

Evaluating the Effectiveness of China's Financial Reform—The Efficiency of China's Domestic Banks*

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May 27th, 2015

Abstract

This paper estimates the cost and profit efficiency of Chinese domestic banking sector to evaluate the effectiveness of China's financial reforms since 1978. We use the performance of foreign banks as the benchmark because foreign banks, subject to intensive worldwide competition, are perceived as possessing superior governing structure and organization, more advanced technologies and better trained labor force. On the other hand, competition in China's banking sector is mainly in the form of nonprice measures, thus putting foreign banks at a disadvantage. We find domestic banks have gradually caught up the cost advantage of foreign banks in a manner consistent with the increased competitive pressure. On the other hand, the profit advantage of domestic banks over foreign banks is widening because of institutional arrangements, cultural and social networks as well as the profit scope and revenue scale economy.

*We would like to thank a referee and a co-editor, G.J. Chen, J. Nugent, J. Strass, G. Tan, T. Zheng for helpful comments and discussions, Irene Hsiao for editorial polishing, and China NSF grant # 71131008 and # 71103004 for partial research support.

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1 Introduction

Since 1978, China has undergone a series of financial reforms aiming to transform an administrative banking system into a market-based banking sector. This paper intends to assess the effectiveness of China's financial reforms on the efficiency of the banking sector. However, contrary to the conventional approach of comparing the outcome of a treatment with the outcome in the absence of that treatment (e.g. Angrist and Pischke, 2014; Chen et al., 2005; Ching et al., 2011; Heckman and Vytlačil, 2005; Hsiao et al., 2012; Hsiao, 2014, Chap. 9), we do not separately identify the effect of each deregulation policy implemented. Instead, we assess the performance of China's domestic banks after a series of financial reforms using the performance of foreign banks as the benchmark. We assume foreign banks, under intensive world-wide competition, possess superior governing structure and organization, more advanced technologies, and better trained labor force. Furthermore, their administrative and operating structures are less likely to be affected by China's reforms in domestic banks' ownership structure and incentive scheme. On the other hand, under the current supervision structure, competition in China's banking sector is more in the nonprice areas which foreign banks probably are in a disadvantageous position.

There are a number of studies on the efficiency of China's banking sector. For instance, Ariff and Can (2008) used a nonparametric data envelope analysis (DEA) based technique to measure the cost- and profit-efficiency of 28 commercial banks from 1995 to 2004, finding that joint-stock banks, on average, were more cost and profit efficient than state-owned banks. Berger, Hansan and Zhou (2009) used the

stochastic frontier analysis (SFA) for domestic banks and two wholly foreign-owned banks during the period 1994 - 2003 and found that the big four state-owned banks were least cost efficient and foreign banks were most cost efficient. On the other hand, Chen et al. (2005) used the DEA method to examine the technical efficiency of 43 banks from 1993 to 2000 and showed that large state-owned banks were more efficient than medium-sized banks. Yin, Yang and Mehram (2013) found that the profit efficiency of foreign banks was not statistically different from that of state-owned banks.

Instead of estimating the envelope of efficiency frontier as in the DEA approach (e.g. Chen et al., 2005; Fu and Heffernan, 2007), we use the stochastic frontier analysis (e.g. Good, Röller, and Sickles, 1995; Kumbhakar, 1990; Schmidt and Sickles, 1984; Sickles, Good, and Johnson, 1986) to study the domestic and foreign banks' cost and profit efficiency relative to the frontier of a given level of input or output factors. Based on BankScope data of 107 commercial banks for the post-WTO period of 2007 to 2012, we find that foreign banks are most cost efficient but least profit efficient during this period. We also explore the reasons behind this phenomenon.

We proceed by first briefly describing the historical evolution of China's banking sector in section 2. Section 3 sets up the stochastic frontier analysis framework. Data and empirical findings are presented in section 4. In section 5 we explore the existence of the economy of scope in China's banking industry. Concluding remarks are presented in section 6.

2 The Evolution of China's Banking Sector

The financial system of the first thirty years of the People's Republic of China since 1949 was an all-inclusive monopoly by a single bank. The People's Bank of China (PBOC) was the only bank, it performed the functions of both the central bank and commercial bank. Under government directions, the PBOC was in charge of issuing currency- *renminbi* (RMB), managing exchange rates, controlling inflation, coordinating government revenue and expense, channeling household savings to state projects, etc.¹ Since 1978, China has embarked on a gradual approach to reform its financial system. The first stage was to put competitive pressure on state-owned banks by establishing more state-owned banks. Three additional banks were established in 1979: the Agriculture Bank of China (ABC) to manage rural finance, the Bank of China (BOC) to handle business related to foreign trade, and the China Construction Bank (CCB) to finance long-term investment and construction activities. In January 1984, the Industrial and Commercial Bank of China (ICBC) was separated from PBOC to manage urban banking business. These became the big four state-owned banks in China (Big Four). In September 1983, the PBOC was designated as the central bank of China in charge of supervising the banking industry.

The second stage of the reform was to gradually establish a hard budget for the management of state-owned banks and allow more diversified bank ownership structures. National-level joint-stock commercial banks began to be established in 1986, starting with the Bank of Communication. Local financial institutions also

¹PBOC website: About us. <http://www.pbc.gov.cn/publish/main/531/index.html>

started to appear in cities. In 1979, the first city credit cooperative was founded in Henan Province. In the 1990s, China had over 5,000 city credit cooperatives and city cooperative banks. However, the central government did not demonstrate full determination to stop commercial banks from making policy loans. Huge amounts of non-performing loans (NPLs) were accumulated in the 1990s. In 2001 the official non-performing loan ratio was 25.4% (1.88 trillion RMB NPLs over 7.4 trillion RMB total loans)²-but if the 1.4 trillion NPLs transferred to asset management companies (AMCs) during 1999 and 2001 were also factored in, the actual NPL ratio would be 37.3%.³

After joining the WTO in 2001, China had five years to strengthen its financial system to fulfill WTO regulations. The goal of this third stage of the reform was the privatization of state-owned banks to establish sound governing structure and operating mechanisms. Several steps were taken to implement the reform. The first step was to inject new capital to the Big Four to make them solvent before transforming state ownership to private ownership. In 2003 Central Huijin Investment Company Limited was established. Through Huijin, foreign reserves in the amount of 60 billion US dollars were injected as new capital of state-owned banks during 2004 and 2005.⁴ Also in 2004 and 2005, 1.24 trillion RMB NPLs were transferred from commercial banks to the AMCs. Next, the China Banking Regulatory Commission

²Almanac of China's Finance and Banking, 2002.

³In 1999, four AMCs were established: China Great Wall AMC, China Orient AMC, China Cinda AMC, and China Huarong AMC.

