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Banking cost efficiency in China: An ownership and time series comparison

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Abstract:

This paper examines the ownership effect on Chinese banking cost efficiency over the period of 1998-2005. After controlling for loan quality, liquidity, capitalization and output mix, the empirical results suggest that there is a systematic difference in the cost efficiency between state-owned banks and joint-equity banks. Joint-equity banks are found to be less cost efficient, generally. Further analysis also was conducted for the unit interest cost, the unit labor cost and the unit cost of physical capital. The empirical analysis on the input mix (i.e. labor cost share) suggests that joint-equity banks prefer labor input in their banking production process. The time series analysis found that overall banking cost efficiency was improving from 1999 to 2002, but dropping from 2003 to 2005. This trend followed the variation in the per unit interest cost. The banking input mix (substitution between labor and physical capital) was found to be unrelated to the time series, indicating that a change was made in the production process of the Chinese banking industry during the period of 1998-2005.

Chapter 1: Introduction

There is a large body of previous literature on banking operating performance, including analyses with both the scale and scope method and the X-efficiency method. While most of previous literatures in this field focus almost exclusively on the US commercial banks, relatively little research has been conducted for the Chinese banking industry. The Chinese financial system is dominated by the banking system. The banking system is in turn dominated by the state owned banks.

Since 1978, China has experienced a progressive transformation from a centralized planning economy to a market-based economy. Banking reform has been a long-time focus in this economic transformation. In this study, we examine the operating efficiency of Chinese banks over the period of 1998 to 2005. Specifically, we compare banking cost efficiency between the state-owned banks and the newly-established joint-equity banks. We then analyze the time effect on the overall Chinese banking industry. Finally, we examine whether there is a systematic change in the banking production process that coincides with technological innovation, i.e. the substitution between labor and physical capital.

Such a study is important not only for bank managers and policy makers in China, but also for foreign banks. In 2007, China will remove all restrictions on foreign financial institutions, allowing full access to the Chinese financial market, according to the protocol of the WTO accession. Understanding the operating efficiency of Chinese banks is of strategic importance for foreign banks operating or interested in establishing presence in China.

The rest of the study is organized as follows. Chapter 2 briefly introduces the background of the Chinese banking system. Chapter 3 reviews the previous literature related to this study. Chapter 4 describes the methodology used for the empirical analysis. The data and empirical analysis are covered in Chapter 5 and Chapter 6, respectively. Finally, Chapter 7 contains the summaries and conclusions of this paper.

Chapter 2: Background of the Chinese banking system

The current Chinese banking system originated in 1948 when the People's Bank of China (PBOC) was established. The banking system followed a mono-bank model where the bank was a part of administrative hierarchy. The PBOC acted as the central bank and the only commercial bank in China. This mono-bank model existed for thirty years until 1978 when the Chinese central government decided to initiate a progressive transformation from a centralized planning economy into a market-based economy. The banking reformation was treated as one of the most important issues in the overall economic transformation of China. Tied with the Central Bank Law and Commercial Bank Law in 1995, the foundation of modern Western-style Chinese banking system was established.

In the early banking reform period of the 1980s, the reform focused on breaking up the mono-bank system, and restricting the Chinese banking industry. Four specialized state-owned banks were established to serve commercial operations. The four state-owned banks are the Agricultural Bank of China (ABC), the Bank of China (BOC), the China Construction Bank (CCB), and the Industrial and Commercial Bank of China (ICBC). The PBOC was still kept its name, and served as the central bank of China. The purpose of the establishment of the four specialized banks was to encourage better service of state-owned enterprises (SOEs), and increase the overall productivity of the banking industry.

The four state-owned banks mainly provided services to SOEs within a designated economic sector or region. The ABC mainly provided financial services in rural areas. The BOC dealt with foreign exchange and foreign businesses. The CCB provided services to urban large construction projects. The ICBC was responsible to serve commercial and industrial customers in urban areas. Each of four state-owned banks was operating in its designated monopolistic market niches and regions, staving off any competition. The four stated-owned banks operated under the administrative control of

the central and local government, as governmental agencies in the centralized planned economic system.

Significant changes were made in 1985. Legislation removed the monopoly of a specialized bank within a designated economic sector. The four state-owned banks were allowed to expand their operating scope and to compete with each other in order to create a competitive market-based banking system. This banking system remained unchanged until the Central Bank Law and Commercial Bank Law were passed in 1995. According to the legislation, the PBOC performs the role of the central bank, mainly formulating economic and monetary policies and supervising the overall financial system. The four state-owned banks register as and perform as commercial banks in accordance with the Commercial Bank Law.

In the mid-1990s, China also saw the explosive development of joint-equity commercial banks. Large joint-equity banks now compete with state-owned banks national-wide. Meanwhile, the state-owned banks still dominate the Chinese banking industry with large economic scales. Currently, a western-styled competitive banking system has been primarily established in China, comprising the state-owned commercial banks, joint-equity commercial banks, and a few qualified foreign banks, under the supervision of People's Bank of China.

Chapter 3: Literature Review

The banking industry has been a long-time focus of corporate efficiency research. Since the banking industry is so important for a country's economy, the public also pays much attention to banking efficiency research. The findings from the literature give implications to the bank management leaders who are willing to improve operating performance, and to policy makers who are concerned with the stability and development of the macro-economy.

There is a large body of previous literature in the banking operating efficiency area. Chen et al. (2005) defined efficiency as 'the extent to which a decision-making unit can increase its outputs without increasing its inputs, or reduce its inputs without reducing its outputs.' Banking efficiency literature can be generally categorized into those early studies that investigated scale and scope efficiency alone [see Mester (1987), Clark (1996), Evanoff & Israilevich (1995), and Berger & Humphrey (1991)], and recent studies which employ the X-efficiency method [see Altunbas et al. (2000), Mester (1996), Kwan (2006) and Cebenoyan et al. (1993)].

