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Size Does Matter for Profitability! Testing Economies of Scale in Chinese Banking Industry

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Abstract: Chinese banking sector has undergone great changes since the mid 1990s. One common feature of Chinese banks is that they all grow larger and more diversified in ownership structure. This study aims to explore the determinants of profitability of Chinese major commercial banks, especially the impact of bank size on bank profitability. Using a panel data set consisting of 87 Chinese major commercial banks over 1998-2011 and regressed with fixed effect models, the study finds that asset size has a statistically significant and positive effect on bank profitability. Specifically, after controlling for other variables, when total assets increase by 1%, net profit per person will increase by 0.48%, return on asset and return on equity will increase by 0.24 and 2.3% points. The finding explains why almost all Chinese commercial banks are trying to growing larger and also explains why most Chinese banks are not willing to serve small and medium-sized enterprises and farmers. This result originates from the monopolized position of Chinese banking sector. This study confirms that there exists significant economies of scale in Chinese banking sector.

Key words: Chinese commercial banks, economies of scale, profitability, monopoly of banking sector

INTRODUCTION

Since the commercialization reform of Chinese banks from the mid-1990s and especially the listing of some banks on the stock exchanges, great changes have taken place in Chinese banking sector. Accompanying with China's economic expansion, almost all Chinese banks have grown larger measured by asset size. Almost all Chinese banks are going all out to grow larger.

Traditional economic theories suggest that in many industrial production processes, within a relevant output range, the larger the firm, the lower the average cost. That is, industrial productions tend to exhibit significant economies of scale over relevant range of output. This study attempts to test whether there are significant economies of scale in Chinese banking sector. That is, the focus of this study is to test whether bank size (usually measured by total asset) is a key determinant of profitability of Chinese commercial banks.

A positive relationship between bank size and profitability should be expected and some previous studies have proved this, such as Molyneux and Thornton (1992). However, literatures in this field fail to reach indisputable conclusions. Boyd and Runkle (1993), for example, finds that there was a negative relationship between size and profitability of American banks in the early 1990s. Zhao and Xiang (2010) reports that from 1993 to 2002, large banks and small (community) banks in the U.S. achieved quite comparable profit margins, measured by ROA. That is, the impact of size on bank performance remains inconclusive. This implies that the impact of bank size on profitability depends on specific institutional environment, including market structure and government policy.

This makes good sense because each study is confined to a specific sample of banks over a specific period (the present study is not an exception either). The institutional environments in which banks are operating are quite different across various countries and over different periods while no one can deny that institutional environment influences bank risk taking and performance (Houston et al., 2010). So the effects of the same variable on bank profitability in different countries may differ. Even in the same country, the effects may vary over different time periods, since a country's institutions may have changed dramatically even within a relatively short period, especially in the transition economics like China.

The aim of this study is to test economies of scale in Chinese banking sector, that is, to check whether bank size has a significant effect on bank profitability.

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MATERIALS

Sources of data: The Chinese banking sector mainly consists of four tiers: (traditionally) state-owned commercial banks (SOBs); nationwide joint-stock commercial banks (JSBs), city commercial banks; and rural commercial banks. One might argue that the separation of SOBs and JSBs is pointless because they are now all joint-stock commercial banks. The separation has been continued to use due to several reasons. First, it has become a convention attributable to their histories; SOBs had been wholly state-owned since their birth. Second, compared with JSBs, SOBs assume more responsibility for maintaining macroeconomic stability (say inflation) and promoting economic growth and the degree of government intervention is much less in JSBs than in SOBs. Third, the personnel management and remuneration system of JSBs are different from those of SOBs. For example, the top leaders of the four SOBs are usually appointed by the central government while leaders of JSBs are determined by board of directors of the banks (Jiang *et al.*, 2009). Moreover, JSBs are offering stronger incentive to individual employees; the income and benefits of employees are more closely related to their performances. While in SOBs, relatively speaking, the payment is more egalitarian (Zhao, 2011).

