variable = ROA</i>			<i>Dependent variable = ROE</i>		
	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.110 [0.030] (0.000)	-0.074 [0.159] (0.644)	0.090 [0.048] (0.067)	2.017 [0.384] (0.000)	0.283 [1.832] (0.878)	1.806 [0.672] (0.008)
<i>CR4</i>	-0.087 [0.029] (0.003)	0.053 [0.127] (0.678)	-0.072 [0.043] (0.100)	-1.759 [0.378] (0.000)	-0.396 [1.416] (0.781)	-1.613 [0.596] (0.008)
<i>XINEFF</i>	-0.029 [0.010] (0.003)	-0.012 [0.043] (0.776)	-0.027 [0.010] (0.006)	-0.448 [0.144] (0.002)	0.095 [0.535] (0.860)	-0.430 [0.143] (0.003)
<i>SINEFF</i>	0.028 [0.014] (0.053)	0.037 [0.020] (0.074)	-0.005 [0.023] (0.819)	0.347 [0.222] (0.112)	-0.162 [0.270] (0.550)	0.135 [0.335] (0.686)
<i>AIP</i>	-0.030 [0.001] (0.000)	0.053 [0.074] (0.478)	-0.019 [0.019] (0.312)	-0.285 [0.117] (0.015)	0.513 [0.984] (0.605)	-0.248 [0.281] (0.379)
<i>OWN</i>	0.008 [0.001] (0.000)	0.007 [0.002] (0.002)	0.010 [0.001] (0.000)	0.094 [0.014] (0.000)	-0.002 [0.025] (0.941)	0.136 [0.017] (0.000)
<i>TT</i>	0.0002 [0.0004] (0.733)	-0.0001 [0.001] (0.910)	-0.0005 [0.001] (0.684)	-0.005 [0.008] (0.546)	-0.008 [0.013] (0.555)	-0.006 [0.018] (0.727)
$\bar{R}^2$	0.48	0.09	0.60	0.35	0.06	0.50
<i>F-statistic</i>	29.24 (0.000)	1.92 (0.099)	34.27 (0.000)	17.81 (0.000)	0.47 (0.828)	23.24 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), ROA = return on assets, ROE = return on equity, INT = intercept, CR4 = four-bank concentration ratio, XINEFF = X-inefficiency, SINEFF = scale inefficiency, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. 3. p-values are in parentheses. 4. The F-statistic is from a test of the hypothesis that of the slope coefficients (excluding the intercept) in the regression jointly equal to zero. 5. Coefficients in 10% significance level are in bold type.

Table 10. Regression results of ROA and ROE on the HERF, XINEFF, SINEFF, and other control variables

	Dependent variable = ROA			Dependent variable = ROE		
	All	1 st Stage	2 nd Stage	All	1 st Stage	2 nd Stage
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.063 [0.014] (0.000)	-0.013 [0.061] (0.829)	0.075 [0.030] (0.015)	1.085 [0.195] (0.000)	-0.004 [0.769] (0.996)	1.496 [0.446] (0.001)
<i>HERF</i>	-0.143 [0.018] (0.004)	0.011 [0.117] (0.925)	-0.213 [0.096] (0.029)	-2.884 [0.651] (0.000)	-0.445 [1.381] (0.749)	-4.895 [1.436] (0.001)
<i>XINEFF</i>	-0.030 [0.010] (0.002)	-0.013 [0.044] (0.778)	-0.027 [0.010] (0.007)	-0.481 [0.144] (0.001)	0.082 [0.543] (0.880)	-0.441 [0.149] (0.004)
<i>SINEFF</i>	0.027 [0.014] (0.054)	0.037 [0.020] (0.073)	-0.005 [0.023] (0.820)	0.335 [0.222] (0.133)	-0.163 [0.270] (0.549)	0.135 [0.346] (0.697)
<i>AIP</i>	-0.024 [0.007] (0.000)	0.031 [0.059] (0.602)	-0.020 [0.017] (0.258)	-0.166 [0.118] (0.160)	0.553 [0.832] (0.510)	-0.269 [0.257] (0.297)
<i>OWN</i>	0.008 [0.001] (0.000)	0.007 [0.002] (0.002)	0.010 [0.001] (0.000)	0.094 [0.014] (0.000)	-0.002 [0.025] (0.945)	0.136 [0.016] (0.000)
<i>TT</i>	-0.0003 [0.001] (0.597)	-5.05E-05 [0.001] (0.956)	-0.001 [0.001] (0.431)	-0.014 [0.009] (0.121)	-0.008 [0.013] (0.510)	-0.014 [0.017] (0.390)
$\bar{R}^2$	0.48	0.09	0.61	0.36	0.06	0.53
<i>F-statistic</i>	29.69 (0.000)	1.87 (0.107)	35.56 (0.000)	18.46 (0.000)	0.47 (0.825)	25.41 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), ROA = return on assets, ROE = return on equity, INT = intercept, HERF = Herfindahl-Hirschman index, XINEFF = X-inefficiency, SINEFF = scale inefficiency, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. 3. p-values are in parentheses. 4. The F-statistic is from a test of the hypothesis that of the slope coefficients (excluding the intercept) in the regression jointly equal to zero. 5. Coefficients in 10% significance level are in bold type.

Table 11. Regression results of ROA and ROE on the MS, XINEFF, SINEFF, and other control variables

