

An Efficiency Comparison of Chinese Banks: A Multidimensional Analysis

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ABSTRACT

China has undergone tremendous changes in transforming its economy in the past decades. However, the Chinese banking sector is far from developed. The sector is still dominated by the four quasi-private, state-owned commercial banks (SOCBs). The Chinese financial markets did not open fully to foreign participation until 2006 to meet its 2001 WTO membership agreements and the urgent need to resolve its massive non-performing loans (NPLs). This paper looks at the efficiency performance comparison of Chinese banks after the reform implementation and restructuring of the Chinese banking sector in the aftermath of the NPLs problems in early 2000s. Applying concentration and efficiency measures as well as clustering methods, we analyzed the Chinese banking sector in China from 2006–2007. Aggregate indicators are also constructed to rank the Chinese banks in a multidimensional space. Lastly, the paper looks at the policy implications for reforms in the Chinese banking market.

JEL Classifications: G20, 21

Keywords: financial institutions and services; socialist institutions and their transitions; financial markets and institutions

I. INTRODUCTION

The Chinese banking system has been undergoing major reform overhaul for over a decade. The banks were faced with massive NPLs problems due to a combination of government policy lending directives to support failing state-owned enterprises, corruption and embezzlement, and political cronyism. In 2006, the banking sector had massive NPLs amounting to 21.67% of GDP, requiring government injection of capital to prevent insolvency. The government resolution agencies, Asset Management Corporations (AMCs), purchased 1.17 trillion yuan (US\$145 billion) of NPLs with 230 billion yuan (US\$25 billion) still unresolved on the books. The bailouts cost the government an estimated \$650 billion. Although the four SOCBs received foreign capital injection through initial public offering, they are still majority owned by the government.

The Chinese banking system experienced macro- and micro-economic shocks from the unprecedented operational risks from bank embezzlements and excesses in real estate and stock market speculations. Bank managers also exhibited moral hazard behavior and “disaster myopia” bank lending. Honohan (1997) finds that “disaster myopia” probabilities increase with the liberalization of financial markets. The Chinese banking system had pervasive systemic problems from inadequate corporate governance, regulations and enforcement, and bureaucratic supervision and monitoring by government agencies. Mid-to-upper bank managers took advantage of inadequate supervision, and embezzlement and corruption were widespread. The ensuing directive to rotate bank managers constantly to prevent the pervasive corruption and “*guangxi*” (cronyism) problems only engenders a lack of continuity and reinforces the myopic and moral hazard behaviors in bank managers lacking incentives and concerns for future accountability. China’s financial system is an endemic problem of underdevelopment, inefficiencies, and a bureaucracy framework that engenders embezzlement and corruption.

The lack of transparency and stifling bureaucracy are obstacles to the development of the Chinese banking sector. Chinese banks lack the technology, corporate governance structure, and management skills needed to assess risk management and competition. The Chinese financial market needs to be overhauled to meet global competition and become a global player as a growing economic power. The recent freeing of the renminbi to foreign trading will mean a bigger role for the Chinese banks as foreign currency dealers in the future.

II. LITERATURE REVIEW

The Chinese banking system has been transforming to adjust to a market based economy, implementing substantial reforms in the last decade after becoming a WTO member and particularly in light of the banks’ non-performing loan problems. The performance of Chinese banks is still in question after the huge effort to resolve the NPLs, recapitalization through initial public offerings (IPOs), and the push to reform the banking sector.

Studies that look at profitability and efficiency tend to find government ownership and interventions have a negative impact on the banking sector. A study by Garcia-Herrero et al. (2005) concludes that heavy government intervention and state

ownership is a key factor to low profitability in Chinese bank. On the other hand, banks that are more market oriented tend to be more profitable in their performance. Berger et al. (2007) finds that the SOCBs are the least efficient while the foreign banks are the most efficient. In addition, the participation of minority foreign ownership contributes significantly to improving efficiency of Chinese banks. Using total factor productivity (TFP) to analyze banking efficiency from 1992-2002, Kumbhakar and Wang (2007) find that joint-equity banks (TFP 5.4% per year) are more efficient than wholly SOCBs (TFP 1.4% per year). Yao and Jiang (2007) examines technical efficiency and the impact of corporate governance and risk taking behavior on Chinese banks from 1995-2005. The authors find that SOCBs are less technically efficient (average efficiency 70%) than non-state owned banks and banks subject to hard budgetary discipline perform more efficiently than SOCBs. Podpiera (2006) finds that SOCBs credit expansion has slowed but behavioral practices have not changed substantially concerning credit risk pricing and lending decisions, driven primarily by funding inflows from deposits where rates are officially set rather than commercial profit operations. The SOCBs continue to lose lending market shares to other financial institutions.

Foreign participation in the banking sector also increasingly plays a significant role in how Chinese banks perform and evolve in the face of global competition. Leigh and Podpiera (2006) find that despite the limited control and minority ownership in Chinese banks, foreign banks realize higher interest margins and higher profitability than domestic banks. Xu and Lin (2007) argue that the competitive edge of foreign banks in expertise and experience will lead to a loss of RMB deposits and loans by domestic banks. Mao and Li (2009) find their empirical results support the premise that domestic banks are increasingly facing greater foreign entry competition by lowering their interest margins and experiencing lower before-tax profits. For an extensive review of the Chinese banking system evolution and reforms, since the 1990s -2005, see Garcia-Herrero et al. (2005). Other reviews of the banking reforms are provided by Cho (1999), and Hope and Hu (2006).

III. CHINESE BANKING REFORMS

China is still essentially a bank-dominated financial system. The 1998 mounting NPLs of the banks forced the government to adopt international banking standards of bad loans classification and recapitalization. A similar U.S. Federal Reserve banking system framework was adopted, the Peoples Bank of China (PBC). The 31 provincial bank branches were replaced with nine regional central-bank branches: Tianjin, Shenyang, Shanghai, Nanjing, Jinan, Wuhan, Guangzhou, Chengdu, and Xian. Regional bank branches have less autonomy on lending decisions based on cozy relationships. The goal is to stop the *guangxi* and corruption that grew from the opportunistic free-for-all environment following the liberalization of the financial markets and end the influence of the regional governments. Conflicts still exist between the provincial government and the new branches of the PBC.