Eighty-seven Chinese commercial banks are selected into the sample. They include four traditionally state-owned commercial banks, thirteen nationwide joint-stock commercial banks, sixty-three city commercial banks and seven rural commercial banks. They are headquartered in twenty-six provinces, autonomous regions and municipalities of China. SOBs and JSBs are operating all across the country while city and rural commercial banks are mainly serving local firms and residents.

The data used in this study are from annual reports of banks. Usually banks publish their annual reports on their official websites or specified newspapers (such as Financial News). The reports must be confirmed by independent auditing firms before they are published.

Because the commercialization reform of large state-owned banks started from late 1990s and the reorganizing and restructuring of many city commercial banks started even later, so most banks have less than ten years of data. Some banks can be traced back to as early as 1998, such as China Minsheng Bank while some banks only have two years of data. On average, each bank has about five years of data. So the panel data set used in this study is an unbalanced one. The period covered here is a unique one with far-reaching changes in China's banking industry. A market-based banking system has taken shape and sixteen commercial banks have been listed on the stock exchanges during this period.

Description of the data: So the 87 banks in the sample is not a randomly chosen sample. Altogether China has about 280 commercial banks of all types, 87 is not a big number among 280 but they represent the largest and most competitive banks in China. The sample used in this study includes the "Big-Four", whose asset size accounts for nearly half of the total assets of all Chinese banking institutions (49.2% by the end of 2010 and 47.3% by the end of 2011). The sample also includes all the 13 nationwide joint-stock commercial banks, whose asset size accounts for about 16% of the total assets of all Chinese banking institutions (15.6% by the end of 2010 and 16.2% by the end of 2011). The total assets of all the city commercial banks only account for less than 10% of the entire banking sector (8.2% in 2010 and 8.8% in 201), although the number of city commercial banks is more than 100, far more than SOBs and JSBs. So it is fair to say that the sample represents the mainstay of Chinese commercial banks at least by size.

A commonly used measure of bank size in the literature is the total asset of a bank. That is, a large bank implies that the bank has a large asset size. Of course, other indicators can also be used to measure bank size, such as the number of employees, or size of gross or net profit but they are much less commonly used than asset size. Notwithstanding, it is reasonably assumed that these indicators are highly (positively) correlated.

Simple calculation verifies this. For example, the correlation coefficient between total assets and number of employees is as high as 0.9524 and the correlation between total assets and net profits is even higher, 0.9797. So this justifies the choice of total assets as the indicator of bank size.

Profitability of a bank, as the name itself implies, means the ability of a bank to make profits. It should not be measured by an absolute value of output, say, total gross profit or net profit; it is best measured by a ratio, a revenue-cost relationship, because no profit is earned without any cost. In the literature, bank profitability is typically measured by "Return on Assets" (ROA) and/or "Return on Equity" (ROE). Besides ROA and ROE, this study uses another measure, "net profit per person", which is defined by "net profit divided by total number of employees". Here, ROE is accurately defined as "weighted average ROE".

Profitability just indicates the ability to make money and it says nothing about why it can make money or how it makes money. That is, profitability is not equivalent to

Table 1: Mean, standard deviation, minimum and maximum values of all the dependent and independent variables in the regression model

Variable Name	Meanings of variable	Mean	Std. dev.	Min	Max
ROA	Return on assets (%)	0.97	0.51	-2.63	3.98
ROE	Weighted return on equity (%)	17.94	7.76	-8.34	56.38
Profit_per_person	Net profit per employee	36.00	23.54	-8.34	130.41
State_ownership	Percentage of state share (%)	33.29	25.64	0.00	100.00
Total_asset	Value of total assets	8013.00	21,915.00	38.00	154,769.00
Top_1	% of loan by the largest debtor	15.89	57.36	1.03	966.50
Top_10	% of loan by the top 10 debtors	70.30	128.12	8.67	1804.00
Liquidity_ratio	Liquidity ratio (%)	50.80	15.47	20.74	115.53
Loan_deposit_ratio	Loan divided by deposit (%)	62.84	9.79	21.03	86.00
Bad_loan_ratio	Bad loan ratio (%)	2.04	2.34	0.00	21.76
Capital_adeq._ratio	Capital adequacy ratio (%)	12.51	4.52	-1.47	62.04
Inflation	National inflation rate (%)	3.11	2.39	-1.40	5.90