⁴In January 2004, foreign reserves with 45 billion US dollars (about 372.4 billion RMB) were injected to Bank of China and China Construction Bank. In April 2005, Central Huijin instilled 15 billion US dollars into Industrial and Commercial Bank of China, and in 2008, Huijin instilled 19 billion US dollars into Agricultural Bank of China.

(CBRC) was created in 2003 to regulate financial institutions. The third step was to gradually adopt new accounting standards, which made definitions of financial items consistent with international accounting standards. The fourth step was to diversify the governing structure of banks by encouraging joint ownership of non-government shareholders.

China's opening to foreign banks has taken a gradual approach. In 1980 the Export Import Bank of Japan opened its first representative office in Beijing, and in 1981 Nanyang Commercial Bank opened its first operational branch in Shenzhen. By the end of 1993, there were 76 operational branches in 13 cities serving foreign enterprises and individuals for business related to foreign currency. In 1994 the first law to regulate foreign banks, "Regulations of the People's Republic of China Governing Financial Institutions with Foreign Capital" was passed, specifying conditions for opening new branches, regulatory standards, and relaxation of regional operations. In 1996, foreign banks were allowed to do RMB business for foreign enterprises and foreign residents in Shanghai. Responding to the Asian Financial Crisis, China further relaxed restrictions on foreign banks' operations in 1998 and 2001, where foreign banks were allowed to access RMB from domestic inter-bank market and to attract RMB deposits in greater regions. By the end of 2006, there had been 14 wholly foreign-owned banks and joint-venture foreign banks with legal entity. Moreover, 74 foreign banks from 22 countries and regions had set 200 branches in 25 cities in China (CBRC, 2007). Starting from 2007, foreign banks speeded up their entry into China: the number of foreign-owned banks and joint-venture foreign banks with legal entity increased to 24 in 2007, to 28 in 2008, and to 38 in 2012.

At the end of 2012, China's banking system was mainly composed of one central bank, three policy banks, the big four state-owned banks, 13 joint-stock commercial banks, 144 city commercial banks (CBs), 337 rural commercial banks (RCB), 1927 rural credit cooperatives, 147 rural cooperative banks, and 38 foreign banks. Table 1 describes the market shares of various banks in China's banking sector. The "Five Main" banks below are the Big Four plus the Bank of Communications, following the categorization of the CBRC annual reports.⁵ The banking industry in China became more privatized over time, with the share of total assets of these five main banks decreasing from 61.83% in 2007 to 52.76% in 2012. The shares of 13 joint-stock banks, city commercial banks (CBs) and rural commercial banks (RCB) increased gradually, with joint-stock banks and city commercial banks together taking over 30% of total assets in 2012. However, the share of foreign banks with legal entity slightly decreased to just over 2% in 2012.

[Table 1 here]

China's banking sector has also evolved in the direction of more diversified ownership structure. Table 2 compares the shares of state ownership in 2007 and in 2012. Overall, state ownership varies significantly across bank types: it is over 70% for the Big Four, around 40% for joint-stock banks, about 30% for city commercial banks, and only slightly above 10% for rural commercial banks. Further, the state ownership share decreased during 2007 and 2012 for all types of domestic banks. For example, in 2007, ABC was still 100% owned by the state, but in 2012, its share dropped to

⁵As the three policy banks report directly to the State Council, and their operational priorities are primarily set by the State Council, we do not include them in calculating the market shares.

82.7%. Similarly, the average state-ownership share for the Big Four dropped from 77.37% in 2007 to 70.24% in 2012. The average state-ownership share for joint-stock banks dropped from 38.53% in 2007 to 35.16% in 2012. For city commercial banks and rural commercial banks, the average state ownership dropped about 5% within five years.

[Table 2 here]

3 Statistical methods

We use the stochastic frontier analysis (Forsund, Lovell and Schmidt, 1980) to assess the effectiveness of financial reforms in China's banking industry. Let y_{it} be some observed performance measure for financial firm i in period t ,

$$\begin{aligned} y_{it} &= \mathbf{x}'_{it}\beta + \epsilon_{it} \\ &= \mathbf{x}'_{it}\boldsymbol{\beta} - u_{it} + v_{it}, \end{aligned} \tag{1}$$

where \mathbf{x}_{it} is the vector of factors that could affect a firm's performance, v_{it} is the random error. The "stochastic frontier" is defined as $y_{it}^* = \mathbf{x}'_{it}\boldsymbol{\beta} + v_{it}$. The inefficiency is measured by the one-sided error $u_{it} \geq 0$. When the dependent variable, y_{it} , is in logarithmic form, then $\exp(-u_{it})$ measures the efficiency of firm i at time t . It is in the range of $[0, 1]$, and the closer it is to 1, the more efficient the financial firm is. Two specifications of u_{it} are considered:

- (i) $u_{it} = u_i$,

(ii) $u_{it} = \gamma_t u_i$, where both γ_t and u_i are treated as unknown as in Lee and Schmidt (1993), Ahn, Lee and Schmidt (2001).

Case (i) assumes the efficiency of a bank stays constant over time. Case (ii) allows the measurement of efficiency to vary across banks and over time in response to external shocks or changes in government policies and regulations, etc.

For case (i), the standard fixed effects estimator (e.g. Hsiao, 2014, Chap. 3) is used in which

$$\hat{\boldsymbol{\beta}}_{CV} = \left[\sum_i \sum_t (\mathbf{x}_{it} - \bar{\mathbf{x}}_i) (\mathbf{x}_{it} - \bar{\mathbf{x}}_i)' \right]^{-1} \left[\sum_i \sum_t (\mathbf{x}_{it} - \bar{\mathbf{x}}_i)' (y_{it} - \bar{y}_i) \right], \quad (2)$$

$$\hat{\alpha}_i = \bar{y}_i - \bar{\mathbf{x}}_i' \hat{\boldsymbol{\beta}}_{CV}, \quad (3)$$

$$\hat{u}_i = \max(\hat{\alpha}_i) - \hat{\alpha}_i, \quad (4)$$

where $\bar{y}_i = (1/T_i) \sum_t y_{it}$, $\bar{\mathbf{x}}_i = (1/T_i) \sum_t \mathbf{x}_{it}$, and T_i denotes the length of time series for the i th unit.