Banking reforms were also implemented to strengthen the regulation and supervision of the four SOCBs and to comply with the international Basle Standards. In 1999, an internal supervisory board for each of the SOCBs, consisting of members from the PBC, the Ministry of Finance (MoF), the National Auditing Office, and other

government agencies, was created to monitor bank performance and behavior of the bank's board of directors. Management accountability, however, is to the supervisory board rather than stockholders with the potential for graft and corruption. The current policy is to rotate managers; and those who neglected their duties, have weak performances, incurred growing losses or bad loans would be removed from office and replaced.

One of the most important reforms undertaken by the Chinese government is the semi-privatization through the IPOs of the SOCBs in 2005, 2006 and 2010 (Table 1) to inject much needed capital into the failing SOCBs.

Table 1
SOCBs IPOs, exchange listing and amount of capitalization

| Bank | Exchange Listing | Amount |
|---|--|---|
| China Construction Bank | Hong Kong listing, October 17, 2005 | US\$ 9.2 billion in the world's largest IPO of 2005 |
| Bank of China | Shanghai listing, July 1, 2006 | US\$11.2 billion in 2006 |
| Industrial and Commercial Bank of China | Shanghai and Hong Kong listing, October 27, 2006 | US\$ 21.9 billion, a world record in IPO capitalization at that point in time |
| Agricultural Bank | Shanghai and Hong Kong listing, July 15, 2010 | US\$22.1 billion, a world record at that point in time |

A number of reforms were undertaken by the authorities in preparing for the IPOs: (i) the SOCBs were recapitalized with foreign exchange reserves and NPLs were transferred to the AMCs; (ii) a system of corporate governance structure and risk management were implemented; (iii) reputable external auditors were used to determine the banks' true financial conditions; and, (iii) strategic foreign investors participated in the IPOs. The new corporate governance structure implemented provides for the conventional shareholders' meeting and the board of directors and top management follow a set of operational rules. Although the board of directors is invested with final decision making, in practice the board has nominal control (Podpiera, 2006). The participation of foreign banks in the IPOs signals a greater measure of openness. However, foreign ownership in a Chinese bank is still a minority limited to only 19.9% for a single investor.

With the elimination of the four SOCBs' monopoly in 2006 (under the WTO agreement), the protected Chinese financial markets are now opened to foreign competition. The centralized bureaucratic banking system and the inability to respond quickly to changing market conditions poses a problem for the banks to become profitable and efficient. Local depositors and corporations now have greater access to foreign banks that are more efficient and can offer better quality services and more choices of banking and investment products. The drying up of captive deposit flows into the four SOCBs may pose a serious threat to the banks' ability to absorb their

NPLs. The SOCBs now face global competition as the Chinese banking market opens to foreign banks and financial institutions. The performance of the SOCBs has improved after NPLs were transferred to the AMC's resolution institutions and the recapitalization of the banks through IPOs (Table 2).

Table 2
Performance measures of some Chinese banks

| Bank | ROA (2006) | ROA (2007) | ROE (2006) | ROE (2007) | Gross NPLs/gross advances to customers | |
|--|---------------|---------------|---------------|---------------|--|-------|
| | | | | | 2006 | 2007 |
| Industrial and Commercial Bank of China | 0.66 | 0.94 | 0.10 | 0.15 | 3.79 | 2.74 |
| China Construction Bank | 0.85 | 1.06 | 0.14 | 0.16 | 3.29 | 2.60 |
| Agriculture Bank of China | 0.10 | 0.20 | 0.06 | 0.13 | 23.34 | 23.50 |
| Bank of China | 0.90 | 1.03 | 0.12 | 0.14 | 4.04 | 3.12 |
| China Development Bank | 1.19 | 1.02 | 0.17 | 0.08 | 0.72 | 0.59 |
| Bank of Communications | 0.73 | 0.98 | 0.14 | 0.16 | 2.54 | 2.05 |
| China Merchant Bank | 0.73 | 1.16 | 0.12 | 0.22 | 2.12 | 1.54 |
| Agricultural Development Bank of China | 0.04 | 0.14 | 0.02 | 0.07 | 7.65 | 6.29 |
| China CITIC Bank | 0.53 | 0.82 | 0.12 | 0.10 | 2.50 | 1.48 |
| China Minsheng Banking | 0.52 | 0.69 | 0.19 | 0.13 | 1.38 | 1.20 |
| Shanghai Pudong Development Bank | 0.49 | 0.60 | 0.14 | 0.19 | 1.83 | 1.46 |
| Industrial Bank | 0.62 | 1.01 | 0.23 | 0.22 | 1.54 | 1.15 |
| Average | 0.61 | 0.80 | 0.13 | 0.15 | 4.56 | 3.98 |

IV. THE CHINESE BANKING ENVIRONMENT

An endemic banking crisis can be caused by excessive government involvement. Transitional countries like China is well known for government targeted policy lending, particularly to insolvent SOEs and favored regional projects, to drawing on the banking system to finance government budget, conditions that can lead to banking failures. The Chinese government is faced with the hard choice of keeping insolvent state enterprises afloat while appeasing potential social unrest from rising unemployment when inefficient state-owned enterprises are closed.

Regional and local governments through political cronyism have been known to use the banks as a source of funding regional projects to win approval from the central authorities. Bank bureaucrats are rewarded more for party loyalty with greater

incentives to conceal worsening problems. The deferment or concealment of problems weakens the banking system, given that the loans are understood to be implicitly irrecoverable. Bank managers consider their primary function is to implement the directives of the central authority and have no market-based, profit-seeking incentives. Local and regional political interference in lending decisions is pervasive. An example of the pervasive government involvement at all levels of banking operations can be seen when to cool overheating in the economy in 2004 the Chinese government directed smaller banks to curb new lending, imposed restrictions on investments, and instituted new price controls.