	<i>Dependent variable = ROA</i>			<i>Dependent variable = ROE</i>		
	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>	<i>All</i>	<i>1st Stage</i>	<i>2nd Stage</i>
<i>N</i>	187	54	133	187	54	133
<i>INT</i>	0.015 [0.003] (0.000)	-0.016 [0.016] (0.343)	0.017 [0.009] (0.055)	0.115 [0.039] (0.003)	-0.334 [0.194] (0.092)	0.113 [0.147] (0.443)
<i>MS</i>	0.027 [0.007] (0.000)	0.048 [0.006] (0.000)	-0.018 [0.009] (0.058)	0.483 [0.085] (0.000)	0.760 [0.056] (0.000)	-0.177 [0.111] (0.111)
<i>XINEFF</i>	-0.026 [0.009] (0.007)	-0.029 [0.035] (0.417)	-0.031 [0.010] (0.001)	-0.392 [0.140] (0.006)	-0.148 [0.347] (0.672)	-0.492 [0.147] (0.001)
<i>SINEFF</i>	0.019 [0.013] (0.142)	0.028 [0.015] (0.082)	0.0002 [0.024] (0.993)	0.188 [0.200] (0.348)	-0.306 [0.199] (0.130)	0.186 [0.352] (0.597)
<i>AIP</i>	-0.029 [0.007] (0.000)	0.024 [0.034] (0.484)	-0.002 [0.013] (0.911)	-0.262 [0.111] (0.019)	0.654 [0.406] (0.113)	0.154 [0.225] (0.496)
<i>OWN</i>	0.014 [0.002] (0.000)	0.018 [0.002] (0.000)	0.005 [0.003] (0.062)	0.206 [0.020] (0.000)	0.176 [0.022] (0.000)	0.096 [0.035] (0.007)
<i>TT</i>	0.001 [0.000] (0.017)	-0.0001 [0.001] (0.879)	-0.001 [0.001] (0.199)	0.011 [0.007] (0.088)	-0.009 [0.008] (0.292)	-0.026 [0.017] (0.127)
$\bar{R}^2$	0.48	0.39	0.60	0.33	0.53	0.49
<i>F-statistic</i>	29.69 (0.000)	6.61 (0.000)	34.01 (0.000)	16.46 (0.000)	10.73 (0.000)	21.73 (0.000)

Notes: 1. All = all banks in the sample; 1st stage = banks existed in the first stage of banking reform (1985-1992); 2nd stage = banks existed in the second stage of banking reform (1993-2002), ROA = return on assets, ROE = return on equity, INT = intercept, MS = market share, XINEFF = X-inefficiency, SINEFF = scale inefficiency, AIP = average income per person. OWN = an ownership dummy variable, equals to 0 if it's wholly state-owned, 1 for joint-stock. TT = a time trend variable, equals to 0 to 17 as from years 1985 to 2002, respectively. 2. White heteroscedasticity consistent standard errors are in brackets. 3. p-values are in parentheses. 4. The F-statistic is from a test of the hypothesis that of the slope coefficients (excluding the intercept) in the regression jointly equal to zero. 5. Coefficients in 10% significance level are in bold type.

Chapter 6. Conclusions

6.1 Conclusions

The objective of this thesis was to investigate X-efficiency, cost economies and structure-performance relationship issues in China's banking sector. It began with a review of the evolution of the banking sector over the past half-century, and included reviews of the related theoretical and empirical studies of efficiency and competition. However, using a data set on the major state and joint-stock banks for the period 1985-2002, the thesis concentrated on:

- Obtaining measures of X-efficiency, with a view to assessing how the gradual reform strategy influenced X-efficiency and whether there were any differences in X-efficiency between the state and joint-stock banks.
- Testing for economies of scale and scope of the sample of Chinese banks and looking for differences in the cost economies between banks with different ownership types and/or at different reform stages.
- Assessing how competitive the market is by testing whether there is empirical support for the market-power or efficient-structure hypotheses.

Chapter 2 reviewed the evolution of China's banking sector from 1949 to 2003, providing the background for more detailed empirical analyses in subsequent chapters. The banking sector underwent significant changes after the Chinese government introduced a series of reforms, commencing in 1979. Employing a gradual approach, the first stage of banking reform (1979-1992) transformed the banking system from a monopoly into a two-tier banking system to strengthen its role in the mobilisation and allocation of financial resources. However, this sector was highly regulated, and was dominated by state-owned specialised banks. Banks had little incentive and scant means to behave efficiently.

The second stage of banking reform (1993-present) was initiated with the objective of developing an effective, competitive and stable banking sector. To

achieve this aim, a package of financial reforms, involving a mix of deregulation and new regulations, was adopted. For example, entry barriers were lowered, the state-owned banks were commercialised, the credit ceiling was removed, an inter-bank market was created, the interest rates were marginally liberalised, and commercial and investment banking business were separated. Technological progress has also boosted competition by eliminating geographical barriers and facilitating product innovations.

In response to these changes, banks adopted strategies aiming at improving efficiency to expand output and increase the range of services offered. The streamlining of the state-owned banks, the expansion of the joint-stock banks, the diversification of portfolios, increased off-balance-sheet activities, and, more recently, a plan to turn some state banks into joint-stock, can be interpreted as responses of this kind. A major motivation has been to realize potential scale and scope economies, and to reduce inefficiencies. Given the above factors, and noting that China's WTO accession may lead to an increasingly integrated banking market, it is important to investigate the progress of China's banking system with respect to efficiency and competition.

The second stage of reform was profound, but the high proportion of non-performing loans has posed a substantial challenge to the sector during this stage. Although the Chinese banks have made certain progress in improving the quality of their loans, their average ratio of non-performing loans is still very high, suggesting that improving asset quality should still be the major task for these banks.

While the state banks are wholly owned by the state, the joint-stock banks are also effectively owned by the state via local governments and state-owned enterprises. They are not private banks typical of the west. However, the issues of social welfare objectives and "soft" budget constraints are more applicable to the state banks, given that they are the mainstream of China's banking sector, and directly controlled by the government.

To provide suggestions for future lines of enquiry and research, Chapter 2 also included a preliminary analysis of the factors influencing bank performance in China over the last two decades. The results show that both the ownership dummy and time trend variables were statistically significant, confirming the need to look into the differences between various reform stages and ownership types. The exercise also showed that standard measures of bank efficiency influence performance even in China, where government controls are so extensive. Future research might focus on new influential variables as these are lifted.

Chapter 3 investigated X-efficiency within the banking system from 1985 to 2002. The results show that the grand mean X-efficiency was in the range of 40%-50%. Joint-stock commercial banks were found to be relatively more X-efficient than the state-owned commercial banks. X-efficiency was found to be more pronounced in the early stage of banking reform. Banks with higher proportions of core deposits were relatively more X-efficient.

Chapter 4 evaluated economies of scale and scope in the banking sector. The results indicate that there are constant returns to scale and significant economies of scope in most of the banks, independent of ownership structure and the stage of banking reform.