Source: Calculated by the author based on dataset of this study. ROA = Net profit divided by the mean of beginning and closing balances of total assets. ROE weighted is calculated according to the information disclosure and compilation rule No. 9–Calculation and disclosure of return on equity and earnings per share (revised in 2010), formulated by China Securities Regulatory Commission (CSRC). Percentage of loan by the largest debtor = Loan borrowed by the largest debtor divided by net capital. Percentage of loan by top 10 debtors = Loan borrowed by the largest 10 debtors divided by net capital. Liquidity ratio = Balance of liquid assets divided by balance of liabilities. Loan-deposit ratio = Balance of loan divided by balance of deposits (balance of deposits does not include deposits by governments and outward remittance). Bad loan ratio = Balance of Bad loan divided by total loans of all debtors. Net profit per person is in unit of RMB 10,000. Total asset is in unit of RMB 100 million. All other variables are in percentages

efficiency or productivity. For example, a bank or firm has high profitability not necessarily because it is efficient or productive, may be because it is under the protection of the government, or it enjoys some preferential policies of the government. In the literature, many previous studies focus on determinant of bank efficiency or productivity (Ariff and Can, 2008) while this study focuses on profitability, this is a distinguishing feature of the present study. The three measures of profitability, namely, net profit per person, ROA and ROE, are either directly reported by the banks in their annual reports, or can be easily calculated based on their definitions. All the three measures are related but different; they measure profitability from different perspectives.

Besides bank size, the regression equation also includes several control variables which are state share, percentage of loan by the largest debtor, percentage of loan by the top 10 debtors, liquidity ratio, loan-deposit ratio, bad loan ratio and capital adequacy ratio. No doubt, macroeconomic environment also affects banks' profitability. This study uses national inflation rate as an indicator of macroeconomic environment. National inflation varies across years but is constant for all panels in any given year. Inflation is controlled for in the regression is also because government monetary policy will affect both inflation and bank profitability, so inflation rate is a good proxy for government monetary policy. Macroeconomic theory suggests that reserve-deposit ratio will affect bank profitability, this study does not control for it because loan-deposit ratio has been controlled for. GDP growth is sometimes included as a proxy for the macroeconomic environment in which banks operate (Jiang *et al.*, 2009) but this effect can be captured by the growth of banks' asset size. Since asset size has

been included, economic growth can be reasonably ignored. The names, definitions and summary statistics of the variables are presented in Table 1.

METHODS

Following Zhao (2013), we use the following model:

$$\text{Profitability} = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + B_6 X_6 + b_7 X_7 + b_8 X_8 + b_9 X_9 + u \qquad (1)$$

Here:

X_1 = State ownership
X_2 = Total asset
X_3 = Top 1
X_4 = Top 10
X_5 = Liquidity ratio
X_6 = Loan-deposit ratio
X_7 = Bad loan ratio
X_8 = Capital adequacy ratio
X_9 = Inflation rate

Here, profitability is measured by the three different measures explained above (so there are three specific models, each model with a different dependent variable measuring profitability); the meanings of all the variables are listed in Table 1. The inclusion of a large set of control variables is to minimize the omitted variable bias, thus to reduce the problem of endogeneity.

To further mitigate the existing heteroscedasticity and possible cross-section correlation problem, this study reports the Driscoll-Kraay standard errors (Driscoll and Kraay, 1998) which are more robust if there exist heteroscedasticity and cross-sectional correlation

problems. Because the panel data used in this study has the characteristic of N>T, i.e., the number of banks is far greater than the number of years (there are 87 banks and on average each bank has only five years of data), so the problems of serial correlation and panel unit root can be reasonably ignored.

REGRESSION RESULTS AND EXPLANATIONS

Table 2 presents the regression results. Regarding the effect of bank size on profitability, all three models indicate that size has a significant positive effect on profitability, both economically and statistically. That is to say, data strongly suggest that Chinese banking industry enjoys apparent economics of scale.