The Chinese financial and credit infrastructure is still rudimentary and trained banking personnel are scarce. The banks, operating in a highly bureaucratic environment, face difficulty in being able to practice prudent market disciplines. Record keeping and data collection, external auditing, and internal controls are typically not widely practiced. Reliable and accurate data to perform risk assessment on clients is therefore difficult. Clients often misrepresent their financial information and lenders have no credible source to substantiate its authenticity. Risk shifting is not an option since the Chinese government does not permit loan securitization.

Growing social unrest from a widening income and economic disparity is another concern. Although less affected by the global contagion from the U.S. sub-prime mortgage crisis in 2009, nevertheless the global recession has hit China's export dominated sectors. The closing of factories and lay-off of migrant workers have led to dissatisfaction and unrest.

The extent of the embezzlement and looting of the state banks¹ was uncovered in preparing for the IPOs of the three state-owned banks in 2005 and 2006. In 2005, the Chinese government uncovered 240 embezzlement cases in the four state commercial banks totaling more than US\$198 million (RMB 1.6billion). In 2006, the embezzlement amounted to almost US\$10 billion (RMB 70 billion) since 1998 (Forbes 2007). Although a corporate governance system is in place, the difficulty in establishing an effective internal control is partly due to the accepted Chinese culture of graft and the insidious corruption from personal connections.

The government seems to be pursuing contradictory policies. The banking reforms have the appearance of market orientation. However, in practice the government continues to implement policy directives, channel savings from the banking system to meet policy goals, have majority state ownership in the banking sector, and set credit pricing and lending policies while bank managers play a nominal role in decision-making.

V. METHODOLOGY AND EMPIRICAL FINDINGS

The study compares Chinese banks by creating clusters containing banks representing similar efficiency level. Traditional financial indicators such as ROA and ROE measure efficiency in a one-dimensional problem. Our study provides a more in-depth analysis of the many characteristics of efficiency measures. We conducted a multidimensional analysis by constructing aggregated efficiency measures and clustering objectives and classifying the banks to homogenous classes.

In our study, we employ unsupervised classification methods that consist of ranking and clustering objects. The procedure of classification consists of several stages:

1. The selection of diagnostic variables that should not be strongly correlated among themselves.
2. The selection of the classification methods.
3. The normalization of variables that is necessary to make all diagnostic variables comparable.
4. The evaluation of taxonomic measures for every object and period.
5. The classification of objects (banks) into defined classes.

A. Data Description

The data is from KPMG Banking Survey 2008² based on 18 financial performance indicator variables and key ratios of 72 Chinese banks for 2006 and 2007. The ratio indicators are: ROA (return on assets), ROE (return on equity), ROS (return on sales), PM (profit margin), EM (equity multiplier), NLDR (net loan/ deposit ratio), GNPLR (gross NPLs/ gross advances to customers ratio); and the variables in millions of RMB are: NII (net interest income), NI (non- interest income), OE (operating expenses), OPBP (operating profit before provisions), PBT (profit before tax), NPAT (net profit after tax), TA (total assets), GATC (gross advances to customers), TDFC (total deposits from customers), TE (total equity) and GNPL (gross non- performing loans). Of the 18 variables, 15 variables are stimulants and 3 are de-stimulants. The de-stimulants are: OE - operating expenses, GNPL - gross non- performing loans and GNPLR - gross NPLs/ gross advances to customers ratio.

We select the diagnostic variables by constructing three sets of diagnostic variables, denoted by A, B and C (Table 3). Set A contains all 18 variables while the two other sets are constructed by eliminating strongly correlated variables for both years separately. There are nine diagnostic variables in years 2006 and 2007 in Set B and seven variables which are common to both years in Set C.

Table 3
Discriminant variables selected in each set

| Set A: 2006 and 2007 | Set B 2006 | Set B 2007 | Set C: 2006 and 2007 |
|--|--|---|----------------------------------|
| ROA, ROE, ROS, PM, EM, NLDR, GNPLR, NII, NI, OE, OPBP, PBT, NPAT, TA, GATC, TDFC, TE, GNPL | ROA, ROE PM, EM, NLDR, GNPLR, OE, NI, TE | ROA, ROE PM, EM, NLDR, GNPLR, OE, ROS, OPBP | ROA, ROE PM, EM, NLDR, GNPLR, OE |

Therefore, the three sets of variables constructed are:

- Set A containing all 18 variables (common to both years of analysis),
- Set B containing 9 selected variables (different sets for each year of analysis),
- Set C containing 7 selected variables common to both years.

B. Construction of the Synthetic Measures

For our study, we chose methods that are well known, simple from the mathematical point of view and easy for interpretation. These methods are classical distance measures (described in the Appendix):

- synthetic development measure (SMR) defined by (1) – (7) in two variants, denoted by SMR(a) and SMR(b) that differs by formulas (5) – (7) [(a) and (b)];
- relative development indicator (BZW) defined by (8).

We use three different synthetic (aggregated) taxonomic measures:

$$MR = \{SMR(a), SMR(b), BZW\}$$

These measures are constructed for the three previously defined sets of variables A, B and C, that is, for every set we have three different indicators:

$$\begin{aligned} MR(A) &= \{SMR(a, A), SMR(b, A), BZW(A)\}, \text{ constructed for Set A,} \\ MR(B) &= \{SMR(a, B), SMR(b, B), BZW(B)\} \text{ constructed for Set B, and} \\ MR(C) &= \{SMR(a, C), SMR(b, C), BZW(C)\} \text{ constructed for Set C.} \end{aligned}$$

In the next step we evaluate the values of all nine measures:

$$\begin{aligned} MR &= \{MR(A), MR(B), MR(C)\} \text{ for 72 banks and for two years of analysis,} \\ MR &= \begin{cases} MR(2006) \\ MR(2007) \end{cases} . \text{ For the values of all measurements,} \\ MR &= \begin{cases} MR(2006) = \{MR(A, 2006), MR(B, 2006), MR(C, 2006)\}, \\ MR(2007) = \{MR(A, 2007), MR(B, 2007), MR(C, 2007)\}, \end{cases} \end{aligned}$$

we constructed 18 different rankings for the banks under study.