For case (ii), the iterative least square method (Lee and Schmidt, 1993; Ahn, Lee and Schmidt, 2001; Bai, 2009) is used. Let $\boldsymbol{\gamma} = (\gamma_1, \gamma_2, \dots, \gamma_T)'$, $\mathbf{u}_i = (u_{i1}, u_{i2}, \dots, u_{iT})'$, $X_i = (\mathbf{x}_{i1}, \mathbf{x}_{i2}, \dots, \mathbf{x}_{iT})'$, $Y_i = (y_{i1}, y_{i2}, \dots, y_{iT})'$, $P_\gamma = \boldsymbol{\gamma}(\boldsymbol{\gamma}'\boldsymbol{\gamma})^{-1}\boldsymbol{\gamma}'$, $M_\gamma = I_{T_i} - P_\gamma$, I_{T_i} is a $T_i \times T_i$ identity matrix, γ_1 is normalized to 1 without loss of generalization. Then, \mathbf{u}_i and $\boldsymbol{\beta}$ can be estimated through minimizing the loss function $\sum_{i=1}^N (Y_i - X_i\boldsymbol{\beta} - \mathbf{u}_i\boldsymbol{\gamma})'(Y_i - X_i\boldsymbol{\beta} - \mathbf{u}_i\boldsymbol{\gamma})$, where

$$\hat{\mathbf{u}}_i = \tilde{\boldsymbol{\gamma}}'(Y_i - X_i\boldsymbol{\beta})/\tilde{\boldsymbol{\gamma}}'\tilde{\boldsymbol{\gamma}}, \quad (5)$$

$$\hat{\boldsymbol{\beta}} = \left(\sum_{i=1}^N X_i' M_{\tilde{\boldsymbol{\gamma}}} X_i \right)^{-1} \left(\sum_{i=1}^N X_i' M_{\tilde{\boldsymbol{\gamma}}} Y_i \right), \quad (6)$$

and $\tilde{\boldsymbol{\gamma}}$ is the eigenvector corresponding to the largest eigenvalue of $\frac{1}{N} \sum_{i=1}^N (Y_i - X_i\boldsymbol{\beta})'(Y_i - X_i\boldsymbol{\beta})$ (Lee and Schmidt, 1993).

Following Berger et al. (2009), the translog function (Christensen, Jorgenson, and Lau, 1973) is employed to estimate the cost and profit efficiency. The specification for the cost translog function for bank i at time t is:

$$\begin{aligned} \ln\left(\frac{TC}{A}\right) = & \alpha_0 + \sum_{s=1}^3 \alpha_s \ln(w_s) + \sum_{m=1}^3 \beta_m \ln\left(\frac{y_m}{A}\right) + \frac{1}{2} \sum_{s=1}^3 \sum_{k=1}^3 \gamma_{sk} \ln(w_s) \ln(w_k) + \\ & \frac{1}{2} \sum_{m=1}^3 \sum_{l=1}^3 \delta_{ml} \ln\left(\frac{y_m}{A}\right) \ln\left(\frac{y_l}{A}\right) + \sum_{s=1}^3 \sum_{m=1}^3 \eta_{sm} \ln(w_s) \ln\left(\frac{y_m}{A}\right) + u + v, \quad (7) \end{aligned}$$

where TC/A is total cost (TC) divided by total asset (A).⁶ The three outputs are total loans net of non-performing loans (y_1), other earning assets (y_2), and total non-interest income (y_3); three input prices are the price of funds proxied by the ratio of total interest expenses to total deposits and other short-term funding (w_1), the price of fixed assets proxied by the ratio of other operating expenses to fixed assets (w_2), the price of labor proxied by the ratio of personnel expenses to total

⁶Total cost and three outputs are divided by total assets to control for potential scale bias following Berger et al. (2009, 2010), Fu and Heffernan (2007), Akhigbe and McNulty (2003).

number of employees (w_3).⁷ Imposing the price homogeneity $\sum_{s=1}^3 \alpha_s = 1$, $\sum_{s=1}^3 \gamma_{sk} = 0$, $\sum_{m=1}^3 \eta_{sm} = 0$ and symmetry conditions $\gamma_{sk} = \gamma_{ks}$, $\delta_{ml} = \delta_{lm}$, Eq. (7) becomes:

$$\begin{aligned} \ln\left(\frac{TC}{Aw_3}\right) = & \alpha_0 + \sum_{s=1}^2 \alpha_s \ln\left(\frac{w_s}{w_3}\right) + \sum_{m=1}^3 \beta_m \ln\left(\frac{y_m}{A}\right) + \frac{1}{2} \sum_{s=1}^2 \sum_{k=1}^2 \gamma_{sk} \ln\left(\frac{w_s}{w_3}\right) \ln\left(\frac{w_k}{w_3}\right) + \\ & \frac{1}{2} \sum_{m=1}^3 \sum_{l=1}^3 \delta_{ml} \ln\left(\frac{y_m}{A}\right) \ln\left(\frac{y_l}{A}\right) + \sum_{s=1}^2 \sum_{m=1}^3 \eta_{sj} \ln\left(\frac{w_s}{w_3}\right) \ln\left(\frac{y_m}{A}\right) + u + v. \quad (8) \end{aligned}$$

The profit translog function is similarly specified using the logarithm of pre-tax profit π divided by Aw_3 as the dependent variable. We assume that a financial firm maximizes its profit for given prices of inputs and outputs. Therefore, we replace quantity of outputs in Eq.(8) with the prices of outputs, where the price of loans is measured by the ratio of interest income from loans to total loans, the price of other earning assets is measured by the ratio of interest income from other earning assets to other earning assets, and the price of non-traditional services is measured by the ratio of total non-interest income to total assets. The prices of inputs are the same as those in the cost translog function.

⁷We add non-interest income as a proxy for non-traditional activities of banks such as loan commitment, letters of credit, bank acceptance, services on deposits accounts, etc.. In addition, non-interest income and the assets generating them are assumed to be proportional, following Clark and Siems, 2002; Akhigbe and McNulty, 2003; Vivas and Pasiouras, 2010).

4 Data and Empirical Findings

4.1 The BankScope Data on China's Banking Sector

Our sample is a set of unbalanced panel data from the BankScope database with a total of 107 commercial banks during the period 2007 to 2012. The accuracy of this dataset is checked against annual reports of relevant banks. We choose this time span for the following reasons: (i) 2007 was the first year that China fully opened up the banking industry to international competition; (ii) new Chinese Accounting Standards conforming to international standards were fully implemented in January 2007; (iii) 1.4 trillion RMB in 1999 and 1.24 trillion RMB in 2004 and 2005, respectively, were injected to write off bad loans to help state-owned banks to become solvent before going public, which could obscure the performance of state-owned banks had the early data been included; (iv) most commercial banks began to provide annual reports in 2007, making it possible to fill in the missing values in BankScope.

The 107 commercial banks include the big four state-owned commercial banks, 13 joint-stock commercial banks, 59 city commercial banks, 10 rural commercial banks, and 21 foreign banks. Our sample appears quite representative by comparing the overall market share reported in Table 1 with the market share of our sample banks (Table 3, Panel 3A)⁸ as well as the percentage share of deposits and loans from the BankScope data relative to the whole banking sector reported in Panel 3B of Table 3. The BankScope data accounts for about 76.5%-78.5% of total deposits, and 72%

⁸As the Bankscope dataset does not include rural cooperative banks and rural credit cooperatives, the state-owned banks and joint-stock banks take up bigger shares than those reported by CBRC annual report.