The scale and scope studies estimate an average practice cost function, relating to the bank's input price to output price. Dietsch (1993) examined the French commercial banking industry, by using a trans-log model of banking operating costs, and found strong evidence of the economies of scale. Zardkoohi & Kolari (1994) studied the savings banks in Finland, and found the same result. In the U.S. banking studies, Hunter et al. (1990) analyzed the operating performance of 311 of the largest commercial banks in the U.S. by a multi-product cost function and intermediation approach. The evidence was found to support the existence of economies of scale, which means that increasing bank size could lead to cost efficiency. The result was also supported by Shaffer (1985), and Berger et al. (1993). However, negative relationships between cost savings and bank size were reported by various studies (see Bauer et al., 1993; and Gilligan et al., 1984). The scale and scope efficiency study of Chinese local banks, done by Huang (1998), concluded that the Chinese banks did not achieve higher efficiency by increasing the size

of bank assets. Although there is a large amount of literature finding the impact of economic scale, the previous literatures did not reach agreement on the relationship between bank size and efficiency. A survey done by Humphrey (1990) suggests that the average cost curve is a flat U-shape, with medium-sized banks being slightly more scale efficient than either very large or small-sized banks.

The traditional scale and scope efficiency studies did not explain why banks with a similar size and output mix show a significant difference in operating efficiencies. Berger et al. (1993) suggested that only less than 5% cost efficiency is due to the scale and scope effect, by comparing with more than 20% affected by X-efficiency. X-efficiency, a relatively new concept in banking efficiency studies, estimates a *best practice cost function* to describe all technical and allocative efficiencies of individual firms. The method predicts the cost function of the most efficient bank (X-efficient), and then compares the banks in the sample to determine the degree of inefficiency relative to this X-efficient bank.

Three common methodologies are used to measure the banks' X-efficiency by different assumptions, which are introduced in Mester (1996) and Berger et al. (1993). The econometric frontier analysis (EFA), where the method employed in Ferrier & Lovell (1990), Mester (1996) and Altumbas et al. (2000), obtains the cost frontier by estimating 'a cost function with a composite error term sum of a two-sided error representing random fluctuations in cost and a one-sided positive error representing inefficiency.' [Mester, 1996] In most studies, this method generally assumes that the error follows a normal distribution. The second method, thick frontier analysis (TFA), divides the banks into various classes (quartiles) based on the size of assets. [see Berger and Hmphrey, 1991] The cost frontier is defined as the estimated cost function for banks in the least average cost quartile. Banks are labeled as efficient if they are in the lowest average cost quartile, and as inefficient if they are in the highest average cost quartile. Meanwhile, the residual term only reflects the random error and luck rather than efficiency differences. The data envelopment analysis (DEA) method determines which bank with a particular output combination is the most efficient bank at the given least input prices. No random

error is allowed in this method, so all deviations from the estimated cost function are treated as inefficiency.

Mester (1996) suggests that none of these three methods is without its problems. A drawback of EFA appears, as seen in the discussion in Schmidt & Sickles (1984), if panel data are available in the sample. Some assumptions of stochastic frontier can not be sustained about both the frontier and the error term. Therefore, it is important to assume that the banks in the sample should operate at the same level of production technology. Further, Berger & Humphrey (1991) pointed out that the TFA method suffers from potential econometric problems. Since banks in the sample are pre-sorted according to the average cost, this could be a fact affecting the efficiency of the bank. Therefore, it is not an easy task to determine which of these three X-efficiency methods would be best employed for this study. Unfortunately, the efficiency measurement would be affected substantially by the choice of research methodology. Overall, the findings of current X-efficiency literature suggests that the average inefficiency of U.S. banks is 20 – 30%, examined by EFA or TFA, which means that the average bank could produce the same products and services while reducing costs by 20 – 30%, if inefficiencies in technical and allocative areas are totally eliminated.

Recently, the X-efficiency method also has been widely used as the banking research methodology outside the U.S and E.U. commercial banks and financial institutions. Huang et al. (1999) examined the efficiency of Taiwan's farmers' credit union. Kwan (2006) researched the Hong Kong commercial banks during the period of 1992-1999, and found that the average efficiency was about 16-30% of observed total cost. Meanwhile, Altunbas et al. (2000) investigated the Japanese banks between 1993 and 1996, and suggested that scale inefficiency dominates in the banking total operating costs rather than X-efficiency. Interestingly, the findings contrasted with the results obtained by Berger et al. (1993) as mentioned above. Prior X-efficiency studies on Chinese banks by Wei and Wang (2000) found the efficiency level of Chinese banks was relatively low, and the average technical efficiency (TE) of jointed-equity banks was 84.59%, higher

than the state-owned banks of 62.39%. The same results were found in Zhao et al. (2001), and Zhao (2000).

In this study, I will further examine the effect of two ownership forms (i.e. state-owned and joint-equity) on Chinese banking operating efficiencies. From the agency theory perspective, different ownership forms would lead to different levels of operating efficiency due to the corporate governance and monitoring mechanism. Theoretically, with a lack of capital market discipline, management would capture its own agenda, and would thus have few incentives to operate efficiently. Therefore, the assumption is that the joint-equity banks are performing at more efficiency, since they are monitored and disciplined by their shareholders.