Since the ranking indicates the position of a certain object (bank) in a multidimensional space³ of 72 banks, it is difficult to draw conclusions about their efficiency. Therefore, to make the comparisons possible, we clustered together similar objects by constructing four clusters⁴ of classification defined as follow (see Malina, 2004):

- 1 – Efficient banks for $MR_{it} \geq MR_t + S_{MRt}$;
- 2 – Good banks for $MR_t + S_{MRt} > MR_{it} \geq MR_t$;
- 3 – Average banks for $MR_t > MR_{it} \geq MR_t - S_{MRt}$;
- 4 – Inefficient banks for $MR_{it} < MR_t - S_{MRt}$.

$$\text{where } MR_t = \frac{1}{n} \sum_{i=1}^n MR_{it} \text{ and } S_{MRt} = \sqrt{\frac{1}{n} \sum_{i=1}^n (MR_{it} - MR_t)^2}.$$

Then we classify all the banks into four homogenous groups of banks in terms of their efficiency level⁵ to obtain 18 classifications for each of the 72 banks. Since these independent classifications (obtained for each bank) are not synonymous⁶, we employed a majority vote rule to choose the best classifier⁷. Based on the majority vote rule, the i -th object belongs to the class when it is classified into that group most often. In our study, we apply this rule to find the efficiency class for every bank for:

- each type of measure SMR(a), SMR(b) and BZW, and year separately, where all types of indicators are calculated for the three sets of variables i.e. we recognize the bank as a member of the most often chosen class (among the three indicator sets), for instance, $SMR(a) = \{SMR(a, A), SMR(a, B), SMR(a, C)\}$, etc.;
- all measurements in both years $MR = \{MR(2006), MR(2007)\}$, i.e. we recognize the bank as a member of the most often chosen class (among the 18 classifications).

C. Results of Classifications

We constructed synthetic taxonomic measures to evaluate the efficiency of the Chinese banks in a multidimensional space. On the basis of the calculated indicators (SMR(a), SMR(b) and BZW), using the defined efficiency classes (1 – 4) and majority vote rule, we classified the banks into the four classes containing banks similar in efficiency measurement. The i -th bank is classified to group l -th if in two or more classifications made by a certain indicator in one of the analyzed years recognized the bank as l -th class object. On the other hand, if a bank is classified to different classes by a certain method (and it is possible since we have three sets of variables and four classes) than the majority vote rule does not work and we cannot classify that bank into any group; then such a case is denoted blank in Table 4. There are also cases when a bank is classified to one class by all indicators constructed for a certain measure but with three different sets of variables (A, B and C). These are denoted by an asterisk (*) in Table 4. In the last stage of our analysis we constructed the aggregate measure independent from time, that is, one classification for both years using the majority vote rule (see Table 5).

In Table 4 all the banks are ranked by total assets (the biggest banks hold first positions) with those highlighted (shaded) in the first two columns denoting banks with foreign investors. Analyzing bank efficiency in a multi-dimensional space using different measures by considering different variables presents problems of classifying banks synonymously. To obtain synonymous classification we apply the majority vote rule with synonymous classification in the majority of the banks as presented in the results in Table 4 and for all banks in Table 5.

For the indicators constructed as SMR(b), half of banks (36) were classified synonymously (regardless of the set A, B or C) in both years. While applying SMR(a)

Table 4
Classification of banks applying majority vote rule for every type of measurement and years
2006-2007 separately