Chapter 5 looked at aspects of competition by investigating the structure-performance relationship within the Chinese banking market. The results suggest that the relative-market-power hypothesis appeared to be supported during the first reform stage, but the second reform stage confirmed the X-efficiency version of the efficient-structure hypothesis, although this was invalidated by a further test. Joint-stock banks were found to have a small market share and lower scale efficiency, but to be more X-efficient and earn greater profits. No significant negative relationship between concentration and efficiency was found for the four big state-owned banks.

The findings from various chapters are consistent with each other, and suggest that: (1) X-efficiency is a critical issue that should receive more attention from researchers, bank regulators and managers. (2) Converting state-owned banks to joint-stock ownership should improve their X-efficiency. In addition, the domestic banks will behave like their foreign counterparts if they are subject to the full force of competition with no interference (or expectation of interference) from the state. (3) Interest rate liberalisation would provide bank managers with more opportunities to boost their X-efficiency. (4) Relying on purchased funds rather than core deposits to finance the portfolio would probably lead to X-inefficiency. (5) Allowing banks to engage in universal banking operations is likely to improve their cost structures. (6) The gradual reform strategy did improve the competitive structure of China's banking sector to some extent. However, policy should be directed at enabling the more efficient banks to gain larger market shares. Given that the joint-stock banks were more efficient than the state-owned banks in this sample, the policy implication is to encourage the expansion of the joint-stock banks to further improve the competitive structure. (7) The big four banks did not enjoy a 'quiet life' during the sample periods. However, the 'quiet life' scenario could become a problem if, in future, banks operate in a highly concentrated market with no restriction on interest rates. For the same reason, the banks could end up with more market-power, which would probably validate the market-power hypothesis. Thus, while interest rate deregulation should improve bank efficiency, policy makers must be wary of potential negative effects from too much market power, 'quiet life' effects, and other anti-competitive behaviour. In other words, interest rate liberalization should be accompanied by reforms which improve competitive structure, such as the deregulation of market entry.

In terms of methodology, several conclusions have been reached from this study. First, applying different distribution assumptions to the disturbance term of the stochastic frontier model yielded similar results, which supports the use of relatively simple distribution. Second, the stochastic frontier approach and the expansion path measures were found to be superior to the traditional non-frontier approach and the standard measures in estimating economies of scale and scope

for the Chinese banks. Finally, although using the standard regression model yielded similar results to other bank studies, the random effects panel data model was found to be more appropriate for this study, according to the Lagrange multiplier test.

6.2 Limitations of this Thesis

As with other studies on bank efficiency and competition, this thesis has some drawbacks. The first issue concerns the limited number of observations, because of the relatively small number and short history of these banks. Thus, some advanced techniques, such as the panel data approach and the Fourier-flexible functional form, cannot be applied to estimate X-efficiency and economies of scale and scope.

In terms of the methodology, as indicated by Berger and Humphrey (1997), one problem with frontier analysis is that rankings of banks by their measured X-efficiencies can differ, although the central tendency of average X-efficiency values for banks is generally similar across frontier techniques. Since rankings will vary depending on the frontier technique used, the common practice of the two-stage regression may lead to misleading results. To make these *ex post* regressions informative, X-efficiency estimates should be obtained from more than just one class of frontier technique. However, this thesis used just one parametric technique, the stochastic frontier approach, to estimate X-efficiency. More frontier techniques are needed to cross-check the results.

Another issue is that X-efficiency is only a relative measure against the best practice bank within the sample. The best practice bank itself may or may not be really efficient in the real economic sense. The latter could cause the mis-measurement of the real efficiency level of China's banking sector.

Finally, as indicated by Berger, Hanweck, and Humphrey (1987), the cost function only captures the cost- or supply-side benefits to banks from joint

production, as in the first two resources of economies of scope (i.e., spreading fixed costs and information production). However, it ignores the revenue- or demand-side benefits, as in the last two resources (i.e., risk reduction and customer cost economies). Therefore, the total economies from joint production may be understated in the empirical estimates here and in other studies.

6.3 Avenues for Future Research

Several suggestions for future research may be derived from this thesis. First, a larger data set should produce more reliable results by enabling more advanced techniques to address the efficiency and competition issues. Second, the nonparametric approach, such as data envelopment analysis, should be applied to cross-check the X-efficiency in the banking sector.

Third, while the efficiency analysis of this thesis concentrated on the cost side of banks' operations, banks in China have already recently put their energies into trying to boost returns to shareholders by focusing on both costs and revenues. Thus, further work is needed to estimate the profit efficiency, which also takes the revenue sides of banks' operations into account.

Finally, while this thesis has made a contribution to estimating the structure-performance relationship within China's banking sector, none of the theories are completely consistent with the observed relationships among profits, market structure and efficiency for banks in the second reform stage. Further research is needed along these lines.

The acceleration of the interest rate liberalization and the full implementation of the WTO commitments in the coming years will change the operational environment of the banks in China greatly, suggesting that the structure-performance relationship should be a more critical topic in future research.

The continuing efforts of researchers will hopefully find answers to these questions and shed more light on the factors that influence efficiency and competition in the banking sector.