There are extensive literatures which link ownership to efficiency in the banking industry. Cebenoyan et al. (1993) studied the U.S. stock and mutual Saving & Loans firms, while the evidence didn't show a significant relationship between the ownership structure and banking efficiency. Mester (1993) also did the same research about the U.S. stock and mutual Savings and Loans. He found a significant difference in cost efficiency between those two types of Savings and Loans. The stock Savings and Loans are less efficient, which is contrary to previous theory and research results. Altunbas et al. (2001) found that the private banks are the most efficient, after investigating German banking industry. The ownership effect on the banking operating efficiency also was found in Bonin et al. (2005), which researched the largest banks in six eastern European countries. The evidence shows state-owned banks are the least efficient. Generally, it is argued that the state-owned banks are operating at less efficiency than the newly established joint-equity banks. This is because the management of joint-equity banks is expected to be well monitored due to strong shareholder control. On the other hand, state-owned banks are not well monitored or efficiently disciplined by the capital market, resulting in the management having less incentive to operate efficiently. Clarke et al. (2005) argue that state-owned enterprises have a wide distribution of ownership; theoretically, all citizens of a country jointly own the state-owned enterprise. Also, since there is no market for selling the ownership, information on firm performance is non-comparable, so that the

institution does not gain from performance monitoring. On the other hand, Yarrow (1986) argues the opposite way: the ownership of state-owned enterprise is concentrated in the government, so that some politicians and bureaucrats can control and use state-owned enterprises to pursue their political and personal goals. Further, it is less likely that a poorly performing state-owned enterprise would be liquidated, go bankrupt or be taken over, therefore management have less motivation to improve operating efficiency because the management jobs are secure. Hence, state-owned banks are expected to exhibit a lower level of efficiency than joint-equity banks because of the absence of an effective monitoring system in the corporation. This argument is supported by Fama & Jensen (1983).

Chinese banking studies, such as Zhao et al. (2001), also found that the state-owned banks perform less efficiently than the joint-owned banks. However, Chen (2005) and Zhao (2000) found that state-owned commercial banks show a relatively high level of operating efficiency. There are several reasons to explain why state-owned banks are more efficient than joint-owned banks. First, government protection is often placed on the state-owned banks. The protection could be in the form of subsidies or fund injections from the central or local government; or it could be in other forms like policy or regulations made in favor of state-owned banks. For example, foreign banks face restricted banking operations in China; the foreign bank branches only can operate in some big cities, and they cannot deal with RMB savings and loans business. This restriction will not be completely removed until 2007, when the WTO protocol of accession comes into effect. Therefore, government protection makes state-owned banks face less competition from other type of banks. Second, state-owned banks can access more resources, which could be advanced technology, professional and knowledgeable personnel, timely information, and financial and monetary supports from government. Generally, they have more branches and ATMs, compared to their competitors. Third, they face less competition. Because of the close relation with government, they have the advantage of being able to attract big corporation customers, e.g. state-owned enterprises (SOEs). Since personal banking is much more costly to serve than corporative banking, state-owned banks are more cost efficient than joint-equity banks.

Chapter 4: Methodology

4.1. Cost efficiency

In this study, the operating efficiency would be examined for individual banks in the sample by focusing on their operating costs of producing banking products and services. The total operating costs is further broken down into interest cost and non-interest cost. The non-interest cost consists of labor cost and cost of physical capital. As suggested by Hao et al. (2001), we could calculate the cost of physical capital as the ratio of total expenses on premises over fixed assets. Unfortunately, the total expense of premises is not disclosed in the Chinese banks' financial reports. In this paper, I followed the method used in Zhao (2000) and Chen et al. (2005). These two studies argued that the expense of premises was normally included in non-interest expenses; therefore, the cost of physical capital is approximately calculated as the non-interest expenses over fixed assets (i.e. cost of physical capital = non-interest operating cost / fixed assets). Sealey & Lindley (1977) argue that banks accumulate deposits and then intermediate these funds, which are viewed as intermediaries. The deposits provide the raw material of loans and investments to financial institutions. The intermediation approach is used in this paper based on this argument. The bank's total operating cost is made by labor cost, cost of physical capital and interest cost. Banks differ in size, and using the total amount of expenses does not make sense. Indeed, this study uses the unit cost for the regression model to compare the banks' performances with different size. The unit operating cost is obtained by deflating the total operating cost over the total earning assets. To create the unit cost of each component of the total operating cost, the unit labor cost and unit cost of physical capital are created by deflating the costs over the total earning assets and fixed assets, respectively; meanwhile, the interest cost per unit is created by dividing the total amount of interest cost by total deposits.

Following Kwan (2003), to examine whether the cost efficiency varies systematically due to the effect of the ownership and time series in Chinese banking industry, I use the following regression model to estimate cost efficiency:

$$C_{jt} = a + bX_{jt} + cD_j + dT_t + e_{jt} \qquad \text{Eq(1)}$$

Where the C_{jt} is the observed unit cost for a specific bank at year t; X_{jt} is the term consisting of a set of control variables; D_j, the ownership dummy variable, in specific, each bank is categorized in state-owned or joint-equity. D equals to 1 when a bank is a joint-equity bank and equals to 0when a bank is a state-owned bank. T_t, the time specific dummy variable; *a, b, c,* and *d,* are the corresponding coefficients for each component of the regression model; and e_{jt}, the residual term.

The dependent variable, Cjt, the cost estimated in the equation could be one of the following cost measures: total operating costs per unit, interest costs per unit, labor cost per unit and the cost of physical capital per unit.

There are four control variables included in the Xjt term: 1) the ratio of loan loss provision to total loans, 2) the ratio of cash and due from banks to total assets, 3) the ratio of equity capital to total assets, 4) the ratio of total loans to total earning assets. First, the ratio of loan loss provision to total loans reflects the loan quality of a specific bank. Previous literature suggests that loan quality may have effects on operating cost efficiency. It is a long standing debate about the issue, while there is no clear answer to how loan quality links to the cost efficiency. Mester (1996) argues that more resources are expected to be spent on credit underwriting and loan monitoring in order to improve the loan quality, which would lead higher operating costs. Therefore, a negative relation is expected to be found between the ratio and the operating cost. The opposite opinion was addressed by Berger and DeYoung (1997), which states that loan quality is endogenous in the quality of management. An inefficient and badly-managed bank would have more problem loans with higher operating costs. Thus, the ratio of loan loss provision has a positive relationship with the operating cost. The second control variable is the ratio of cash and dues from banks to total assets. This ratio controls for the asset liquidity of the bank. Although liquid assets provide financial flexibility to reduce the liquidity risk, the cash ratio is expected to have a positive coefficient. It is more costly to

handle more liquid assets (e.g. cash), involving such additional costs as transportation cost, storage cost, protection cost, security cost and labor cost. The third control variable used in the regression model is the ratio of equity capital to total assets. With a higher ratio of equity capital, the bank would bear less risk due to the financial distress. The bank management is expected to take a high level of risk aversion. Thus, the coefficient of the ratio may show a negative sign, which reflects a high quality of management and aversion to risk taking. Well-capitalized banks are more likely to be more efficient in operating costs and produce banking products and services. Finally, the ratio of total loans to total earning assets is used as a proxy for outputs mix. Generally speaking, two kinds of banking outputs are shown in the financial statements, loans and investment securities. Since more expenses would be spent on loan credit underwriting and monitoring, the ratio is expected to have a positive relationship with operating costs.