| No | Name of bank (ranked by total assets) | 2006 | | | | 2007 | | | |
|----|--|------------|------------|-----|-----|------------|------------|-----|-----|
| | | SMR (b) | SMR (a) | BZW | MVR | SMR (b) | SMR (a) | BZW | MVR |
| 1 | Industrial and Commercial Bank of China | 1 | | | 1 | | | 2 | 2 |
| 2 | China Construction Bank | 1 | | 2 | (2) | | | 2 | 2 |
| 3 | Agricultural Bank of China | 1 | 3 | | 3 | | | | (3) |
| 4 | Bank of China | 1 | 1 | 1 | 1 | | | | (2) |
| 5 | China Development Bank | 1 * | 1 * | 1 * | 1 | 1 * | 1 | 1 | 1 |
| 6 | Bank of Communications | | | | (2) | | | | (2) |
| 7 | China Merchants Bank | 2 | 2 | 2 | 2 | 2 | 1 | 2 * | 2 |
| 8 | Agricultural Development Bank of China | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 2 |
| 9 | China CITIC Bank | | 3 | 3 | 3 | 3 | | | 3 |
| 10 | China Minsheng Banking | 3 | 2 * | 2 * | 1 | 3 | | | 3 |
| 11 | Shanghai Pudong Development Bank | 2 | | | 2 | 3 | 2 | 2 * | 2 |
| 12 | Industrial Bank | 2 * | 1 | 1 | 2 | 2 | 2 | 2 | 2 |
| 13 | Hua Xia Bank | 4 | | 3 | 3 | 3 | 2 | 2 | 2 |
| 14 | Bank of Beijing | 3 * | 2 * | 2 * | 2 | 3 * | | 3 | 3 |
| 15 | Shenzhen Development Bank | 2 | 2 | 2 | 2 | 3 | 1 | 2 | 2 |
| 16 | Bank of Shanghai | 3 * | | | 3 | 3 * | | | 3 |
| 17 | Beijing Rural Commercial Bank | 3 * | | 4 | 3 | 4 | 4 | 4 | 4 |
| 18 | Shenzhen Ping An Bank | 3 * | 3 | 4 | 3 | 3 | 2 | 2 | 2 |
| 19 | Huishang Bank | 1 | 1 | 1 | 1 | 3 | 2 | 2 | 2 |
| 20 | Bank of Tianjin | 3 * | 3 * | 3 * | 3 | 3 * | 3 * | 3 * | 3 |
| 21 | Bank of Dalian | 3 * | 2 | 3 | 3 | 3 * | 3 | 2 | 3 |
| 22 | Bank of Nanjing | 3 * | 2 | 2 | 3 | 3 * | 3 | 3 * | 3 |
| 23 | Bank of Ningbo | 2 | 2 | 2 | 2 | 3 * | 3 | 2 | 3 |
| 24 | Bank of Hangzhou | 3 | 2 * | 2 * | 2 | 3 * | 2 * | 2 * | 2 |
| 25 | Bank of Dongguan | 2 | 2 * | 2 * | 2 | 3 * | 2 | 2 | 2 |
| 26 | Baoshang Bank | 2 | 2 | 2 | 2 | 3 * | 2 | 2 | 3 |
| 27 | Bank of Chongqing | 3 | 3 * | 3 | 3 | 3 * | 2 | 2 * | 2 |
| 28 | Xi' An City Commercial Bank | 3 * | 4 * | 4 * | 4 | 3 * | 4 * | 4 * | 4 |
| 29 | Jinan City Commercial Bank | 3 * | 3 * | 3 * | 3 | 3 * | 3 * | 3 * | 3 |
| 30 | Fuzhou City Commercial Bank | 3 * | 2 | 2 | 2 | 3 * | 2 | 2 | 2 |
| 31 | China Bohai Bank | 4 | 4 * | 4 * | 4 | 3 | 4 | 4 | 4 |
| 32 | Bank of Qingdao | 3 * | 4 | 4 * | 4 | 3 * | 3 | 3 | 3 |
| 33 | Commercial Bank of Zhengzhou | 3 * | | 3 | 3 * | 3 * | 3 | 3 | 3 |
| 34 | Bank of Wenzhou | 3 * | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| 35 | Bank of Lanzhou | 3 * | 4 | 4 * | 4 | 3 * | 4 * | 4 * | 4 |
| 36 | Jiangyin Rural Commercial Bank | 3 * | 2 | 2 | 3 | 3 * | 2 | 1 | 3 |
| 37 | Bank of Nanchang | 3 * | 3 * | 3 * | 3 | 3 * | 4 | 4 | 3 |

Table 4 (continued)

| No | Name of bank (ranked by total assets) | 2006 | | | | 2007 | | | |
|----|---|------------|------------|---------|-----|------------|------------|-----|-----|
| | | SMR (b) | SMR (a) | BZ W | MVR | SMR (b) | SMR (a) | BZW | MVR |
| 38 | Ningbo Yinzhou Rural Cooperative Bank | 3 * | 3 * | 3 | 3 | 3 * | 2 | 2 | 3 |
| 39 | Yinchuan City Commercial Bank | 1 | 2 | 2 | 2 | 3 * | 3 * | 3 * | 3 |
| 40 | Shaoxing City Commercial Bank | 3 * | 2 | 2 | 3 | 3 * | 3 * | 3 * | 3 |
| 41 | Commercial Bank of Luoyang | 3 * | 3 * | 3 * | 3 | 3 * | 3 * | 3 * | 3 |
| 42 | Wujiang Rural Commercial Bank | 3 * | 2 * | 2 | 2 | 3 * | 2 * | 2 | 2 |
| 43 | Zibo City Commercial Bank | 3 * | 3 | 3 * | 3 | 3 * | 3 * | 3 * | 3 |
| 44 | Taizhou Commercial Bank | 3 | 2 * | 1 | 2 | 3 * | 2 * | 1 | 2 |
| 45 | Jinhua City Commercial Bank | 3 * | 3 * | 3 | 3 | 3 * | 3 | 3 * | 3 |
| 46 | Linyi City Commercial Bank | 4 | 3 | 3 | 3 | 3 * | 4 | 4 | 3 |
| 47 | First Sino Bank | 2 | 3 | 3 | 3 | 1 | | 2 | 2 |
| 48 | Laishang Bank | 2 | | | 2 | 2 | 2 | 1 | 2 |
| 49 | Dongying City Commercial Bank | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| 50 | Zhejiang Tailong Commercial Bank | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| 51 | Jiaxing City Commercial Bank | 3 * | 3 * | 3 * | 3 | 3 | | 2 | 3 |
| 52 | Zhanjiang Commercial Bank | 1 | 1 | 1 | 1 | 2 | | 1 | (2) |
| 53 | Zhejiang Chouzhou Commercial Bank | 3 | 2 | 2 | 2 | 2 * | 2 * | 2 | 2 |
| 54 | Nanchong City Commercial Bank | 3 | | 2 | 2 | 2 | 2 | 2 | 2 |
| 55 | Panzhuhua City Commercial Bank | 2 | 1 | 1 | 1 | 2 * | 1 | 1 | 2 |
| 56 | Nanning City Commercial Bank | 3 * | 3 * | 3 * | 3 | 3 * | 3 | 4 | 3 |
| 57 | Zhejiang Mintei Commercial Bank | 2 | 3 | 2 | 2 | 3 | 3 * | 3 * | 3 |
| 58 | Xinxiang City Commercial Bank | 3 * | 2 | 3 | 3 | 2 | | 1 | (2) |
| 59 | Quanzhou City Commercial Bank | 3 * | 3 | 4 | 3 | 3 * | 4 | 4 | 3 |
| 60 | Deyang City Commercial Bank | 3 * | 4 | 4 | 3 | 3 * | 3 | 4 | 3 |
| 61 | Jiaozuo City Commercial Bank | 3 * | 3 | 3 | 3 | 3 | 2 | 3 * | 3 |
| 62 | Jiujiang City Commercial Bank | 2 | 2 * | 2 | 2 | 2 | 2 | 2 | 2 |
| 63 | Huzhou City Commercial Bank | 3 | 2 | 2 | 2 | 3 | 2 * | 2 * | 2 |
| 64 | Mianyang City Commercial Bank | 3 | 3 | 3 * | 3 | 3 | 3 | 3 * | 3 |
| 65 | Cangzhou City Commercial Bank | 3 * | 2 | 3 | 3 | 3 | 2 * | 2 * | 2 |
| 66 | Guilin City Commercial Bank | 3 * | 3 * | 3 | 3 | 3 | 3 | 3 * | 3 |
| 67 | Ganzhou City Commercial Bank | 2 | | | 2 | 2 * | 2 | 1 | 2 |
| 68 | Heng Yang City Commercial Bank | 3 * | 4 | 3 | 3 | 3 * | 4 * | 4 | 4 |
| 69 | Chengde City Commercial Bank | 2 * | 1 | 1 | 2 | 2 | 1 * | 1 * | 1 |
| 70 | Shangrao City Commercial Bank | 4 | 3 | | (3) | 4 * | 4 | 4 | 4 |
| 71 | Huangshi City Commercial Bank | 3 * | 3 | | 3 | 2 | 1 | 2 | 2 |
| 72 | Xiaogan City Commercial Bank | 3 * | | | 3 | | 1 | 1 | 1 |
| | Number of banks that are not classified | 2 | 11 | 10 | 0 | 6 | 13 | 6 | 0 |
| | Number of banks that are classified synonymously | 36 | 20 | 17 | 69 | 36 | 17 | 21 | 67 |