- 74% of total loans of China's banking sector during 2007 - 2012.

[Table 3 here]

4.2 Empirical Findings

In this subsection we report the estimated cost and profit efficiency for banks in China. There is an efficiency measure for each bank for each year. To provide a summary measure, we group domestic banks into four categories, the big four state-owned banks (Big Four), the national joint-stock banks (Joint-Stock), the city commercial banks (CBs) and the rural commercial banks (RCB). The reasons for these groupings are: (i) The central government remains the dominant shareholder for the Big Four. Thus, most state revenues and expenses, and large state-owned enterprises' (SOEs) business are handled by the Big Four; (ii) CBs are established by the local government to meet local economic development need, to manage local government revenues and expenses, and to finance local infrastructure expenses; (iii) RCB mainly serves business related to rural finance for rural residents and rural enterprises; (iv) joint-stock banks are national-level banks that do not have specific relations with specific clients, nor do they have close connections with big state-owned enterprises.

Table 4 presents the mean value of the cost efficiency based on both time-invariant (denoted as FE) and time-varying specifications (denoted as LS93). Whatever specification is used for the efficiency measure, foreign banks are the most cost efficient banks. This result is significant at 1% significance level and is robust to estimation methods utilized.

[Table 4 here]

Table 5 presents the estimated mean value of the profit efficiency for each type of banks. Here, again no matter what specification is used, foreign banks are least profit efficient, and such difference is statistically significant at 1% significance level.

[Table 5 here]

To check if efficiency measures stay constant over time (specification (i) vs. (ii)), we use the Hausman (1978) type specification test. Let $\hat{\beta}_I$ denote the estimates of translog function coefficients under specification (i) with covariance matrix $var(\hat{\beta}_I)$ and $\hat{\beta}_{II}$ denote the estimates under specification (ii) with covariance matrix $var(\hat{\beta}_{II})$. Under the null of constant efficiency measure, $\hat{\beta}_I$ is the efficient estimator and $\hat{\beta}_{II}$ is consistent but inefficient. Under the alternative that efficiency measure is time-varying, $\hat{\beta}_I$ is inconsistent but $\hat{\beta}_{II}$ remains consistent. Thus a Hausman type specification test statistic of constant efficiency measure ((i) vs. (ii))

$$\left(\hat{\beta}_I - \hat{\beta}_{II}\right)' \left[var\left(\hat{\beta}_{II}\right) - var\left(\hat{\beta}_I\right) \right]^{-1} \left(\hat{\beta}_I - \hat{\beta}_{II}\right) \sim \chi_k^2 \quad (9)$$

is asymptotically chi-squared distributed, where k denotes the dimension of the vector β . The Hausman test statistic for cost efficiency is 45.90 and 161.12 for profit efficiency. The critical value for the 5% significance level of chi-square distribution with 20 degree of freedom is 31.41. In other words, the Hausman specification analysis favors models with time-varying individual bank's efficiency measure. So we focus on specification (ii) to analyze cost and profit efficiency over time.

Figure 1 plots the changes in cost efficiency over time, showing that foreign banks are most cost efficient. Among domestic banks, joint-stock and rural commercial banks are most cost efficient, followed by city commercial banks. The Big Four are least cost efficient.⁹The gap between foreign banks and different types of domestic banks are relatively wide in 2007. However, with reforms deepening, the relative efficiency of all banks are converging and getting close to 1, indicating that, on average, all five types of banks have increased their efficiencies.¹⁰ Among these banks, although foreign banks are most cost efficient during this period, domestic banks have caught up very quickly. The gap between the mean value of cost efficiency for foreign banks and the least cost-efficient banks is 0.07 in 2007, but in 2012, it drops to a negligible 0.009. The results indicate that the cost efficiency of foreign banks over domestic banks has been gradually evaporating as the banking sector becomes more competitive.

[Figure 1 here]

In Figure 2 we plot the profit efficiency measures for domestic banks and foreign banks. It is interesting to note that the Big Four are most profit efficient, followed by city commercial banks. The foreign banks are least profit efficient. Moreover, except for city commercial banks vis-a-vie the Big Four, the profit efficiency measures have been diverging over time for all types of banks. The gap between domestic and

⁹Our relative rankings of the cost efficiency of different types of domestic banks corroborate those of Ariff and Can (2009) based on the nonparametric DEA technique using 28 Chinese banks for the period 1995 to 2004, and those of Berger, Hansan and Zhou (2009) for the period 1994 - 2003.

¹⁰This improvement of cost efficiency over time following the financial deregulation, over the period 1993 to 2000, is also found by Chen, Skully and Brown (2005).

foreign banks' profit efficiency is widening over time. The gap between foreign banks and the most profit efficient group of domestic banks (the Big-Four) has widened from 0.1151 in 2007 to 0.2538 in 2012.¹¹

[Figure 2 here]

5 Profit Scope Economy and Revenue Scale Economy

Can one attribute the phenomenon that foreign banks are most cost efficient but least profit efficient to the monopolistic power of domestic banks? ¹² Table 6 summarizes the laws governing domestic and foreign banks. The laws governing domestic and foreign banks with legal entities do not appear very different. Neither is there any feasible discrimination or any available evidence against foreign banks after 2007.

[Table 6 here]

¹¹A referee raised the question that "new entrants may deviate from those banks that have been present in the market for a longer period" that could affect the benchmark. Our data contains two new foreign banks. The mean value of the cost efficiency of these new entrants is 0.774 for 2009, 0.919 for 2010, 0.951 for 2011, 0.975 for 2012, which does not deviate much from the mean value of 21 existing banks measures of 0.776 for 2009, 0.909 for 2010, 0.944 for 2011, and 0.971 for 2012. On the other hand, the mean value of the profit efficiency of these two new entrants is above the mean value of the existing banks, 0.631 vs. 0.363 in 2009, 0.653 vs. 0.391 in 2010, 0.701 vs. 0.451 in 2011, and 0.668 vs. 0.389 in 2012, perhaps due to their aggressive measures to capture market share. Excluding the new entrants from the existing ones only makes the widening of the profit efficiency gap between domestic and foreign banks over time even more apparent.

¹²A similar phenomenon is observed in some European transition economies and in Australia (Yildirim and Philippatos 2007, Sturm and Williams 2004), but not so in developing countries, where foreign banks tend to be more efficient than domestic banks.