The dummy variable, D, examines whether there is a systematic difference of operating cost efficiency between the different types of ownership, after controlling for loan quality, liquidity, management quality and risk preference. Clarke et al. (2005) suggest that it significantly and systematically varies in the operating performance of different types of ownership. They also give the explanation that the improvement of banking performance is attributed to the competition increases in the industry once developing countries open up their domestic markets.

Over time, banking operating efficiency may be affected by technology innovation, and factors such as change in regulation and change in input mix. Some exogenous events such as an Asian financial crisis may also impact on the banking operating costs. As suggested in Altunbas et al. (2000), the time trend serves as a ‘catch-all’ variable that captures the effects of disembodied technical changes. In this study, the time specific dummy variable is used to identify whether there are systematic changes in cost efficiency over time. For identification purposes, the year 1998 is excluded from the time dummy. Therefore, the dummies are the measurement of the time effect relative to 1998.

4.2. Choice of inputs

The second issue to examine is whether the choice of input mix varies systematically between the different types of ownership and over time. That is, the mix of labor and physical capital used in banking production. To estimate the ownership and time effect on the choice of input mix, the following regression model is used:

$$L_{jt} = a + bX_{jt} + cD_j + dT_t + e_{jt} \qquad \text{Eq(2).}$$

Where L_{jt} is the dependent variable, which is the ratio of labor cost to non-interest operating costs for bank j at year t; X_{jt}, the term contains the same control variables as in Equation (1), controlling for the impact of loan quality, liquidity, capitalization and output mix. Again, those control variables are 1) the ratio of loan loss provision to total loans, 2) the ratio of cash and dues from banks to total assets, 3) the ratio of equity capital to total assets, 4) the ratio of total loans to total earning assets. Also, as in Equation (1), D_j is the ownership dummy variable and T_t is the time specific dummy variable; *a, b, c and d* is the corresponding coefficient.

The current banking efficiency theories are silent about the input mix, i.e. the substitution between labor and physical capital in the banking production. In this paper, the regression model liquidity and output mix changes. The dummy variables examine whether ownership and time would have an impact on the choice of banking input in the Chinese banking industry. For example, the newly established joint-equity banks could have more physical capital cost in order to set up the service network such as branches and ATMs. Again, the dummy for 1998 is excluded in the test, so that the measurement of the time impact is relative to 1998. With the passing of time, newly advanced technology would be used in the banking production process. This can result in the replacing of labor by machines.

Chapter 5: Data Description

To investigate the Chinese banking operating performance and to examine the existence and extent of the impact of ownership structure over time, the annual data of Chinese banks are collected from the Mergent Online database, which consists of company data worldwide. Since the Mergent online database comprises the financial data of Chinese nationwide banks usually back to the year 1998, and Chinese banks have not yet released their 2006 financial statements, the study period is from 1998 to 2005. The data for this study covers the nationwide commercial banks in China, but exclude the regional banks, trust corporations and other finance companies. During the study period, no single bankruptcy case was reported in the Chinese banking industry, so the data are valid and clean, and avoid the survival bias.

One obstacle in researching the operating performance of Chinese banks is that there is little available information on the banks. Moreover, because of the nature of the Chinese banking industry, only a few large banks dominate the Chinese banking industry, which results in a relatively small sample. Only 12 banks are listed under the category of nationwide banks according to the Chinese Statistical Yearbook 2003. The final sample examined in this study consists of 10 major nationwide banks and the time period from 1998 to 2005, while some banks' historical data are missing in the early few years in the database. For the empirical analysis, the construction of variables is based on the information provided from the individual banks' historical financial statements.

Table 1 shows that on average, the ratio of loan loss provision to total loans has a mean of 2.81% throughout the study sample. The standard deviation is 2.1% with a minimum of 0.24%, and a maximum of 13.31%. The second row of the table shows that on average, bank liquid assets (cash and due from banks) account for 17.97% of total assets in the Chinese banking industry throughout the study period of 1998-2005. The highest cash-to-asset ratio is 32.41%, about double the mean. The lowest cash-to-asset ratio is 9.81%, approximately half of the mean. The standard deviation of the cash-to-asset ratio is 5.75%. The third row of Table 1 shows that the average ratio of equity to total assets is

4.83%, and the standard deviation is 4.24%. Generally speaking, for a bank, the earning assets are made by loans and investments. The ratio of loans to total earning assets, on average, is 79.99% in the Chinese banking industry. The minimum of the ratio of loans to total earning assets is 53.76%, and the maximum is 99.63% with a standard deviation of 9.53%. The ratio of total operating costs to total assets shows that on average, the total operating cost accounts for 5.55% of the total assets every financial year. The standard deviation of the ratio of total operating cost to total asset is 2.34%. On average, the Chinese banking industry has a ratio of interest cost to deposits of 2.79% during the sample period. Labor costs on average, account for 1.72% of total assets with a standard deviation of 1.70%. In the Chinese banking industry, physical capital cost is on average, 1.04% of the fixed asset with a standard deviation of 0.57% in every financial year.