References

- Adams, R.M., A.N. Berger, and R.C. Sickles (1999), "Semiparametric Approaches to Stochastic Panel Frontiers With Applications in the Banking Industry", *Journal of Business and Economic Statistics*, 17, 3, July, 349-358.
- Aigner, D., K. Lovell, and P. Schmidt (1977), "Formulation and Estimation of Stochastic Frontier Production Models", *Journal of Econometrics*, 6, 21-37.
- Allen, L. and A. Rai (1996), "Operational Efficiency in Banking: An International Comparison", *Journal of Banking and Finance*, 20, 655-672.
- Altunbas, Y. and P. Molyneux (1996), "Economies of Scale and Scope in European Banking", *Applied Financial Economics*, 6, 367-375.
- Altunbas, Y., M. Liu, P. Molyneux, and R. Seth (2000), "Efficiency and Risk in Japanese Banking", *Journal of Banking and Finance*, 24, 1605-1628.
- Altunbas, Y. and S. P. Chakravarty (2001a), "Frontier Cost Functions and Bank Efficiency", *Economics Letters*, 233-240.
- Altunbas, Y., L. Evans, and P. Molyneux (2001b), "Bank Ownership and Efficiency", *Journal of Money, Credit, and Banking*, 33, 4, 926-954.
- Altunbas, Y., E.P.M. Gardener, P. Molyneux, and B. Moore (2001c), "Efficiency in European Banking", *European Economic Review*, 45, 1931-1955.
- Aly, H.Y., R. Grabowski, C. Pasurka, and N. Rangan (1990), "Technical, Scale, and Allocative Efficiencies in US Banking: An Empirical Investigation", *Review of Economics and Statistics*, 72, 211-218.
- Bain, J.S. (1951), "Relation of Profit Rate to Industry Concentration: American Manufacturing 1936-1940", *Quarterly Journal of Economics*, LXV, 3, 293-324.
- Baltagi, B.H. (1995), *Econometric Analysis of Panel Data*, England: John Wiley and Sons Ltd.
- Battese, G.E. and G.S. Corra (1977), "Estimation of a Production Frontier Model: with Application to the Pastoral Zone of Eastern Australia", *Australian Journal of Agricultural Economics*, 21 (3), December, 169-179.
- Bauer, P.W., A.N. Berger, and D.B. Humphrey (1993), "Efficiency and Productivity Growth in U.S. Banking", in H.O. Fried, C.A.K. Lovell, and S.S. Schmidt (ed.) *The Measurement of Productive Efficiency: Techniques and Applications*, New York: Oxford University Press.
- Bauer, P.W., A.N. Berger, G.D. Ferrier, and D.B. Humphrey (1998), "Consistency

Conditions for Regulatory Analysis of Financial Institutions: A Comparison of Frontier Efficiency Methods”, *Journal of Economics and Business*, 50, 85-114.

Baumol, W.J., J.C. Panzar, and R.D. Willig (1982), *Contestable Markets and the Theory of Industry Structure*, New York: Harcourt Brace Jovanovich, Inc.

Benston, G. J., G.A. Hanweck, and D.B. Humphrey (1982), “Scale Economies in Banking: A Restructuring and Reassessment”, *Journal of Money, Credit and Banking*, 14, 1, 435-456.

Berger A.N., G.A. Hanweck, and D.B. Humphrey (1987), “Competitive Viability in Banking: Scale, Scope, and Product Mix Economies”, *Journal of Monetary Economics*, 20, 501-520.

Berger, A.N. and T.H. Hannan (1989), “The Price-Concentration Relationship in Banking”, *Review of Economic and Statistics*, 71, 2, 291-299.

Berger, A.N. and D.B. Humphrey (1991), “The Dominance of Inefficiencies over Scale and Product Mix Economies in Banking”, *Journal of Monetary Economics*, 28, 117-148.

Berger, A.N. and T.H. Hannan (1992), “The Price-Concentration Relationship in Banking: A Reply”, *Review of Economic and Statistics*, 74, 2, 376-379.

Berger, A.N. (1993), “‘Distribution-Free’ Estimates of Efficiency in the U.S. Banking Industry and Tests of the Standard Distributional Assumptions”, *Journal of Productivity Analysis*, 4, 261-292.

Berger, A.N., W.C. Hunter, and S.G. Timme (1993), “The Efficiency of Financial Institutions: a Review and Preview of Research Past, Present, and Future”, *Journal of Banking and Finance*, 17, 221-249.

Berger, A.N. and D.B. Humphrey (1994), “Bank Scale Economies, Mergers, Concentration, and Efficiency: the U.S. Experience”, University of Pennsylvania, The Wharton school, Working Paper, 94-25.

Berger, A.N. (1995), “The Profit-Structure Relationship in Banking – Tests of Market-Power and Efficient-Structure Hypotheses”, *Journal of Money, Credit and Banking*, 27, 2, 404-431.

Berger, A.N. and R. DeYoung (1997), “Problem Loans and Cost Efficiency in Commercial Banks”, *Journal of Banking and Finance*, 21, 6, 849-870.

Berger, A.N. and T.H. Hannan (1997), “Using Efficiency Measures to Distinguish among Alternative Explanations of the Structure-Performance Relationship in Banking”, *Managerial Finance*, 23, 1, 6-31.

Berger, A.N. and D.B. Humphrey (1997), “Efficiency of Financial Institutions:

International Survey and Directions for Future Research”, *European Journal of Operation Research*, 98, 175-212.

Berger, A.N. and L.J. Mester (1997), “Inside the Black Box: What Explains Differences in the Efficiencies of Financial Institutions?” *Journal of Banking and Finance*, 21, 895-947.

Berger, A.N. and T.H. Hannan (1998), “The Efficiency Cost of Market Power in the Banking Industry: A Test of the ‘Quiet Life’ and Related Hypotheses”, *The Review of Economics and Statistics*, 80, 454-465.

Berk, K. N. and P. M. Carey (2000), *Data Analysis with Microsoft Excel*, Canada: Duxbury Press.

Bonin, J.P. and Y. Huang (2002), “Foreign Entry into Chinese Banking: Does WTO Membership Threaten Domestic Banks?”, *The World Economy*, 25, 1077-1093.

Breusch, T. and A. Pagan (1980), “The LM Test and Its Applications to Model Specification in Econometrics,” *Review of Economic Studies*, 47, 239-254.

Buono, M.J. and B.K. Eakin (1990), “Branching Restrictions and Banking Costs”, *Journal of Banking and Finance*, 14, 1151-1162.

Charnes, A., W.W. Cooper, and E. Rhodes (1978), “Measuring the Efficiency of Decision Making Units”, *European Journal of Operational Research*, 2, 429-444.

Chen, T.Y. (2001), “An Estimation of X-inefficiency in Taiwan’s Banks”, *Applied Financial Economics*, 11, 237-242.

China Finance Society (1986-2003), *Almanac of China’s Finance and Banking (Annual)*, Beijing: China Financial Publishing House.

Church, J. and R. Ware (2000), *Industrial Organization: A Strategic Approach*, Boston: Irwin McGraw-Hill.