If the difference in profitability between domestic and foreign banks cannot be attributed to the laws governing foreign and domestic banks, then the difference must come from the competitive advantages of domestic banks over foreign banks. There appear to be several advantages:

1. The spreads between loan interest rate and deposit interest rate are much higher in RMB than those in foreign currencies. The foreign currency loan rate and deposit rate are determined through global competition while the RMB loan rate and deposit rate are regulated by PBOC during this period. In addition, commercial banks in China are only allowed to make RMB loans out of RMB deposits and foreign currency loans out of foreign currency deposits. With the elimination of special privileges granted to foreign banks in 2006, foreign banks and domestic banks have to meet the same requirements in many activities, such as meeting the same loan-to-deposit ratio. PBOC sets the upper limit of this ratio to 75%, and requires foreign banks with legal entities to meet this standard by the end of 2011. In addition, PBOC requires this ratio applied to loans in RMB and in foreign currencies separately, i.e., RMB loans can only be made against RMB deposits and foreign loans can only be made against foreign deposits. Table 7 shows that the average loan-to-deposit ratio of foreign banks has decreased steadily from 183.58% in 2007 to 71.60% in 2012, while domestic banks have kept that ratio relatively stable.

[Table 7 here]

To decrease the loan-to-deposit ratio from 183.58% to about 75%, foreign banks have to either increase deposits quickly, slow down the growth of loans, or both. The BankScope data shows that the requirement is met mainly by slowing down the

growth of loans. The deposit growth rate of foreign banks is slightly higher (27.87% for foreign banks v.s. 24.11% for domestic banks), but given their small size this growth rate is not fast enough to meet the upper limit of the loan-to-deposit ratio. In this period, the average loan growth rate of foreign banks is 5.46%, but it is 11.96% for state-owned banks, 21.63% for joint-stock commercial banks, 24.64% for city commercial banks, and 13.50% for rural commercial banks.

2. Chinese customers prefer to make RMB deposits because the RMB deposit rate is much higher than the foreign currency deposit rate. Moreover, domestic banks tend to make long-term loans while foreign banks tend to make short-term or medium-term loans, which makes the returns to loans for domestic banks higher than those of foreign banks.¹³

3. It is advantageous for both customers and banks to maintain long-term relationships. Ho (2014) estimates that the cost of switching banks is approximately 0.8% of the deposit value. Therefore, it is difficult for foreign banks, especially the new entrants, to attract customers who have deposits in domestic banks.

4. Customers prefer banks with more employees and branches (Ho, 2014). Foreign banks are small compared to domestic banks. Table 8 compares the relative size of foreign banks with domestic banks in terms of variables such as total costs, total assets, and total loans. Foreign banks are tiny compared to the Big Four, with the mean value of all key variables to be less than 1% of those for the Big Four.

¹³Using BankScope data for 107 commercial banks in China and 6532 commercial banks in the U.S., the average deposit rate in 2012 is 1.82% in China and 0.38% in U.S.. In 2012, the average loan rate is 6.74% in China and 4.96% in the U.S.. The average deposit interest rate is calculated by dividing interest expense from deposits by total deposits. The average loan interest rate is calculated by dividing interest income from loans by total loans.

For example, the mean value of total asset (TA) for foreign banks is only 0.56% of those of the Big Four state-owned banks, 4.28% of joint-stock banks, 56.81% of city commercial banks, and 38.97% of rural commercial banks. The average value of total loans for foreign banks is only 0.53% of the Big Four, 3.91% of the joint-stock, 59.65% of the city commercial banks, and 38.39% of rural commercial banks.

[Table 8 here]

Table 9 compares the number of banks and branches for foreign banks and domestic banks. From 2007 to 2012, branches of foreign banks increased from 125 to 275. In other words, the average number of branches per foreign bank only increased from 5.2 in 2007 to 6.8 in 2012. On the other hand, domestic banks had slightly over 189,000 branches in 2007, which increased to approximately 196,000 in 2010.¹⁴

[Table 9 here]

5. The broad customer base makes it profitable for banks to offer differentiated products and fee-based services such as mortgage financing and paying utility bills on behalf of bank clients. As a result, banks are becoming increasingly reliant on fees, service charges, and other types of non-interest income. For instance, U.S. banks earned 42% of their net operating revenue from non-interest income in 2004 (Stiroh, 2006). Foreign banks in China are mainly concentrated in large cities with limited number of branches, which compels them to focus their business on large

¹⁴The CBRC data in 2010 is an approximate number, as starting from 2009, to promote the development of small and medium-sized domestic banks, CBRC waived the requirement of commercial banks to go through lengthy application process to set up branches. Consequently, the number of branches of commercial banks are no longer reported in CBRC annual report after 2010.

customers or large enterprises. Neither is it profitable to offer fee-based services or many differentiated financial instruments with a small customer base.¹⁵ Table 10 compares the share of non-interest income in total operating income for domestic and foreign banks. Even though the share of assets in non-loan activities has been increasing for foreign banks from 42.11% to 54.94%, the share of non-interest income has decreased from 39.26% in 2007 to 25.88% in 2012 while the share of non-interest income for most of the domestic banks has been increasing. It appears that it is hard for foreign banks to assure a dominant role in China's banking sector unless foreign banks can substantially expand their size.

[Table 10 here]

6. Banks with large size are more likely to develop strong relationship with the government at various levels. Under the current financial supervision system in China, banks with stronger ties to the government are more likely to get stronger government support and higher bargaining power against the state monetary authority to obtain more credit line that ultimately allows banks to produce more outputs (e.g., Chang et. al, 2014; Hou et. al, 2014).

However, there are also arguments against banks offering diversified products such as diluting the comparative advantage of management by going beyond their existing expertise (e.g. Klein and Saldenberg, 1998) or increased agency costs resulting from value-decreasing activities of the managers (e.g. Deng and Elyasiani, 2008). These

¹⁵Relying on noninterest income could expose banks to return volatility (e.g. Hou, Wang and Zhang, 2014; Storch, 2006). However, such risk is mitigated by the government's implicit credit guarantee.

observations raise two issues: complementarity of different lines of bank products and economy of scale.