Table 1
Descriptive statistics

	Mean	Median	Standard Deviation	Minimum	Maximum
Ratio of Loan loss provision to total loans	2.81%	2.76%	2.10%	0.24%	13.31%
Ratio of Cash and due from banks to total assets	17.97%	16.46%	5.75%	9.81%	32.41%
Ratio of Equity to total assets	4.83%	3.88%	4.24%	1.84%	26.79%
Ratio of loans to total earning assets	79.99%	79.36%	9.53%	53.76%	99.63%
Ratio of total operating cost to total assets	5.55%	5.23%	2.34%	1.69%	10.87%
Ratio of interest cost to total deposits	2.45%	2.00%	1.46%	1.15%	8.22%
Ratio of labor cost to total assets	1.72%	1.01%	1.70%	0.22%	5.91%
Ratio of physical capital costs to fixed assets	1.04%	0.88%	0.57%	0.37%	3.05%

Table 2 shows the correlation among the variables used in the study. The first column of the table shows that the ratio of loan loss provision to total loans is positively correlated to the cash-to-asset ratio, the ratio of loans to total earning assets, the ratio of total operating costs to total assets, and the ratio of labor cost to total asset. However, the ratio of loan loss provision to total loans is negatively correlated to equity-to-asset ratio, the ratio interest cost to total deposits, and ratio of physical capital cost to fixed assets. The second column of the table shows that the ratio of cash and dues from banks to total assets is positively correlated to all other variables, except the ratio of loans to total earning assets. The third column shows that the ratio of equity to total assets is positively correlated to the ratio of physical capital cost to fixed assets. However, this ratio is negatively correlated to the other variables. The fourth column shows that the ratio of loans to total earning assets are positively correlated to the ratio of total operating cost to total assets and the ratio of interest cost to total deposits. Meanwhile, it is negatively correlated to the ratio of labor cost to total assets and ratio of physical capital costs to fixed assets. The ratio of total operating cost to total assets has positive correlations with the ratio of interest cost of total deposits, ratio of labor cost to total assets and ratio of physical capital costs to fixed assets.

Table 2
Correlation among the variables

	Var 1	Var 2	Var 3	Var 4	Var 5	Var 6	Var 7	Var 8
Var 1	1.00							
Var 2	0.28	1.00						
Var 3	-0.17	0.18	1.00					
Var 4	0.23	-0.12	-0.20	1.00				
Var 5	0.19	0.58	-0.01	0.04	1.00			
Var 6	-0.01	0.43	-0.11	0.07	0.52	1.00		
Var 7	0.22	0.23	-0.13	-0.05	0.62	-0.17	1.00	
Var 8	-0.19	0.37	0.64	-0.15	0.41	0.16	0.08	1.00

Var 1: *Ratio of Loan loss provision to total loans*
Var 2: *Ratio of Cash and due from banks to total assets*
Var 3: *Ratio of Equity to total assets*
Var 4: *Ratio of loans to total earning assets*
Var 5: *Ratio of total operating cost to total assets*
Var 6: *Ratio of interest cost to total deposits*
Var 7: *Ratio of labor cost to total assets*
Var 8: *Ratio of physical capital costs to fixed assets*

Chapter 6: Empirical Results

6.1. The unit operating costs

The regression results of Eq.(1) with operating costs per unit are shown in Table 3. The operating cost per unit is created by deflating the total operating cost over the total earning assets. (Unit cost of operating cost = total operating costs / total earning assets.) The adjusted R-square is 48% for the regression test, indicating that the regression model is quite suitable to test the operating cost per unit. The coefficient of cash-to-asset ratio is found positive at 10% significant level. This finding indicates that the unit operating cost tends to increase as banks hold more liquid assets. The result confirms that the liquid assets would incur additional costs, although they provide liquidity to reduce the banking risk. However, this relationship is quite weak, since it is only statistically significant at 10% significance level. As stated in the previous chapters, the ratio of loan loss provision to total loans, the ratio of equity to total assets, and the ratio of loans to earning assets represent the loan quality, capitalization, and banking output mix, respectively. The regression results did not find that these three control variables are significantly related to the operating costs. This finding suggests that none of the loan quality, capitalization, or output mix had an impact on the unit operating costs. This result is interesting since both loan quality and capitalization are used to reflect the quality of management. The insignificant relations of these two control variables indicate that the managerial quality may not have a significant impact on the banking production costs.

Table 3
Regression results of operating cost per unit

	Coefficient		P-value
Intercept	0.0614	*	*0.06*
Loan loss provision to total loans	0.0295		*0.82*
Cash to total assets	0.1034	*	*0.10*
Equity to total assets	-0.0562		*0.34*
Loans to earning assets	0.0076		*0.78*
D	0.0187	***	*0.00*
2005	-0.0405	***	*0.01*
2004	-0.0442	***	*0.00*
2003	-0.0485	***	*0.00*
2002	-0.0489	***	*0.00*
2001	-0.0395	***	*0.01*
2000	-0.0318	**	*0.03*
1999	-0.0167		*0.25*
Adjusted R Square	0.4792		

Co-efficients are reported in four decimal places in the table.
P-values are reported in two decimal places, and in Italic.
****,**,* indicate significance at the 1%, 5%, and 10% levels respectively.*

The ownership effect dummies show a significantly positive coefficient given by the regression model. This result suggests that, on average, joint-equity banks have higher operating costs per unit than state-owned banks. Therefore, state-owned banks show a relatively higher level of operating efficiency, compared to joint-equity banks. The

similar results are found in the previous Chinese banking research [see Chen et al. (2005) and Zhao (2000)]. However, this finding is contrary to some previous research results explained by agency theory. Moreover, it suggests that it is necessary to consider the unique banking system when we study Chinese banking issues. Normally, state-owed banks are protected by the central or local government, they deal extensively with the big state-owed enterprises (SOEs) and they have the advantage of being able to attract big corporate customers without incurring significant expenses like advertising and promotions. Those advantages make state-owned banks perform more efficiently than jointed-equity banks. Another explanation is that state-owned banks are typically much larger than non-state owned banks. The above results may indicate that state-owned banks enjoy economies of scale and scope whereas non-state owned banks do not have optimal size.