Clark, J.A. (1988), “Economies of Scale and Scope at Depository Financial Institutions: a Review of the Literature”, *Economic Review*, Federal Reserve Bank of Kansas City, 16-33.

Clark, J.A. and T.F. Siems (2002), “X-Efficiency in Banking: Looking beyond the Balance Sheet”, *Journal of Money, Credit, and Banking*, 34, 4, November, 987-1013.

Dai, X. (ed.) (1997), *The Banking Industry in China: 1997*, Beijing: China Financial Publishing Housing.

Dai, X. (ed.) (1998), *The Banking Industry in China: 1998*, Beijing: China Financial Publishing Housing.

Demsetz, H. (1973), "Industry Structure, Market Rivalry, and Public Policy," *Journal of Law and Economics*, 16, 1-9.

Demsetz, H. (1974), "Two Systems of Belief about Monopoly," in H. Goldschmid (ed.), *Industrial Concentration: The New Learning*, Boston: Little, Brown.

Deprins, D., L. Simar, and H. Tulkens (1984), "Measuring Labor-Efficiency in Post Office", in M. Marchand, P. Pestieau, and H. Tulkens (ed.) *The Performance of Public Enterprises: Concepts and Measurement*, Amsterdam: North-Holland.

DeYoung, R. and D.E. Nolle (1996), "Foreign-Owned Banks in the United States: Earning Market Share or Buying It?" *Journal of Money, Credit and Banking*, 28, 4, November, 622-636.

DeYoung, R. (1997), "A Diagnostic Test for the Distribution-free Efficiency Estimator: An Example Using US Commercial Bank Data", *European Journal of Operational Research*, 98, 243-249.

DeYoung, R. and I. Hasan (1998), "The Performance of De Novo Commercial Banks: A Profit Efficiency Approach", *Journal of Banking and Finance*, 22, 565-587.

DeYoung, R., I. Hasan, and B. Kirchhoff (1998), "The Impact of Out-of-State Entry on the Cost Efficiency of Local Commercial Banks", *Journal of Economics and Business*, 50, 191-203.

Drake, L. and M.J.B. Hall (2002), "Efficiency in Japanese banking: An Empirical Analysis", *Journal of Banking and Finance*, 27, 5, 891-917.

Eisenbeis, R.A., G.D. Ferrier, and S.H. Kwan (1999), "The Informativeness of Stochastic Frontier and Programming Frontier Efficiency Scores: Cost Efficiency and Other Measures of Banking Holding Company Performance", Federal Reserve Bank of Atlanta, Working Paper Series, 99-23.

Evanoff, D.D. and D.L. Fortier (1988), "Reevaluation of the Structure-Conduct-Performance Paradigm in Banking", *Journal of Financial Services Research*, 1, 277-294.

Farrell, M.J. (1957), "The Measurement of Productive Efficiency", *Journal of Royal Statistical Society*, 120, Sec. A, 253-281.

Ferrier, G.D. and C.A.K. Lovell (1990), "Measuring Cost Efficiency in Bankig: Econometric and Linear Programming Evidence", *Journal of Econometrics*, 46, 229-245.

- Ferrier, G.D., S. Grosskopf, K.J. Hayes, and S. Yaisawarng (1993), "Economies of Diversification in the Banking Industry", *Journal of Monetary Economics*, 31, 229-249.
- Fried, H.O., C.A.K. Lovell, and S.S. Schmidt (ed.) (1993), *The Measurement of Productive Efficiency*, New York: Oxford University Press.
- Gilbert, R.A. (1984), "Bank Market Structure and Competition: a Survey", *Journal of Money, Credit and Banking*, 16, 4 2, 617-645.
- Girardone, C., P. Molyneux, and E. P. M. Gardener (2004), "Analyzing the Determinants of Bank Efficiency: the Case of Italian Banks", *Applied Economics*, 36, 215-227.
- Goddard, J.A., P. Molyneux, and J.O.S. Wilson (2001), *European Banking: Efficiency, Technology, and Growth*, England: John Wiley and Sons, Ltd.
- Goldberg, L.G. and A. Rai (1996), "The Structure-Performance Relationship for European Banking", *Journal of Banking and Finance*, 20, 745-771.
- Greene, W.H. (1993), "The Econometric Approach to Efficiency Analysis", in Fried, H.O., C.A.Knox Lovell, and S.S. Schmidt (ed.) *The Measurement of Productive Efficiency*, New York: Oxford University Press.
- Greene, W.H. (2000), *Econometric Analysis*, 4th edition, New Jersey: Prentice Hall International, Inc.
- Gropper, D.M (1991), "An Empirical Investigation of Changes in Scale Economies for the Commercial Banking Firm, 1979-1986", *Journal of Money, Credit and Banking*, 23, 4, 718-727.
- Grosskopf, S. (1993), "Efficiency and Productivity," in H.O. Fried, C.A.K. Lovell, and S.S. Schmidt (ed.) *The Measurement of Productive Efficiency: Techniques and Applications*, New York: Oxford University Press.
- Hannan, T.H. (1991), "Foundations of the Structure-Conduct-Performance Paradigm in Banking", *Journal of Money, Credit and Banking*, 23, 1, 68-84.
- Hanoch, G. (1975), "The Elasticity of Scale and the Shape of Average Costs", *American Economic Review*, 65, 492-497.
- Hao, J., W.C. Hunter, and W.K. Yang (2001), "Deregulation and Efficiency: the Case of Private Korean Banks", *Journal of Economics and Business*, 53, 237-254.
- Hardy, D.C. and E.B. Patti (2001), "Bank Reform and Bank Efficiency in Pakistan", IMF Working Paper, WP/01/138.
- Hasan, I. and K. Marton (2003), "Development and Efficiency of the Banking

Sector in a Transitional Economy: Hungarian Experience”, *Journal of Banking and Finance*, 27, 12, 2249-2271.

Hay, D.A. and D.J. Morris (1991), *Industrial Economics and Organization: Theory and Evidence*, 2nd ed, New York: Oxford University Press.

Heffernan, S.A. (1996), *Modern Banking in Theory and Practice*, England: John Wiley & Sons Ltd.

Heffernan, S.A. (2004), “The Effect of UK Building Society Conversion on Pricing Behaviour”, *Journal of Banking and Finance*, forthcoming.