The regression results show that, on average, when total assets increase by 1%, net profit per person will increase by 0.48%, ROA and ROE will increase by 0.24 and 2.3% points. These are economically significant effects since the mean ROA is less than 1% while the mean of ROE is 18%. When the dependent variable is ROA, state ownership does not have a significant impact on profitability. In model (1) and model (3), when the dependent variable is Log(net profit per person) and ROE, respectively, state ownership does have a statistically negative effect on bank profitability. This seems to be consistent with theoretical predictions, i.e., private ownership outperforms public ones. The coefficients, however, are not practically significant. For

example, even if state ownership increases by one percentage point, profit per person of banks only declines by 0.013% and ROE will drop by 0.13% points. These effects are largely negligible. It can be reasonably concluded that ownership structure is not a key determinant of profitability of Chinese commercial banks over the period coved in the sample.

The significant effect of size on bank profitability is easy to understand and explain. The monopolistic banking sector and the competitive manufacturing sector do not match with each other. There is a shortage of banking services (especially loans) in China. It is easy for a bank to find a customer but it is difficult for a firm (especially small and medium-sized firm) to get loan. Therefore, a bank does not have to lower interest rate to attract large customers. For a bank, to grant a RMB 1 million loan and RMB 1 billion loan, the administrative costs are very close but the benefits are 1000 times different. This is the effect of economies of scale.

Economies of scale was first proposed to describe industrial production but it is even more appropriate to characterize the banking sector. Some previous studies have confirmed the economies of scale effect in banking industry, such as Molyneux and Forbes (1995), who found that a handful of large banks tend to emerge over time in European banking markets. This may because of government encouragement or the workings of the market mechanism.

Table 2: Estimated coefficients and standard errors of each independent variable in the regressions

	(1)	(2)	(3)
Independent variables	Dependent variable: Log (net profit per person)	Dependent variable: ROA	Dependent variable: ROE
State_ownership	-0.013***	-0.003	-0.130***
	(0.0028)	(0.0017)	(0.0370)
Log (total_asset)	0.478***	0.242***	2.288***
	(0.0395)	(0.0522)	(0.5437)
Top_1	0.007***	0.003**	-0.024**
	(0.002)	(0.0012)	(0.0109)
Top_10	-0.00***	-0.002***	-0.003
	(0.0010)	(0.0006)	(0.0054)
Liquidity_ratio	-0.001	0.003	0.060***
	(0.0014)	(0.0019)	(0.0204)
Loan_deposit_ratio	-0.001	0.005**	-0.020
	(0.0029)	(0.0022)	(0.0565)
Capital_adeq._ratio	0.016	-0.008	-0.049
	(0.0131)	(0.0083)	(0.0792)
Bad_loan_ratio	-0.023	0.024	0.362
	(0.0274)	(0.0164)	(0.3825)
Inflation	0.018***	0.022***	0.324***
	(0.0052)	(0.0052)	(0.0593)
Constant	0.481	-1.080**	4.048
	(0.4418)	(0.4575)	(8.5798)
Observations	367	370	370
Within R-Squared	0.8472	0.6233	0.4857
Adj. R-squared	0.8031	0.5157	0.3388
Model	Fixed Effect	Fixed Effect	Fixed Effect

(1) ***, ** and * besides the estimates stand for statistically significant at 10, 5 and 1%, respectively. (2) Figures in parentheses are Driscoll-Kraay standard errors of the estimates. (3) In the regression equations, total asset is in unit of RMB trillion; other independent variables are in units of percentage. In the regressions, net profit per person and total asset are in logarithm

Undoubtedly, large banks enjoy the advantage of economies of scale. To give a more vivid illustration, let us examine the data to compare two banks. In 2011, the single largest loan of ICBC is RMB 40.5 billion while the single largest loan of Bank of Ningbo is only RMB 500 million. The benefit of ICBC would be more than 80 times larger than that of Bank of Ningbo, since their costs are very close.

Thus the effect of economies of scale is very significant in the banking industry. Regressions also show that the percentage of loan borrowed by the single largest debtor and the top ten debtors do not produce any economically significant effects on bank profitability. That is because these two percent levels are strictly controlled and regulated by CBRC and out of risk aversion, most commercial banks decline to "put all one's eggs in a basket". In contrast, size of assets is not regulated and constrained by any authorities, so effect of economies of scale in the banking industry is more reflected by their size of assets.