and BZW, only 26% of banks were classified to the same class regardless of the variable set. If for each set of variables the bank is classified to a different class of efficiency, then we cannot conclude the certain class of efficiency for that bank. The biggest count of unclassified banks is observed for SMR(a) (11 and 13 banks in years 2006 and 2007, respectively), and BZW (10 and 6 banks in years 2006 and 2007, respectively). In comparing the classifications of the 72 banks for the two analyzed years, the biggest number of them (46 banks) were classified in the same way by SMR(b), 37 banks by BZW, and 29 by SMR(a).

From Table 4 we see that in the case of the Bank of Communications (holding the 6th position in total assets ranking), and using the majority voting rule (for every type of measurement and different sets of variables, and years) we have the most difficulty in classifying the bank since each set of variables generated a different class for that object. We also could not classify the first four banks, i.e., Industrial and Commercial Bank of China, China Construction Bank, Agricultural Bank of China and Bank of China, into one class since each of the synthetic measures recognizes these banks as members of a different class. The solution in such a case, when we cannot recognize the class of efficiency on the basis of each aggregated measure, is to apply the majority voting rule (MVR) independent of the method of analysis, and also from the year of investigation. Then there are more results of classification (9 for each year of study and 18 for both years) and the application of the majority-voting rule is more applicable. For example, the classification results, regardless of the taxonomic measure, are presented in Table 4 in columns denoted by MVR. Again the results indicated that the Bank of Communications for both years, as well as China Construction Bank, Agricultural Bank of China and Bank of China together with three smaller banks (Zhanjiang Commercial Bank, Shangrao City Commercial Bank and Xinxiang City Commercial Bank) for one year cannot be synonymously classified. Therefore, in such cases the class of efficiency is the mathematical average class determined by the different methods and variable sets for each year denoted by parenthesis in the MVR column. Applying that solution all banks are classified although not all of them synonymously.

However, in the classification that is independent from time (Table 5), it is clear that the biggest banks belong to the first two efficiency groups and can be considered as efficient and good banks. China Development Bank (which holds the 5th position in total assets ranking) was found to be an efficient bank (belonging to the first class), and in 2006 all measures (regardless of the set of variables that was employed for the measure construction) show the same results indicated by an asterisk (*). Looking at this bank, we see that it is efficient in both years for 2006 and 2007. Among the five biggest banks two of them (China Development Bank and Agricultural Bank of China) have no foreign investors during the period under study.

In Table 5, the Chinese banks are ranked according to their membership in the certain class of efficiency regardless of the period of analysis, type of measures and set of diagnostic variables. There are five banks that are classified as efficient: Bank of China, China Development Bank, Zhanjiang Commercial Bank, Panzhihua City Commercial Bank, Chengde City Commercial Bank, although three of which are rather small since they hold the 52nd, 55th and 69th position in total assets ranking, respectively.

Table 5
Classification of banks applying majority vote rule independent from time

| Rank by total assets | Name of bank | Class | Rank by total assets | Name of bank | Class |
|----------------------|---|-------|----------------------|---------------------------------------|-------|
| 4 | Bank of China | 1 | 71 | Huangshi City Commercial Bank | 2 |
| 5 | China Development Bank | 1 | 72 | Xiaogan City Commercial Bank | 2 |
| 52 | Zhanjiang Commercial Bank | 1 | 9 | China CITIC Bank | 3 |
| 55 | Panzhuhua City Commercial Bank | 1 | 13 | Hua Xia Bank | 3 |
| 69 | Chengde City Commercial Bank | 1 | 14 | Bank of Beijing | 3 |
| 1 | Industrial and Commercial Bank of China | 2 | 16 | Bank of Shanghai | 3 |
| 2 | China Construction Bank | 2 | 18 | Shenzhen Ping An Bank | 3 |
| 3 | Agricultural Bank of China | 2 | 20 | Bank of Tianjin | 3 |
| 6 | Bank of Communications | 2 | 21 | Bank of Dalian | 3 |
| 7 | China Merchants Bank | 2 | 22 | Bank of Nanjing | 3 |
| 8 | Agricultural Development Bank of China | 2 | 27 | Bank of Chongqing | 3 |
| 10 | China Minsheng Banking | 2 | 29 | Jinan City Commercial Bank | 3 |
| 11 | Shanghai Pudong Development Bank | 2 | 32 | Bank of Qingdao | 3 |
| 12 | Industrial Bank | 2 | 33 | Commercial Bank of Zhengzhou | 3 |
| 15 | Shenzhen Development Bank | 2 | 37 | Bank of Nanchang | 3 |
| 19 | Huishang Bank | 2 | 38 | Ningbo Yinzhou Rural Cooperative Bank | 3 |
| 23 | Bank of Ningbo | 2 | 39 | Yinchuan City Commercial Bank | 3 |
| 24 | Bank of Hangzhou | 2 | 40 | Shaoxing City Commercial Bank | 3 |
| 25 | Bank of Dongguan | 2 | 41 | Commercial Bank of Luoyang | 3 |
| 26 | Baoshang Bank | 2 | 43 | Zibo City Commercial Bank | 3 |
| 30 | Fuzhou City Commercial Bank | 2 | 45 | Jinhua City Commercial Bank | 3 |
| 34 | Bank of Wenzhou | 2 | 46 | Linyi City Commercial Bank | 3 |
| 36 | Jiangyin Rural Commercial Bank | 2 | 51 | Jiaxing City Commercial Bank | 3 |
| 42 | Wujiang Rural Commercial Bank | 2 | 56 | Nanning City Commercial Bank | 3 |