To study the first issue, we follow Berger et. al (2010) to define the economy of scope as the proportional increase in profits from producing all outputs jointly by a diversified bank compared to producing each output individually by hypothetical focused banks. More specifically,

$$Economy\ of\ Scope = \frac{\pi(y_1, y_2) - [\pi(y_1, 0) + \pi(0, y_2)]}{\pi(y_1, y_2)} > 0 \quad (10)$$

where y_1 is total earning assets including total loans and other earning assets, y_2 is total non-interest income. If the inequality of Eq.(10) is reversed, there is a diseconomy of scope. A translog function is not suitable to study this issue because of the difficulty in determining the value of $\pi(y_1, 0)$ and $\pi(0, y_2)$. Therefore, we follow Pulley and Braunstein (1992) and Berger et al. (2010) to specify a composite function of the form

$$\begin{aligned} \frac{\pi}{A \cdot w_3} = & \left[a_0 + \sum_{j=1}^2 b_j \left(\frac{y_j}{A} \right) + \frac{1}{2} \sum_{j=1}^2 \sum_{l=1}^2 d_{jl} \left(\frac{y_j}{A} \right) \left(\frac{y_l}{A} \right) + \sum_{j=1}^2 \sum_{i=1}^2 e_{ji} \left(\frac{y_j}{A} \right) \ln \left(\frac{w_i}{w_3} \right) \right] \cdot \\ & \exp \left[\sum_{i=1}^2 a_i \ln \left(\frac{w_i}{w_3} \right) + \frac{1}{2} \sum_{i=1}^2 \sum_{k=1}^2 c_{ik} \ln \left(\frac{w_i}{w_3} \right) \ln \left(\frac{w_k}{w_3} \right) \right] + u, \end{aligned} \quad (11)$$

where the definitions of w_i and A are same as those in Eq. (7). Following Berger et al. (2010), we divide π and y_j by total assets to control size heterogeneity and divide π and w_i by w_3 to reflect price homogeneity. The nonlinear least square method is

employed to estimate the parameters of Eq. (11).

Table 11 presents the asset-weighted average of the economy of scope for domestic banks and foreign banks based on estimated parameters of Eq. (11). As can be seen from Table 11, on average, the large domestic banks including the Big Four and joint stock banks have achieved economy of scope. On the other hand, there exists diseconomy of scope for foreign banks, domestic city and rural commercial banks. However, it should be mentioned that the degree of the diseconomy of scope for city and rural commercial banks is decreasing, although we do not observe any sign of improvement for the economy of scope of foreign banks. More importantly, the difference of the economy of scope for profit between the big four domestic banks and foreign banks is 0.8072 in 2007, but it widens to 1.3975 in 2012.

[Table 11 here]

Table 8 shows that the big four and joint stock commercial banks are much larger in size than foreign banks, domestic city and rural commercial banks. To see if the size indeed matters in achieving the economy of scope, we analyze the revenue scale economy. The logarithm of total revenue from different lines of bank products are used as the output and the logarithm of total deposits, fixed assets, and total number of employees of banks are used to approximate the inputs. A Cobb-Douglas type production of the form

$$\ln(\text{revenue})_{it} = \beta_0 + \beta_1 \ln(\text{deposits})_{it} + \beta_2 \ln(\text{fix_assets})_{it} + \beta_3 \ln(\text{num_emp})_{it} + \alpha_i + \lambda_t + u_{it} \quad (12)$$

is estimated, where α_i denote bank-specific effects and λ_t denote the time-specific effects.

[Table 12 here]

The sum of β_1, β_2 and β_3 is 1.1077 (Table 12). The F -statistic to test if the sum of $\beta_1, \beta_2,$ and β_3 is significantly different from the null hypothesis of constant return to scale $H_0: \beta_1 + \beta_2 + \beta_3 = 1$ is 7.36. The critical value for the 1% significance level of a F -statistic with one degree of freedom in the numerator and 277 degree of freedom in the denominator is 6.64, implying that large banks are more capable to exploit economy of scale in revenue.

To take the greatest advantage of managers' expertise and to reduce the cost of capital, the results in Table 11 and 12 appear to suggest that large banks should diversify while smaller banks should focus on a single line of business. This appears to be what happened in China's banking industry. Therefore, if foreign banks in China wish to reduce the profit gap with domestic banks, they will need to expand in size substantially in order to take advantage of economy of scope.

6 Concluding remarks

Chinese banks provide approximately three quarters of national capital financing, therefore the health and competitiveness of China's banking industry play a critical role in the sustainability of China's economic growth. The state ownership and government directions that led to mounting non-performing loans and low efficiency of Chinese banks in the 1990s are considered to be the most serious threats to the

long-term economic growth of China, especially after joining the World Trade Organization in 2001 (Lardy,1998; 1999). Whether domestic banks can survive competition from foreign banks has been heavily debated, especially after China's full accession to the WTO. For example, Xu and Li (2007) argue that the performance of domestic banks would deteriorate in the post-WTO era, because foreign banks' competitiveness would exert huge pressure on domestic banks' profitability and solvency. Leung and Chan (2006) believe that only a very small number of foreign banks would be able to emerge as big players in China's banking industry due to the increasing competitiveness of domestic banks and high entry barriers and operating costs for foreign banks. In the past three decades, Chinese government has taken successive steps to create a good competitive environment among banks in domestic markets through

1. establishing more banks. From a single bank monopoly in 1979, China has seen the establishment of 473 banks with 196,000 branches by 2010, and these numbers continue to increase. By 2012, there were 646 domestic banks with legal entities.
2. privatization of ownership structure and governing structure from state ownership to joint-stock ownership, and from state direction to market allocation.
3. lessening and simplifying state regulations.
4. opening up the market for international competition.

In this paper we use stochastic frontier analysis and BankScope dataset of 107 commercial banks for the period 2007 - 2012 to evaluate the competitiveness of

China's banking industry. While our findings corroborate studies using data before 2005 that foreign banks are the most cost efficient banks (Ariff and Can, 2008; Berger, Hansan and Zhou, 2009; Chen et al., 2005; Jiang et al., 2009), our findings indicate that the operating efficiency of Chinese domestic banks is catching up, consistent with arguments that the relaxation of administrative interventions and increasing number of competitors have increased the market pressure, which in turn compels banks of different sizes and ownership structures to adopt more advanced technology and managerial skills. On the other hand, under the current banking supervision scheme, the competitive advantage of domestic banks over foreign banks is widening. The gradual deregulation of loan rates and deposit rates started in 2013 is expected to reduce the competitive advantage of domestic banks over foreign banks on the RMB loan market. However, foreign banks still face stiff competition from domestic banks over non-loan activities because of their limited scale. Customers prefer to manage their business with local banks. The large number of branches of domestic banks in the country provides them with an advantage in attracting customers. A large customer base allows domestic banks to offer a variety of loans or financial products as well as many fee-based services, such as providing mortgage loans and paying utility bills on behalf of bank clients, which are not profitable to foreign banks. Therefore, foreign banks should further expand their size to face challenges from domestic banks.