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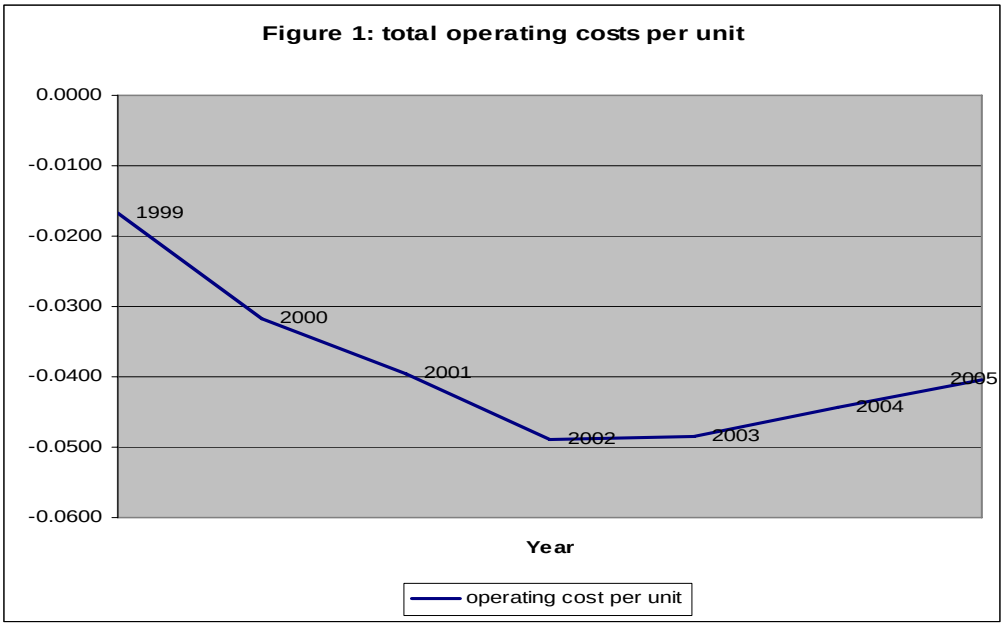

Regarding the time effect dummies, all the coefficients are significantly negative, except for 1999. The result indicates that on average, the operating cost per unit of Chinese banking industry from 2000 to 2005 is relatively lower than that in 1998. The coefficient for the 1999 dummy variable is negative, but not statistically significant. Figure 1 shows the average operating cost per unit from 1999 to 2005 relative to 1998. Overall, the curve

is “U” or “V” shaped. From 1999 to 2002, the average operating costs per unit declined sharply and reached the lowest point in 2002. Then, it turned up slightly and gradually from 2002 to 2005. The decline in average operating cost per unit suggests that Chinese banking industry was improving in overall operating performance. Although the average level runs up from 2002, the negative significant coefficients indicate that the overall industry still performs more efficiently than it did in 1998. It is not clear why operating costs increased from 2002 onwards.

6.2. The unit interest cost

The operating cost is further broken down into interest cost, labor cost and the cost of physical capital. To delve deeper into the banking production process, interest cost per unit, labor cost per unit and unit cost of physical capital are tested by the Eq.(1). The regression results are reported in Tables 4, 5 and 6, respectively. The regression results of Eq. (1) for interest cost per unit are represented in Table 4. The interest per unit is obtained by dividing the total amount of interest costs by the total amount of deposits. Table 4 shows that interest cost per unit is negatively related to the equity-to-asset ratio, indicating that a well-capitalized bank would suffer less interest expense per unit. The coefficient is statistically significant at 10%. The result does make sense that a high-capitalized bank would have less interest-bear liabilities, paying less unit cost of interest adjusted by the amount loanable funds. There is no statistically significant coefficient found in the ratio of loan loss provision to total loans, the ratio of cash to total assets, nor the ratio of loans to earning assets. The results suggest that none of asset liquidity, loan quality and output mix is related to the unit interest cost.

Table 4
Regression results of interest costs per unit

	Coefficient		P-value
Intercept	0.0593	***	*0.01*
Loan loss provision to total loans	-0.538		*0.045*
Cash to total assets	0.0574		*0.12*
Equity to total assets	-0.0586	*	*0.08*
Loans to earning assets	0.0090		*0.55*
D	-0.0041		*0.18*
2005	-0.0470	***	*0.00*
2004	-000491	***	*0.00*
2003	-0.0516	***	*0.00*
2002	-0.0533	***	*0.00*
2001	-0.0440	***	*0.00*
2000	-0.0394	***	*0.00*
1999	-0.0361	***	*0.00*
Adjusted R Square	0.5907		

Co-efficients are reported in four decimal places in the table.
P-values are reported in two decimal places, and in Italic.
****,**,* indicate significance at the 1%, 5%, and 10% levels respectively.*

The ownership effect dummies are not significant. On average, there is no systematic difference in interest cost between state-owned and joint-equity banks. This result seems puzzling at first as typically large and state-owned banks are "too-big-to-fail" and hence should enjoy lower cost of funds. But in China, deposit rates are regulated by the government. In fact, the deposit rates are set by the central bank and all the banks offer the same rates. Interest cost differs across banks only through the relative proportion of different types of deposits such as demand, savings and time deposits. The time effect dummies are all significantly negative at 1% significance level. This is very strong evidence that most banks paid less unit interest cost during the period of 1999-2005 relative to 1998. Figure 2 shows the similar trend as Figure 1. The unit interest cost declined during 1999 – 2002 and reached the lowest point in 2002, and then rebounded from 2003 to 2005. Also, the lines in Figure 2 reflect the general trend of domestic interest rate in China. When comparing these two Figures, we find that the per unit total operating cost drops faster than the per unit interest cost before 2001. However, the slope of the interest cost per unit is much sharper in 2001. Furthermore, the line of the operating cost per unit rebounds steadier and smoother than the line of interest cost per unit in 2003.