Table 5 (continued)

| Rank by total assets | Name of bank | Class | Rank by total assets | Name of bank | Class |
|----------------------|-----------------------------------|-------|----------------------|---------------------------------|-------|
| 44 | Taizhou Commercial Bank | 2 | 57 | Zhejiang Mintei Commercial Bank | 3 |
| 47 | First Sino Bank | 2 | 59 | Quanzhou City Commercial Bank | 3 |
| 48 | Laishang Bank | 2 | 60 | Deyang City Commercial Bank | 3 |
| 49 | Dongying City Commercial Bank | 2 | 61 | Jiaozuo City Commercial Bank | 3 |
| 50 | Zhejiang Tailong Commercial Bank | 2 | 64 | Mianyang City Commercial Bank | 3 |
| 53 | Zhejiang Chouzhou Commercial Bank | 2 | 66 | Guilin City Commercial Bank | 3 |
| 54 | Nanchong City Commercial Bank | 2 | 68 | Heng Yang City Commercial Bank | 3 |
| 58 | Xinxiang City Commercial Bank | 2 | 17 | Beijing Rural Commercial Bank | 4 |
| 62 | Jiujiang City Commercial Bank | 2 | 28 | Xi' An City Commercial Bank | 4 |
| 63 | Huzhou City Commercial Bank | 2 | 31 | China Bohai Bank | 4 |
| 65 | Cangzhou City Commercial Bank | 2 | 35 | Bank of Lanzhou | 4 |
| 67 | Ganzhou City Commercial Bank | 2 | 70 | Shangrao City Commercial Bank | 4 |

We also consider if there is any relationship between foreign investments and bank efficiency, defined before as belonging to the certain class. The results obtained imply that the presence of foreign capital does not improve the efficiency of the Chinese banks since banks with foreign investment belong to each class, even to the worse one. This result is supported by the chi-square test for independence because we could not reject the null hypothesis that bank efficiency and foreign investments are independent at the significance level of 0.05 or 0.01.

The four SOCBs are classified in the two top efficiency classifications with the Bank of China classified as the most efficient although ranked 4th in total assets after Industrial and Commercial bank of China, China Construction Bank and Agricultural Bank of China, respectively. The SOCBs have improved in efficiency after the NPLs resolution by the government and the injection of IPO capitalization as supported by our results, although we cannot conclude that foreign investment improved the banks' efficiency.

The majority of the Chinese banks are classified as belonging to the second and third efficiency class as either good or average banks. There are five inefficient banks (belonging to the last class): Beijing Rural Commercial Bank (17th position in total assets), Xi' An City Commercial Bank (28th position and foreign investments), China

Bohai Bank (31st position and foreign investments) and Shangrao City Commercial Bank (70th position).

However, our study only looks at a comparison of efficiency among the Chinese banks by ranking the Chinese banks according to a defined efficiency classification. Asset size does not seem to play a big role in improving a bank's efficiency nor does the presence of foreign investment. The biggest SOCBs in asset size (63.3% in total assets in 2007) are not necessarily the most efficient compared to some of the smaller banks, except for the Bank of China.

Our results may imply that the SOCBs are still highly bureaucratic and tightly controlled through government directive despite the restructuring and reforms that have been implemented. The limited ownership share allowed foreign banks in domestic Chinese banks may be a factor as to why foreign presence is not significant in improving the efficiency of the local banks and that the level of corporate governance and market disciplines may still need to improve further.

VI. CHALLENGES FOR CHINESE BANKS

The recognition and attempts to resolve the massive NPLs are admittance by the government of the fragility of the Chinese banking system. The crackdown by the government on the pervasive corruption and embezzlement has not eliminated the problem. The lack of transparency and burdensome bureaucracy not only imposes cost on the banks doing business in China but also encourages the embezzlement. Until the Chinese government privatizes the banking system and take on only the regulatory and supervisory role and the lender of last resort, the banking system will not develop vibrantly through market disciplines and incentives to one comparable to western banking sophistication and standards.

Fundamental behavioral changes in the Chinese banking culture have not been as forthcoming despite the push for new reforms and structural changes in governance. Improving the corporate culture is a step forward to better bank performance. Commercial lending practices based on strong market based incentives and risk management rather than central government policy directives are still not the norm. Banking operations still tend to be bureaucratic and inefficient. The Chinese banks need to follow sound commercial banking principles rather than accede to government pressure to achieve bank performance. Reducing the degree of government intervention and ownership in the banking sector would help the Chinese banks to improve on their bank performance.

VII. CONCLUSION

The bad debt problems plaguing the Chinese banking system have been reprieved through the purchase of the NPLs by the AMC's government resolution agencies from the books of the major Chinese banks and with the injection of new capital from IPOs and selling minority stakes to foreign banks. The Chinese banks, in particular the SOCBs, seem to have improved in efficiency based on our results of efficiency measurements. We can conclude that the SOCBs that make up the biggest share of the Chinese banking market are maintaining their efficiency in the top two levels compared

to other Chinese banks. However, their efficiency may not be comparable to banks in developed countries.