Tables and Figures

Table 1 Share of Total Assets for Banks in China, 2007-2012 (%)

	2007	2008	2009	2010	2011	2012
Five main	61.83	60.20	59.72	57.15	55.28	52.76
Joint-stock	15.78	16.32	17.30	18.16	18.95	20.67
CBs	7.53	7.78	8.35	9.57	10.29	10.85
RCB	12.15	13.20	12.65	12.99	13.26	13.63
Foreign	2.72	2.49	1.97	2.12	2.22	2.09

Note: Data source is Annual Report of China Banking Regulatory Commission, 2007-2012. Five main represents the big four state-owned commercial banks including Industrial and Commercial Bank of China, China Construction Bank, Agricultural Bank of China, and Bank of China, plus the Bank of Communications; Joint-stock represents 12 joint-stock commercial banks; CBs represents city commercial banks; RCB represents rural commercial banks and rural cooperative banks; Foreign represents foreign banks.

Table 2 The Share of State Ownership in 2007 and 2012 (%)

	2007			2012		
	mean	min	max	mean	min	max
Big-Four	77.37	67.97	100	70.24	59.53	82.70
Joint-stock	38.53	0	78.47	35.16	0	72.15
CBs	31.74	0	94.74	26.95	0	92.64
RCB	14.67	0	65.10	10.71	0	37.02

Note: Data source is BankScope from Bureau van Dijk and FitchRatings. Big-Four represents the big four state-owned commercial banks including Industrial and Commercial Bank of China, China Construction Bank, Agricultural Bank of China, and Bank of China. Joint-stock represents 12 joint-stock commercial banks; CBs represents city commercial banks; RCB represents rural commercial banks and rural cooperative banks.

3A: Market Share of Total Assets, 2007-2012 (%)						
	2007	2008	2009	2010	2011	2012
Five-main	67.01	65.39	64.43	61.93	60.05	57.90
Joint-Stock	23.60	24.51	25.01	25.96	27.22	28.88
CBs	6.15	6.72	7.08	8.46	8.97	9.54
RCB	1.48	1.75	2.04	2.06	2.10	2.14
Foreign	1.73	1.59	1.41	1.55	1.60	1.48
3B: Total Share of the Chinese Banking Sector (%)						
Deposits	76.53	77.75	77.33	78.49	78.45	77.94
Loans	72.41	72.45	73.23	73.98	74.21	73.60

Note: Data source is Annual Report of China Banking Regulatory Commission and BankScope from Bureau van Dijk and FitchRatings, 2007-2012. Five main represents the big four state-owned commercial banks including Industrial and Commercial Bank of China, China Construction Bank, Agricultural Bank of China, and Bank of China, plus the Bank of Communications; Joint-stock represents 12 joint-stock commercial banks; CBs represents city commercial banks; RCB represents rural commercial banks and rural cooperative banks; Foreign represents foreign banks.

Table 4 Mean Value of the Estimated Overall Cost Efficiency, 2007 - 2012

	N	FE	LS93
Domestic	451	0.6216	0.8329
Big-Four	24	0.6262	0.8196
Joint-stock	78	0.6348	0.8305
CBs	299	0.6170	0.8328
RCB	50	0.6294	0.8442
Foreign	99	0.7335	0.8678
Total	544	0.6435	0.8392

Note: Domestic represents domestic banks; Big-Four represents the big four state-owned commercial banks including Industrial and Commercial Bank of China, China Construction Bank, Agricultural Bank of China, and Bank of China. Joint-stock represents 12 joint-stock commercial banks; CBs represents city commercial banks; RCB represents rural commercial banks and rural cooperative banks; Foreign represents foreign banks.

Table 5 Mean Value of the Estimated Overall Profit Efficiency, 2007 - 2012

	N	FE	LS93
Domestic	357	0.5143	0.6967
Big-Four	24	0.4700	0.7293
Joint-stock	72	0.4202	0.6002
CBs	219	0.5468	0.6797
RCB	42	0.4898	0.5905
Foreign	84	0.1773	0.4820
Total	441	0.4469	0.6232

Note: Domestic represents domestic banks; Big-Four represents the big four state-owned commercial banks including Industrial and Commercial Bank of China, China Construction Bank, Agricultural Bank of China, and Bank of China. Joint-stock represents 12 joint-stock commercial banks; CBs represents city commercial banks; RCB represents rural commercial banks and rural cooperative banks; Foreign represents foreign banks.

Table 6 Regulations on Domestic Banks and Foreign Banks

	Domestic Banks	Foreign Banks
Establishment Requirements (Legal Entity)	Registered capital: No less than 1 billion yuan for joint-stock commercial banks, 100 million yuan for CBs, and 50 million yuan for RCBs	1.Registered capital no less than 1 billion yuan. 2.Have representative office in China for at least 2 years. 3.Total asset no less than 10 billion US dollars
Establishment Requirements (Branches)	1.Legal entity should provide no less than 100 million yuan working capital to the branch. 2.Legal entity cannot provide more than 60% of its working capital to all of its branches.	Same as domestic banks.
Line of Business	Take deposits; make loans; settlement of accounts; bill acceptance; issue and sale financial bond and government bond; inter-bank borrowing; foreign exchange trading; business of credit card; provision of gurantees including credit of letters; insurance agency	Issue of financial bond and government bond is not allowed; other business are same as domestic banks.
Asset and Liability Management	1.The loan-deposit ratio cannot exceed 75%. 2.The ratio of loans to a single borrower cannot exceed 10% of its total equity.	1.The loan-deposit ratio should meet the 75% upper limit by Dec. 31th, 2011. 2.The ratio of loans to a single borrower cannot exceed 10% of its own equity by Dec. 31th, 2009.
Reserve Requirements	Meet the legal deposit reserve requirement set by PBOC.	Same as domestic banks.

Note: Foreign banks include wholly foreign-funded banks and Chinese-foreign joint-venture banks. For more details please refer to "Regulations of the People's Republic of China on Administration of Foreign-funded Banks" and "Law of Chinese Commercial Banks".

Table 7 The Loan-to-deposit Ratio, 2007 - 2012 (%)

	2007	2008	2009	2010	2011	2012
Domestic	65.26	66.20	65.95	60.96	61.46	62.48
Big-Four	62.73	57.64	62.06	63.09	64.75	66.20
Joint-stock	72.70	74.56	74.54	71.13	70.24	68.22
CBs	63.13	64.26	63.85	58.45	58.89	60.67
RCB	64.28	69.50	67.64	61.49	63.53	63.35
Foreign	183.58	153.53	120.73	93.88	68.49	71.60

Note: Data source is BankScope from Bureau van Dijk and FitchRatings. Domestic represents domestic banks; Big-Four represents the big four state-owned commercial banks including Industrial and Commercial Bank of China, China Construction Bank, Agricultural Bank of China, and Bank of China. Joint-stock represents 12 joint-stock commercial banks; CBs represents city commercial banks; RCB represents rural commercial banks and rural cooperative banks; Foreign represents foreign banks.