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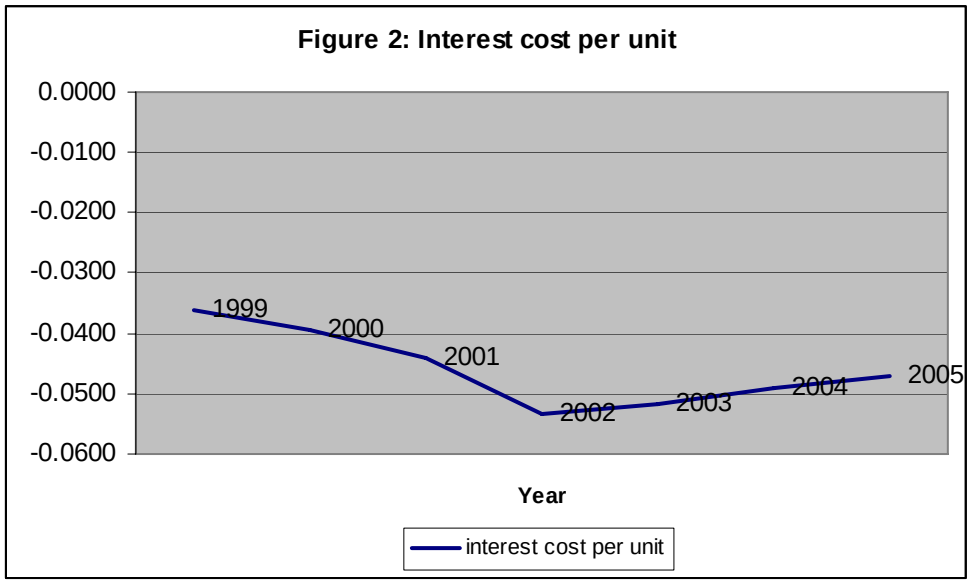

6.3. The unit labor cost

Table 5 represents the regression estimates of Eq.(1) with labor cost per unit. The unit labor cost is obtained by dividing the total amount of labor cost by the total earning assets as data on the number of employees in China are not available. We can see that there is no significant coefficient of control variables found by the regression model. This finding indicates that the labor cost per unit is unrelated to the loan quality, liquidity, capitalization or output mix. Since the loan quality and capitalization are the control variables that capture managerial quality, the regression results also suggest that managerial quality has no relationship with the management compensation. It is also interesting to discover that the labor cost per unit is not related to the banking liquidity. Generally speaking, handling liquidity assets (e.g. cash) is a kind of labor intensive process. But, this situation is not found in this study. The coefficient of cash-to-asset ratio is insignificant, indicating there is no relationship between the liquidity and the labor cost per unit. Additional cash holdings by banks would not increase the unit cost of labor. Therefore, it seems that handling liquidity is not a labor intensive process for the Chinese banking industry.

With regards to the ownership effect, the coefficient of ownership dummy variable is found to be positive at 1% significance level. Thus, it is a systematic difference in the unit cost of labor between state-owned banks and joint-equity banks. Since a positive coefficient is given by the regression model, it suggests that the joint-equity banks have a higher level of labor cost. This result implies that joint-equity banks pay more staff salaries and benefits than do state-owned banks, after adjusting the nominal amount of labor cost by the total earning assets. For the time effect dummy variables, none of coefficients is found to be statistically significant. This result suggests that labor cost per unit remains unchanged over the study period from 1998 to 2005. Compared to the labor cost in 1998, on average, Chinese banks did not increase or decrease their labor cost per unit over the time.

Table 5
Regression results of labor costs per unit

	Coefficient		P-value
Intercept	0.0228		*0.45*
Loan loss provision to total loans	0.0834		*0.49*
Cash to total assets	0.0076		*0.90*
Equity to total assets	-0.0680		*0.22*
Loans to earning assets	-0.0180		*0.48*
D	0.0170	***	*0.00*
2005	-0.0030		*0.84*
2004	-0.0016		*0.91*
2003	-0.0031		*0.81*
2002	-0.0023		*0.85*
2001	-0.0030		*0.82*
2000	0.0030		*0.82*
1999	0.0070		*0.60*
Adjusted R Square	0.1482		

Co-efficients are reported in four decimal places in the table.
P-values are reported in two decimal places, and in Italic.
****,**,* indicate significance at the 1%, 5%, and 10% levels respectively.*

6.4. The unit cost of physical capital

The regression results for the unit cost of physical capital are reported in Table 6. The cost of physical capital per unit is created by dividing the total amount of the physical capital cost by the total fixed assets. For the four control variables, only the coefficient of the ratio of equity to total asset is found to be statistically significant, and at 1% significance level. The positive coefficient of the capitalization indicates that banks would raise the unit cost of physical capital with the increase in equity-to-asset ratio. This result suggests that well-capitalized banks tend to spend more money on the physical capital, such as equipment maintenance, setting up new braches, ATMs, or applying newly advanced technology. The other coefficients of control variables are not statistically significant given by the regression model for the unit cost of physical capital. The finding suggests that the unit cost of physical capital of the Chinese banking industry is not related to the loan quality, liquidity, or output mix.

The unit cost of physical capital has a systematic difference between the state-owned banks and joint-equity banks in the Chinese banking industry. The significantly positive coefficient of the ownership effect dummy indicates that the joint-equity banks would have more money spend on per unit physical capital. Regarding the time effect dummies, the regression model gives significantly negative coefficients in 2000 and 2001. This finding suggests that the overall unit cost of physical capital of the Chinese banking industry is relatively lower in 2000 and 2001 than that in 1998. However, the coefficients of time effect dummies in the other years are insignificant, indicating it is not a systematical difference in the unit cost of physical capital between 1999 and 2005 relative to 1998, other than 2000 and 2001.