For Chinese banks to achieve sustained performance in an increasing competitive banking market, the government should (i) promote strong incentives based on commercial profitability; (ii) privatize the banking sector by reducing government ownership; (iii) restructure the banking operations to improve transparency and reduce the bureaucracy that tends to engender embezzlement and corruption; and (iv) develop a consistent and an unbiased legal, regulatory and supervisory system that enforce and protect investor's rights. Ultimately, liberalizing the financial system fully should be the goal of the Chinese government if the Chinese banks are to meet the challenges of global competition and play a significant role in the global financial stage.

APPENDIX

In our analysis, we apply several composite indicators (MR), such as SMR and BZW that are evaluated for each bank and every year of analysis. The synthetic development measure (SMR) defines the distance between the benchmark and analyzed bank in the efficiency level. The benchmark is defined as the hypothetical object that is characterized by maximal values of stimulants (de-stimulants are transformed into stimulants). Maximal and minimal values are estimated for every year separately (based on all the banks). Therefore, for the i -th bank in t -th period of time, the value of the taxonomic measure SMR_i is defined as (see Hellwig, 1968):

$$SMR_i = 1 - \frac{q_i}{q_0} \quad i = 1, 2, \dots, n; \quad (1)$$

where q_i is the distance of the i -th object from the benchmark:

$$q_i = \sqrt{\sum_{j=1}^k v_j (z_j^i - z_j^0)^2} \quad (2)$$

evaluated for weights v_j and standardized variables z_j^0 , z_j^i that describe the benchmark and the i -th investigated bank, respectively. The benchmark is defined as:

$$z_j^0 = \max_{i=1,2,\dots,n} \{z_j^i\} \text{ for } z_{S_j}^i \quad (3)$$

where for the j -th variable:

$$z_j^i = \frac{x_j^i - \bar{x}_j}{S_j^x} \quad (4)$$

where z_j^i is standardized variables; x_j^i is observations of raw variables for the i -th country; \bar{x}_j , S_j^x - average and standard deviation, respectively; and $z_{S_j}^i$ are variables describing stimulants.

The synthetic indicator SMR is constructed in two variants of:

- the denominator in formula (1):

$$q_0 = \max\{q_i\} \quad (5a)$$

$$q_0 = \bar{q} + 2 \cdot S_q \quad (5b)$$

transformation method of de-stimulants x_{Dj}^i into stimulants x_{Sj}^i

$$x_{Sj}^i = -x_{Dj}^i \quad (6a)$$

$$x_{Sj}^i = \frac{1}{x_{Dj}^i} \quad (6b)$$

- weights v_j in formula (2):

$$v_j = \frac{1}{k} \quad (7a)$$

$$v_j = \frac{S_j^x / \bar{x}_j}{\sum_{j=1}^k S_j^x / \bar{x}_j} \quad (7b)$$

where \bar{q} and S_q is the average and the standard deviation of distances q_i , respectively.

In other words, for variant (a) the weights are constant and in variant (b) the weights depend on the variability of the discriminant variables. The measure is constructed using the formulas (1) – (4) and (5a) – (7a) which is denoted as SMR(a) while the indicator evaluated for (1) – (4) and (5b) – (7b) is denoted as SMR(b).

Constructing the SMR requires the determination of the benchmark, which may cause some problems. To overcome these problems, we also use the relative development indicator (BZW) which is a synthetic taxonomic measure that does not need the benchmark definition and for the stimulants it is given by the following formula (see Łuniewska and Tarczyński, 2006):

$$BZW_i = \frac{\sum_{j=1}^k \left(z_j^i + \left| \min_i \{z_j^i\} \right| \right)}{\sum_{j=1}^k \max_i \left\{ z_j^i + \left| \min_i \{z_j^i\} \right| \right\}} \quad (8)$$

where for $i=1,2,\dots,n; j=1,2,\dots,k$ de-stimulants are transformed into stimulants based on formula (6a), and z_j^i is obtained based on formula (4).

ENDNOTES

1. China Daily (2005). "Banks Uncover 894 Corruption Cases." http://www.chinadaily.com.cn/english/doc/2005-11/09/content_492785.htm.
2. KPMG Mainland China Banking Survey 2008, p. 18-30. We employ only data that is complete for both years 2006 and 2007.
3. The dimension of space k (for each bank and every year of analysis) is defined by the number of variables used in the measurement construction. Therefore, for every measure (and there are 9 of them) we consider separately k variables and 72 banks, for instance for BZW(A) we have $k = 18$ variables and 72 banks, BZW(B) - $k = 9$ variables and 72 banks and BZW(C) - $k = 7$ variables and 72 banks.
4. Clusters = classes = groups
5. We have three measures (defined by different formulas as: SMR(a), SMR(b) and BZW) and three sets of diagnostic variables (A, B and C, containing all 18, 9 or 7 variables). Therefore, we have $3*3=9$ different indicators. These measures are evaluated for the year 2006 and for 2007, i.e. we have 9 (values of indicators) *2 (years)=18 values of measures, that are calculated for each bank separately. (We analyzed $72*18=1296$ measurements). Based on the indicator values we classify each bank to the certain (among four defined) class of efficiency. Therefore, we have (9 values of indicators * 2 years) =18 classifications for each bank.
6. i.e. not the same - based on different measures (that take into account different features) the bank can belong to different classes.
7. Majority vote rule is applied when the aggregated classifier is constructed. The goal is to obtain an aggregate classifier to achieve maximum recognition gains with the lowest number of classifiers. The final decision is made following a majority vote rule. If the classifiers made independent errors, the majority vote outperforms the best classifier. Therefore, the aggregate classifier should be formed by classifiers exhibiting individual accuracy and diversity. See Orrite et.al 2008.

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