Heggstad, A.A. (1977), “Market Structure, Risk and Profitability in Commercial Banking”, *The Journal of Finance*, xxxII, 4, September, 1207-1216.

Hicks, J. R. (1935), “Annual Survey of Economic Theory: The Theory of Monopoly”, *Econometrica*, 3, January, 8.

Humphrey, D.B. (1990), “Why Do Estimates of Bank Scale Economies Differ?” *Economic Review*, Federal Reserve Bank of Richmond.

Humphrey, D.B. (1992), “Flow Versus Stock Indicators of Banking Output: Effects on Productivity and Scale Economy Measurement”, *Journal of Financial Services Research*, 6, 115-135.

Hunter, W.C. and S.G. Timme (1995), “Core Deposits and Physical Capital: a Reexamination of Bank Scale Economies and Efficiency with Quasi-Fixed Inputs”, *Journal of Money, Credit and Banking*, 27, 1, 165-185.

Isik, I. and M.K. Hassan (2002), “Technical, Scale and Allocative Efficiencies of Turkish Banking Industry”, *Journal of Banking and Finance*, 26, 719-766.

Jackson, W.E. (1992), “The Price-Concentration Relationship in Banking: A Comment”, *Review of Economics and Statistics*, 74, 291-299, and “Reply” by Berger and Hannan, 373-376.

Jatiani, J., A. Nathan, and G. Sick (1995), “Scale Economies and Cost Complementarities in Commercial Banks: On-and Off-balance-sheet Activities”, *Journal of Banking and Finance*, 19, 1175-1189.

Jagtiani, J. and A. Khanthavit (1996), “Scale and Scope Economies at Large Banks: Including Off-balance-sheet Products and Regulatory Effects (1984-1991)”, *Journal of Banking and Finance*, 20, 1271-1287.

Jiang, C. (ed.) (2001), *The Banking Industry in China: 2001*, Beijing: China Financial Publishing Housing.

Jin, L. (1994), *Monetary Policy and the Design of Financial Institutions in China, 1978-90*, London: Macmillan Press Ltd.

Jondrow, J., C.A.K. Lovell, I.S. Materov, and P. Schmidt (1982), "On Estimation of Technical Inefficiency in the Stochastic Frontier Production Function Model", *Journal of Econometrics*, 19, 233-238.

Karafolas, S. and G. Mantakas (1996), "A Note on Cost Structure and Economies of Scale in Greek Banking", *Journal of Banking and Finance*, 20, 377-387.

Kim, M. (1985), "Scale Economies in Banking: A Methodological Note," *Journal of Money, Credit and Banking*, 17, 1, 96-102.

Kim, H. Y. (1986), "Economies of Scale and Economies of Scope in Multiproduct Financial Institutions: Further Evidence from Credit Unions", *Journal of Money, Credit and Banking*, 18, 2, 220-226.

Kolari, J. and A. Zardkoohi (1987), *Bank Costs, Structure and Performance*, Lexington, Mass: Lexington Books.

Kolari, J. and A. Zardkoohi (1990), "Economies of Scale and Scope in Thrift Institutions: the Case of Finnish Cooperative and Savings Banks", *Scand. Journal of Economics*, 92(3), 437-451.

Koopmans, T.C. (1951), "An Analysis of Production as an Efficient Combination of Activities," in T.C. Koopmans (ed.) *Activity Analysis of Production and Allocation*, Cowles Commission for Research in Economics, Monograph No. 13. New York: John Wiley and Sons, Inc.

Kraft, E. and D. Tirtiroglu (1998), "Bank Efficiency in Croatia: A Stochastic-frontier Analysis", *Journal of Comparative Economics*, 26, 282-300.

Kulasekaran, S. and S. Shaffer (2002), "Cost Efficiency among Credit Card Banks", *Journal of Economics and Business*, 54, 595-614.

Kumbhakar, S.C. (1991), "The Measurement and Decomposition of Cost Efficiency: the Translog Cost System", *Oxford Economic Papers*, 43, 667-683.

Kumbhakar, S.C. (1996), "Efficiency Measurement with Multiple Outputs and Multiple Inputs", *Journal of Productivity Analysis*, 7, 225-255.

Kumbhakar, S.C. and C.A.K. Lovell (2000), *Stochastic Frontier Analysis*, Cambridge: Cambridge University Press.

Kwan, S.H. and R.A. Eisenbeis (1996), "An Analysis of Inefficiencies in Banking: A Stochastic Cost Frontier Approach", *Economic Review*, Federal Reserve Bank of San Francisco, 2, 16-27.

Lambson, V.E. (1987), "Is the Concentration-Profit Correlation Partly and Artifact of Lumpy Technology?" *American Economic Review*, 77, 731-733.

Lardy, N.R. (1998), *China's Unfinished Economic Revolution*, Washington, D.C.: Brookings Institution Press.

Lardy, N.R. (1999), "The Challenge of Bank Restructuring in China", *BIS Policy Papers*, 7, October 17-39.

Lawrence, C. (1989), "Banking Costs, Generalized Functional Forms, and Estimation of Economies of Scale and Scope", *Journal of Money, Credit and Banking*, 21, 3, 368-379.

Lee, J.W. (2000), "Banking Reform in China (1978-1998) – A Review and Appraisal", *Asian Profile*, 28, 3, June, 169-185.

Leibenstein, H. (1966), "Allocative Efficiency vs 'X-efficiency'", *American Economic Review*, 56, 392-415.

Li, Y., G. Wang, and D. He (ed.) (2001), *Frontier of the Theoretical Development of China: Finance*, Beijing: Social Science Literature Press.

Liu, S. (1999), "China's Experience in Small and Medium Financial Institution Resolution", *BIS Policy Papers*, 7, October, 298-303.

Liu, D. (2000), *China's Banking Industry: Challenges from Foreign Banks*, Shanghai: Shanghai Far East Press.

Liu, C. (2002), "Results of RCCs Reform", *Financial Digest*, 9, 6.

Lloyd-Williams, D.M., and P. Molyneux (1994), "Market Structure and Performance in Spanish Banking", *Journal of Banking and Finance*, 18, 433-443.