Moreover, in China, large banks also have more opportunities to cooperate with governments at various levels; the benefit is obvious. Chinese governments, central and local, still control most of the key areas of the national economy such as petroleum, telecom and railway, etc. To stimulate the economy after the world financial crisis occurred in 2007-2008, Chinese governments have invested heavily in infrastructure construction in recent years, such as highways, railways and airports. The local government had to turn to ICBC finally. To construct those large projects, governments have to turn to large banks. Zhao (2011) reports the Zhengzhou government had thought to borrow money from Bank of Zhengzhou to build city subway but this local city commercial bank has not enough capital to finance this project. Then Zhengzhou government had to turn to ICBC finally. Bank of Zhengzhou lost this opportunity to cooperate with government.

The finding explains why almost all Chinese commercial banks are trying to become larger, especially those relatively smaller banks. Smaller banks face more competition pressure to become larger and that is why new employees of these banks are strongly encouraged to attract deposits. Moreover, given the monopoly position of the entire banking industry (private investors are not allowed to open banks), existing banks have no difficulty in finding customers to grant loans provided they have enough capital (deposits). So not only small and medium-sized banks want to grow larger but large banks want to become even larger.

The empirical results also explain why almost all Chinese commercial banks are reluctant to serve the rural areas given the average loan size there is much smaller. For example, Agricultural Bank of China (ABC) had been specified to serve agriculture and farmers since its establishment in 1979. So its operations had been mainly in the countryside. However, once ABC was expected to become a real commercial bank seeking profit maximization, it has gradually exited the rural areas and moved to cities (Zhao, 2011). Accompanying this process, many rural credit cooperatives and later township and village banks have been established to make up the gap.

The situation is quite different from banks in developed countries which are operating in much more competitive markets. Sinkey (1992), for example, reports that there exists an inverse U-shaped relationship between profitability and size of banks in the U.S. The "invisible hand" would drive down large banks' profit margin if the market is competitive enough.

Because large banks compete for large customers to realize the benefit of economies of scale, then large customers would have a better bargaining position to drive down loan interest rates that large banks could charge. Chinese banking industry is still far from that situation. That is why Chinese large banks could reap a higher profit margin than smaller ones.

CONCLUSION

Employing an unbalanced bank-level panel data set, this study tests the effect of size on bank profitability. The study finds that size has a significant and positive effect on bank profitability, both economically and statistically. That is to say, there exists strong "economies of scale" in Chinese banking sector. The finding of this study could help to explain two related phenomena in China. Almost all Chinese commercial banks are trying to grow larger; and no large bank is really willing to serve Small and Medium-sized Enterprises (SMEs) and farmers. The reasons are obvious. Only large banks could finance large projects and only serving large customers could they reap the benefit of economies of scale.

The findings of this study reflect a fundamental problem in the economic structure of today's China. Compared with the industrial and manufacturing sectors, the banking sector is still monopolized and highly controlled, in the sense that no private investors are allowed to open a bank. At the controlled interest rates, the demand for loans far exceeds the supply of it. Therefore, almost all banks, state-owned or non-state owned, make profits far more easily than the competitive manufacturing industries. Moreover, Chinese government controls benchmark interest rates and risk-related ratios

like reserve-deposit ratio but it does not control a bank's size, so almost all banks are trying hard to grow larger.

The findings of this study have shed important policy implications concerning banking reforms in China. Economists and the public have long complained about a lack of progress in reform of the state-dominated banking and financial industry in China and of inadequate services for the country's large number of SMEs and farmers. A metaphor vividly reveals the plight. Asking large banks to serve SMEs and farmers, just like inviting lions to catch mouse. The lions have no interest in catching mouse, nor are they good at catching mouse. The solution is not to force lions to catch mouse but to invite cats to do the job. That is, the government should allow the establishment and operation of large number of small private banks; as a first step, the government may legalize the large number of "underground private banks" in eastern China. Up to now, although some progress has been made, it is still far from being adequate.

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