Table 8 The Proportion of Foreign Banks over Other Types of Banks (%)

Variables	Big-Four	Joint-stock	CBs	RCB
TC	0.63	4.22	59.36	40.79
profit	0.35	3.00	39.31	29.61
TA	0.56	4.28	56.81	38.97
loans	0.53	3.91	59.65	38.39
OEA	0.53	4.19	51.68	40.70
TNI	0.77	8.55	158.46	90.69
deposits	0.52	3.99	53.67	36.53
FA	0.15	1.85	20.06	10.60
NE	0.16	2.18	24.20	13.12

Note: Data source is BankScope from Bureau van Dijk and FitchRatings. TC: total cost=total interest expense+total non-interest expense; profit: pre-tax profit; TA: total assets; loans: net loans; OEA : other earning assets; TNI: total non-interest income; deposits: customer deposits and other short-term funding; FA: fixed assets; NE: number of employees. Big-Four represents the big four state-owned commercial banks including Industrial and Commercial Bank of China, China Construction Bank, Agricultural Bank of China, and Bank of China. Joint-stock represents 12 joint-stock commercial banks; CBs represents city commercial banks; RCB represents rural commercial banks and rural cooperative banks.

Table 9 Number of Commercial Banks and Their Branches

	2007	2008	2009	2010	2011	2012
Foreign banks with legal entity	24	28	33	37	37	38
Branches of Foreign banks	125	163	206	230	253	275
Domestic Banks with legal entity	272	339	400	473	564	646
Branches of banking industry	189921	193000	193000	196000	-	-

Note: Data source is Annual Report of China Banking Regulatory Commission, 2007-2012.
Domestic banks with legal entity do not include rural credit cooperatives.

Table 10 The Ratio of Non-interest Income to Total Operating Income (%)

	2007	2008	2009	2010	2011	2012
Domestic	11.12	13.09	12.93	12.50	12.06	13.59
Big-Four	13.40	16.28	22.15	21.59	23.52	22.98
Joint-stock	9.35	11.61	12.90	14.47	17.77	17.18
CBs	12.46	13.96	12.62	11.23	9.99	12.10
RCB	4.52	8.29	10.56	13.70	11.81	13.23
Foreign	39.36	32.51	23.65	24.07	26.59	25.88

Note: Data source is BankScope from Bureau van Dijk and FitchRatings. Domestic represents domestic banks; Big-Four represents the big four state-owned commercial banks including Industrial and Commercial Bank of China, China Construction Bank, Agricultural Bank of China, and Bank of China. Joint-stock represents 12 joint-stock commercial banks; CBs represents city commercial banks; RCB represents rural commercial banks and rural cooperative banks; Foreign represents foreign banks.

Table 11 The Economy of Scope for Domestic and Foreign Banks :2007-2012

	2007	2008	2009	2010	2011	2012
Big-Four	0.7565	0.8451	1.0899	1.2960	1.2672	1.3044
Joint-stock	0.0520	0.0661	0.0795	0.0997	0.1160	0.1324
CBs	-0.1227	-0.1036	-0.0949	-0.1173	-0.0626	-0.0315
RCB	-0.0626	-0.0195	-0.0609	-0.0820	-0.0389	0.0209
Foreign	-0.0507	-0.0588	-0.0923	-0.0797	-0.0574	-0.0931

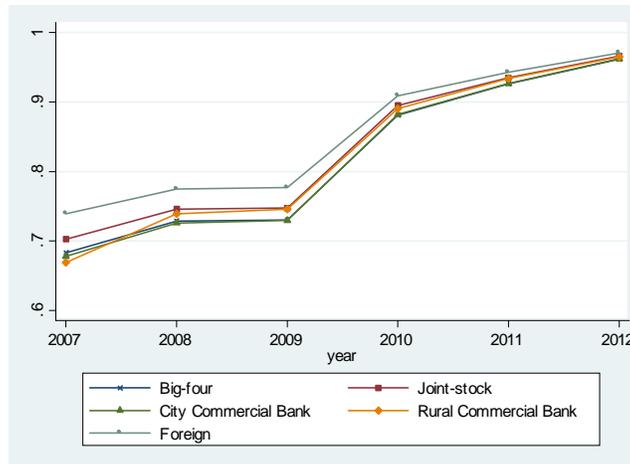
Note: Data source is BankScope from Bureau van Dijk and FitchRatings. Big-Four represents the big four state-owned commercial banks including Industrial and Commercial Bank of China, China Construction Bank, Agricultural Bank of China, and Bank of China. Joint-stock represents 12 joint-stock commercial banks; CBs represents city commercial banks; RCB represents rural commercial banks and rural cooperative banks; Foreign represents foreign banks.

Table 12 The Economy of Scale for Revenue by Two-way Effects

Dependent variable: ln(revenue)	
ln(deposits)	0.8230*** (0.0454)
ln(fix_assets)	0.0193 (0.0227)
ln(num_emp)	0.2660*** (0.0459)
Constant	-2.7390*** (0.7840)
Observations	371
R^2	0.9970

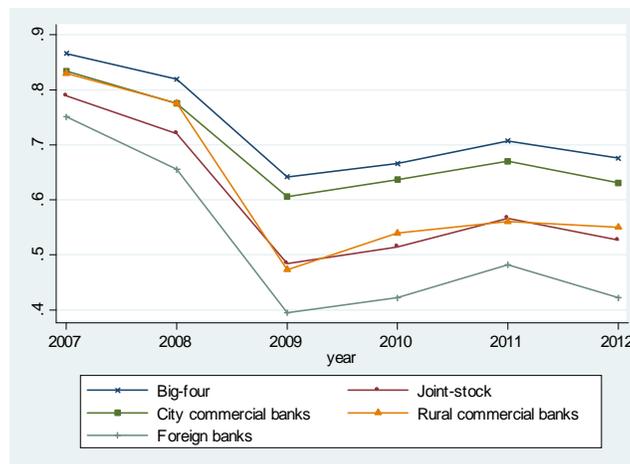
Note: Data source is BankScope from Bureau van Dijk and FitchRatings. ln(revenue) represents the logarithm of total operating revenue; ln(deposits) represents total deposits; ln(fix_assets) represents fixed assets; ln(num_emp) represents the number of employees for each bank.

Figure 1: The Mean Value of the Cost Efficiency by Year



Note: Data source is BankScope from Bureau van Dijk and FitchRatings. Big-Four represents the big four state-owned commercial banks including Industrial and Commercial Bank of China, China Construction Bank, Agricultural Bank of China, and Bank of China.

Figure 2: The Mean Value of the Profit Efficiency by Year



Note: Data source is BankScope from Bureau van Dijk and FitchRatings. Big-Four represents the big four state-owned commercial banks including Industrial and Commercial Bank of China, China Construction Bank, Agricultural Bank of China, and Bank of China.

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