Lo, W.C. (2001), "A Retrospect on China's Banking Reform", *The Chinese Economy*, 34, 1, 15-28.

Lou, J. (ed.) (1997), "Macroeconomic Reform in China", World Bank Discussion Paper, No. 374.

Lovell, C.A.K. (1993), "Production Frontiers and Productive Efficiency", in Fried, H.O., C.A.K. Lovell, and S.S. Schmidt (ed.) *The Measurement of Productive Efficiency*, New York: Oxford University Press.

Lu, D. and Q. Yu (1998), "Banking Credit-quota Plan as a Macroeconomic Policy Instrument in China: Effectiveness and Costs", *Economic Systems*, 22, 2, June, 147-174.

- Mahajian, A., N. Rangan, and A. Zardkoohi (1996), "Cost Structures in Multinational and Domestic Banking", *Journal of Banking and Finance*, 20, 283-306.
- Mason, E.S. (1939), "Price and Production Policies of Large-scale Enterprise", *American Economic Review*, 29, 61-74.
- Mason, E.S. (1949), "The Current State of the Monopoly Problem in the United States," *Harvard Law Review*, 62, 1265-1285.
- Maudos, J. (1998), "Market Structure and Performance in Spanish Banking Using a Direct Measure of Efficiency", *Applied Financial Economics*, 8, 2, 191-201.
- McAllister, P.H. and D. McManus (1993), "Resolving the Scale Efficiency Puzzle in Banking", *Journal of Banking and Finance*, 17, 389-405
- McKillop, D.G., J.C. Glass, and Y. Morikawa (1996), "The Composite Cost Function and Efficiency in Giant Japanese Banks", *Journal of Banking and Finance*, 20, 1651-1671
- McKillop, D.G., J.C. Glass, and C. Ferguson (2002), "Investigating the Cost Performance of UK Credit Union Using Radial and Non-radial Efficiency Measures", *Journal of Banking and Finance*, 26, 1563-1591.
- McNulty, P. J. (1967), "A Note on the History of Perfect Competition", *Journal of Political Economy*, 75, 1, 395-399.
- McNulty, P. J. (1968), "Economic Theory and the Meaning of Competition", *Quarterly Journal of Economics*, 82, 639-656.
- Meeusen, W. and J. van den Broeck (1977), "Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error," *International Economic Review*, 18, 435-444.
- Mendes, V. and J. Rebelo (2003), "Structure and Performance in the Portuguese Banking Industry in the Nineties", *Portuguese Economic Journal*, 2, 53-68.
- Mertens, A. and G. Urga (2001), "Efficiency, Scale and Scope Economies in the Ukrainian Banking Sector in 1998", *Emerging Markets Review*, 2, 292-308.
- Mester, L.J. (1987), "A Multiproduct Cost Study of Savings and Loans", *Journal of Finance*, XLII, 2, JUNE, 423-445.
- Mester, L.J. (1992), "Traditional and Nontraditional Banking: an Information-theoretic Approach", *Journal of Banking and Finance*, 16, 545-566
- Mester, L.J. (1993), "Efficiency in the Savings and Loan Industry", *Journal of Banking and Finance*, 17, 267-286

Mester, L.J. (1996), "A Study of Bank Efficiency Taking into Account Risk-preferences", *Journal of Banking and Finance*, 20, 1025-1045

Mitchell, K. and N.M. Onvural (1996), "Economies of Scale and Scope at Large Commercial Banks: Evidence from the Fourier Flexible Function Form", *Journal of Money, Credit and Banking*, 28, 2, 178-199

Mo, Y. (1999), "A Review of Recent Banking Reforms in China", *BIS Policy Papers*, 7, October, 90-109.

Molyneux, P. and J. Thornton (1992), "Determinants of European Bank Profitability: A Note", *Journal of Banking and Finance*, 16, 1173-1178.

Molyneux, P. and W. Forbes (1995), "Market Structure and Performance in European Banking", *Applied Economics*, 27, 155-159.

Molyneux, P., Y. Altunbas, and E. Gardener (1996), *Efficiency in European Banking*, England: John Wiley & Sons Ltd.

Murrell, P. (1995), "The Transition According to Cambridge, Mass.", *Journal of Economic Literature*, 33, March, 164-178.

National Bureau of Statistics of China (2003), *China Statistical Yearbook (2003)*, Beijing: China Statistical Press.

Panzar, J.C. and R.D. Willig (1977), "Economies of Scale in Multi-output Production", *Quarterly Journal of Economics*, 91, 481-493.

Panzar, J.C. and R.D. Willig (1981), "Economies of Scope", *American Economic Review*, 71, 268-273.

Peltzman, S. (1977), "The Gains and Losses from Industrial Concentration", *Journal of Law and Economics*, 20, 229-263.

People's Bank of China (1995), "General Rules on Loans (for trial implementation)", *Financial News*, August 23, p. 2.

People's Bank of China (1997), *China Financial Statistics 1952-1996*, Beijing: China Finance and Economy Press.

People's Bank of China (1999), *China Financial Overview*, Beijing: The People's Bank of China

People's Bank of China (2003a), *Annual report 2002*, Beijing: The People's Bank of China