Table 6
Regression results of physical capital cost per unit

	Coefficient		P-value
Intercept	0.0093		*0.21*
Loan loss provision to total loans	-0.0483		*0.11*
Cash to total assets	0.0133		*0.36*
Equity to total assets	0.0775	***	*0.00*
Loans to earning assets	-0.0009		*0.88*
D	0.0035	***	*0.01*
2005	-0.0055		*0.13*
2004	-0.0059	**	*0.08*
2003	-0.0049		*0.14*
2002	-0.0050		*0.11*
2001	-0.0060	*	*0.07*
2000	-0.0070	**	*0.03*
1999	0.0005		*0.88*
Adjusted R Square	0.5523		

Co-efficients are reported in four decimal places in the table.
P-values are reported in two decimal places, and in Italic.
****,**,* indicate significance at the 1%, 5%, and 10% levels respectively.*

6.5. Labor input share

To explore the choice of the inputs share, i.e. the mix of labor and physical capital, in Chinese banking production between the two types of ownership and over time, the labor cost share is tested by Eq.(2). The labor cost share describes the share that labor cost occupies in the non-interest operating costs. Banks tend to use relatively more labor than capital in the banking production possibly because either this labor is relatively cheap, or the labor productivity is relatively high, therefore, it is more cost efficient to use labor input compared to capital investment. Table 7 reports the regression results of Eq. (2) with the labor cost share. It is a ratio created by deflating the amount of labor cost over the non-interest operating cost (i.e. labor cost + cost of physical capital). The coefficient of loan loss provision to total ratio is found to be significantly positive. The loan quality would improve as the increase of labor cost share. The finding suggests that credit underwriting and loan monitoring are more effectively done by labor. However, the significance level for this relationship is just 10%, indicating weak evidence for the relationship. The labor cost share is also found to be significantly negatively related to equity-to-asset ratio. Furthermore, the labor cost share is unrelated to the cash-to-asset ratio and the ratio of loan to earning asset. Thus, the liquidity and output mix has no impact of the choice of banking input mix. Labor seems to be doing well equally as physical capital in the banking production. They are good substitutes for each other in handling liquidity assets and the choice of banking outputs. However, the loan quality improves as more labor is involved in loan production, suggesting the labor input exhibits high productivity compared to physical capital input in the banking production process. The ownership effect dummy variable is significantly positive, indicating that there is a systematic difference in the labor cost share in the banking production process between the two types of ownership. The finding shows that joint-equity banks have the preference to choose more labor share in their production process. Regarding the time effect dummies, none of the coefficients are found to be significant. This result indicates that, on average, there is no adjustment in the production process by changing their input mix in the Chinese banking industry over the time covered in the study period.

Table 7
Regression results of labour cost share (input mix)

	Labor cost to non-interest operating costs		
	Co-efficient		*p-value*
Intercept	0.5795		*0.11*
Loan loss provision to total loans	2.4434	*	*0.09*
Cash to total assets	-0.6420		*0.36*
Equity to total assets	-1.4576	**	*0.03*
Loans to earning assets	-0.1208		*0.69*
D	0.1481	**	*0.02*
2005	0.0598		*0.73*
2004	0.0810		*0.62*
2003	0.0592		*0.71*
2002	0.1201		*0.42*
2001	0.1357		*0.40*
2000	0.2432		*0.12*
1999	0.1011		*0.53*
Adjusted R Square	0.2183		

Co-efficients are reported in four decimal places in the table.
P-values are reported in two decimal places, and in Italic.
****,**,* indicate significance at the 1%, 5%, and 10% levels respectively.*

Chapter 7: Conclusions

This study investigates the Chinese banking cost efficiency from 1998 to 2005. The observed bank operating costs are compared across the different ownership forms and over time. After controlling for variables such as loan quality, liquidity, capitalization and output mix, the unit operating costs are found to be significantly different between state-owned banks and joint-equity banks. Thus, using operating cost per unit as a measure of banking cost efficiency, the findings suggest that state-owned banks perform better than joint-equity banks. This result is consistent with the previous Chinese banking literatures. Zhao (2000) and Chen et al. (2005) found similar results—that state-owned banks show a relatively higher efficiency level. The regression results also found that there is a weak positive relationship between the operating cost per unit and banking liquidity. This finding suggests that the institution would incur additional operating costs per unit when that bank is handling more liquid assets. In other words, banking efficiency would suffer from holding additional cash in operating.

The operating cost is further broken down into interest cost, labor cost and cost of physical capital. To compare the banking cost efficiency with different sizes, the unit cost of each component of operating cost is created to run the regression model. The unit interest cost, unit labor cost and the unit cost of physical capital are obtained by deflating the amount of cost over the total deposits, total assets, and fixed assets, respectively. Each of those three measures is separately tested by the regression model.

The interest cost per unit is not affected by the ownership effect, suggesting state-owned banks and joint-equity banks have the similar interest cost per unit. The regression model also gives a weak relationship between the equity-to-asset ratio and the interest cost per unit. A bank with more equity seems to have less unit interest cost paid. The regression model found the ownership effect on the unit labor cost. Joint-equity banks seem to suffer more unit labor cost compared to state-owned banks. In addition, there is no significant relationship found between the labor cost per unit and the control variables. The regression test on the unit cost of physical capital also suggests that joint-equity

banks have a higher unit cost of physical capital than state-owned banks. Capitalization is found to be a factor affecting the unit cost of physical capital. Banks with higher capitalization tend to have a higher unit cost of physical capital.

To examine the choice of input mix, i.e. the mix of labor and physical capital, in Chinese banking production process, the labor cost share is tested in Eq.(2). The results indicate that there is a systematic difference in choice of input mix between the two types of banking ownership. Joint-equity banks prefer labor input in their production process.

Regarding the time effect on Chinese banking efficiency, the operating cost per unit is found to decline from 1999 to 2002, indicating that the Chinese banking industry, on average, was improving in cost efficiency. Although the operating cost per unit rebounds from 2003 to 2005, the level is still low relative to 1998. Moreover, interest cost per unit is found to have the similar trend with the unit operating cost. However, this time effect does not exist in the unit labor cost and the unit cost of physical capital. Therefore, the efficiency change in the industry average depends on the change of interest cost, which is subject to the change in interest rate over time. The regression results with labor cost share found the coefficient of time effect dummies are insignificant, indicating that the banking production process dose not evolve from 1998 to 2005. In other words, Chinese banks do not make significant changes in the choice of inputs over the time.

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