- People's Bank of China (2003b), *China Monetary Policy Report 2002*, Beijing: China Financial Publishing House.
- Pinho, P.S.D. (2001), "Using Accounting Data to Measure Efficiency in Banking: an Application to Portugal", *Applied Financial Economics*, 11, 527-538.
- Posner, R. A. (1979) "The Chicago School of Economic Analysis", *University of Pennsylvania Law Review*, 127, April, 925-948.
- Ravenscraft, D. J. (1983), "Structure-Profit Relationships at the Line of Business and Industry Level," *Review of Economics and Business*, 65, 22-31.
- Reder, M. W. (1982), "Chicago Economics: Permanence and Change", *Journal of Economic Literature*, 20, March.
- Resti, A. (1997), "Evaluating the Cost-efficiency of the Italian Banking System: What Can be Learned from the Joint Application of Parametric and Non-parametric Techniques", *Journal of Banking and Finance*, 21, 221-250.
- Rezvanian, R. and S. Mehdian (2002), "An Examination of Cost Structure and Production Performance of Commercial Banks in Singapore", *Journal of Banking and Finance*, 26, 79-98.
- Rhoades, S.A. and R.D. Rutz (1982), "Market Power and Firm Risk: a Test of the 'Quiet Life' Hypothesis", *Journal of monetary economics*, 9, 73-85.
- Rime, B. and K.J. Stiroh (2003), "The Performance of Universal Banks: Evidence from Switzerland", *Journal of Banking and Finance*, 27, 2121-2150
- Ritter, C. and L. Simar (1997), "Pitfalls of Normal-Gamma Stochastic Frontier Models", *Journal of Productivity Analysis*, 8, 167-182.
- Sachs, J.D. and W.T. Woo (1994), "Structural Factors in the Economic Reforms of China, Eastern Europe, and the Former Soviet Union", *Economic Policy*, 18, April, 102-145.
- Saving, T.R. (1970), "Concentration Ratios and the Degree of Monopoly", *International Economic Review*, 11, 1, 139-146.
- Scherer, F.M. and D. Ross (1990), *Industrial Market Structure and Economic Performance*, Boston: Houghton Mifflin Company.
- Shepherd, W.G. (1953), *Cost and Production Functions*, Princeton, NJ: Princeton University Press.
- Shepherd, W.G. (1982), "Economies of Scale and Monopoly Profits", in *Industrial Organization, Antitrust, and Public Policy*, edited by J.V. Craven. Boston: Klumer Nijhoff.

- Shepherd, W.G. (1986), "Tobin's q and the Structure-Performance Relationship: Comment", *American Economic Review*, December, 1205-1210.
- Shi, J. (2001), "Financial Innovations in China 1990-2000", Beijing University, China Center for Economic Research, Working Paper No. E2001006.
- Smirlock, M. (1985), "Evidence on the (Non) Relationship between Concentration and Profitability in Banking", *Journal of Money, Credit and Banking*, 17, 1, 69-83.
- Stevenson, R.E. (1980) "Likelihood Functions for Generalised Stochastic Frontier Estimation", *Journal of Econometrics*, 13, 57-66.
- Stigler, G. J. (1957), "Perfect Competition, Historically Contemplated", *Journal of Political Economy*, 65, 1-17.
- Stigler, G. J. (1968), *The Organization of Industry*, New York: Macmillan.
- Stiroh, K.J. (2000) "How Did Bank Holding Companies Prosper in the 1990s?", *Journal of Banking and Finance*, 24, 1703-1745.
- Sun, Q., W.H.S. Tong, and J. Tong (2002), "How Does Government Ownership Affect Firm Performance? Evidence from China's Privatization Experience", *Journal of Business Finance and Accounting*, 29, 1-27.
- Tang, S. (2004), "Reforms of State-owned Commercial Banks in China", www.cbrc.gov.cn/english/module/viewinfo.jsp?infoID=562
- Vander Venet, R. (2002), "Cost and Profit Efficiency of Financial Conglomerates and Universal Banks in Europe", *Journal of Money, Credit, and Banking*, 34, 1, February, 254-282.
- Walder, A.G. (1996), "China's Transitional Economy: Interpreting Its Significance", in Walder, A.G. (ed.), *China's Transitional Economy*, Oxford: Oxford University Press
- Waldman, D.E. and E.J. Jensen (2001), *Industrial Organization: Theory and Practice*, 2nd ed., Boston: Addison Wesley Longman, Inc.
- Wen, M., D. Li, and P. Lloyd (2002), "Ownership and Technical Efficiency: A Cross-section Study on the Third Industrial Census of China", *Economic Development and Cultural Change*, 50, 709-734.
- Whalley, J. (2003), "Liberalization in China's Key Service Sectors Following WTO Accession: Some Scenarios and Issues of Measurement", NBER Working Paper Series, No. 10143, December.

- Wheelock, D.C. and P.W. Wilson (2001), "New Evidence on Returns to Scale and Product Mix among U.S. Commercial Banks", *Journal of Monetary Economics*, 47, 653-674
- White, H. (1980), "A Heteroscedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity," *Econometrica*, 48, 817-838.
- Williams, J. and E.P.M. Gardener (2003), "The Efficiency of European Regional Banking", *Regional Studies*, 37.4, 321-330.
- Woo, W.T. (1994), "The Art of Reforming Centrally Planned Economies: Comparing China, Poland, and Russia", *Journal of Comparative Economics*, 18, June, 276-308.
- World Bank (2004), *Global Development Finance 2004 – Harnessing Cyclical Gains for Development*, Washington: World Bank.
- Wu, X. (ed.) (1998), *China's Financial Industry in the New Stage of Financial Reform*, Tianjin: Tianjin People's Press.
- Wu, J. (1999), "Preface", in N.R. Lardy (1998) *China's Unfinished Economic Revolution (Chinese)*, Beijing: China Development Press.
- Wu, F. (2001), "China's WTO Membership: Implications for Macroeconomic Outlook and Financial Sector", *Asian Profile*, 29, 5, October, 363-378.
- Xiao, G. (ed.) (1999), *The Banking Industry in China: 1999*, Beijing: China Financial Publishing House.
- Xie, P. (1999), "Bank Restructuring in China", *BIS Policy Papers*, 6, August, 124-129.
- Xie, P. (2001), "Debates on the Reform of the UCC System in China", *Jin Rong Yan Jiu*, 1, 1-17.
- Xie, P. and J. Jiao (2002), *The Reform of Chinese Commercial Banks*, Beijing: The Economics and Science Press.
- Xu, X. (1998), *China's Financial System under Transition*, London: Macmillan Press Ltd.
- Yu, Q., X. Xin, and H. Qu (2000), *Management of Modern Commercial Banks*, Shanghai: Shanghai People's Press.
- Zhou, L. (1992), "Banking Structure of China", in G.G. Kaufman (ed.), *Banking Structures in Major Countries*, Dordrecht: Kluwer Academic Publishers.

www.pbc.gov.cn/english/jinrongfagui

www.pbc.gov.cn/english/speeches

www.pbc.gov.cn/quanwenjiansuo/detail.asp?col=cinwen&ID=387&keyword