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A comparative analysis of operational efficiency between Chinese and Indian commercial banks

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Abstract:

Aim: The objective of this paper is to make comparative analysis on operational efficiency between Chinese and Indian commercial banks (CBs).

Design / Research methods: Following the previous scholars' study, two models with different sets of input and output variables have been used to show how efficiency scores vary with change in inputs and outputs. The efficiency scores are measured by using data envelopment analysis (DEA) approach.

Conclusions / findings: The mean technical efficiency score of Chinese CBs is always relatively higher than the corresponding score of Indian CBs in 2012-2013, respectively. In terms of technical efficiency and pure technical efficiency, the performance of foreign banks in China is always relatively lower than that of foreign banks in India.

Originality / value of the article: While many similar studies have evaluated the performance of banking industries in different countries, very few studies have evaluated the performance of banking sectors between Chinese and Indian economies. The paper would be of interest for OR scholars and practitioners in financial industry.

Implications of the research (if applicable): The next step of this study could collect more samples and use Malmquist index method to conduct further study on efficiency, efficiency changing and productivity, in order to conduct further competitive power analysis on both of banking industries of China and India.

Key words: Data envelopment analysis, Commercial banks, China, India.

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1. Introduction

Organization management gets people together for organizational strategic objectives and enables the optimal use of scarce resources through planning, organizing, leading and control at the workplace. Usually, a commercial bank (CB), which is a special service organization, is a type of financial intermediary and of bank that provides services such as accepting deposits, making business loans, and offering basic investment products. Banks are vital organizations in any country as they significantly contribute to the development of an economy through serving customers, and play the major role in economic development.

The objective of this paper is to make comparative analysis of operational efficiency between Chinese and Indian CBs by using data envelopment analysis (DEA) approach introduced by Charnes, Cooper and Rhodes (1978). While many similar studies have evaluated the performance of banking industries in different countries, very few studies have evaluated the performance of banking sectors between Chinese and Indian economies.

Both of China and India belong to developing countries. They are the two most populous countries and fastest growing major economies in the world. In this paper, following the previous scholars' study and using DEA method, with available published data and by setting up two models, we make comparative analysis of operational efficiency (including technical efficiency, pure technical efficiency and scale efficiency) between Chinese and Indian CBs for the span of two years, 2012 and 2013, respectively.

The paper is organized as follows. A brief review of the current state of the Chinese and Indian banking sector is provided in Section 2. In Section 3 methodology is discussed. Section 4 presents the results and Section 5 concludes this paper.

2. A brief overview of the Chinese and Indian banking industry

China and India are separated by the geographical obstacles of the Himalayas. The China's population of in 2013 is about 1.36 billion. India is the second-most populous country over 1.2 billion people. Historically, China and India have had relations for more than 2,000 years. On 1 January 1950, the People's Republic of China established diplomatic relations with the Republic of India. Since then the bilateral economic relationship has been increased significantly.

In China, the CBs are those enterprise legal persons which are established to absorb public deposits, make loans, arrange settlement of accounts and engage in other businesses. CBs shall work under the principles of safety, liquidity and efficiency, with full autonomy and assume sole responsibility for their own risks, profits and losses, and with self-restraint. At the end of 2013, the Chinese banking industry had 3,949 financial institutions with 3.55 million employees. The banks include: 5 large and state-owned CBs (Industrial & Commercial Bank of China, China Construction Bank, Agricultural Bank of China, Bank of China and Bank of Communications), 12 joint-stock CBs, 145 city CBs, 468 rural CBs, 122 rural cooperative banks, 1,803 rural credit cooperatives, one postal savings bank and 42 foreign financial institutions, etc. (China Banking Regulatory Commission 2014).

Since July 2013, the Chinese banks have been free to set their own lending rates. In comparison to their counterparts, the 5 state-owned CBs exhibit strong capabilities and competitiveness compared to either in terms of financial indicators: such as asset scale and profitability. E.g., at the end of 2013, the total sum of assets of 5 big banks is RMB 11.254 trillion (US$ 1.844 trillion), hold 43.34% of total financial asset of the Chinese banking financial institutions (China Banking Regulatory Commission 2014).

The Indian banking industry is broadly classified into scheduled banks and non-scheduled banks. The scheduled banks are further classified into: State Bank of India and its associates; nationalized banks; Indian private sector banks; foreign banks; and regional rural banks. Generally banking in India is fairly mature in terms of supply, product range and reach-even though reach in rural India. The term CBs in India refers to both scheduled and non-scheduled CBs. The CBs are consisted of

public sector CBs, private sector CBs and foreign CBs. Public sector CBs are owned and operated by the government as the government holds a major share in them. A well-operated public sector CB can help state and local governments in getting through cash crunches. The Indian government presently hires the CBs for different purposes like tax collection and refunds, payment of pensions, etc. (Reserve Bank of India 2014).

By 2013 the Indian Banking Industry employed 1.18 million employees and had a total of 109,811 branches in India and 171 branches abroad and manages an aggregate deposit of ₹67,504.54 billion (US$1.1 trillion) and bank credit of ₹52,604.59 billion (US$820 billion). During the financial year Mar 2013-Mar 2014, there were 27 public sector CBs in India out of which 6 were State Bank of India and its 5 associates banks (State Bank of Bikaner and Jaipur, State Bank of Hyderabad, State Bank of Mysore, State Bank of Patiala and State Bank of Travancore), and 21 were nationalized CBs. At the same time, there were 20 private sector CBs, 43 foreign CBs, regional rural banks, cooperative banks, other type banks and financial institutions in India. On the performance of Indian scheduled CBs, in terms of consolidated operations, the consolidated balance sheet of the CBs in 2013-2014 registered a decline in growth in total assets and credit for the fourth consecutive year. With both credit and deposit growth more or less same, the outstanding credit to deposit ratio at the aggregate level remained unchanged at around 79% (Reserve Bank of India 2014).

3. Methodology

3.1. Data envelopment analysis

Charnes, Cooper and Rhodes (1978) introduced DEA as non-parametric efficiency analysis for measuring the efficiency of Decision Making Units (DMUs). Consider a set of J decision-making units (DMUs) with n input and m output in T (t=1,…,T) periods. Assume in time period t, decision-makers are using inputs $x^t \in R_+^n$, to produce outputs $y^t \in R_+^m$. Define the input requirement set in period t, which is:

$L^t(y^t) = \{ x^t: x^t \text{ can produce } y^t\}$.

Assume that $L^t(y^t)$ is non-empty, closed, convex, bounded and satisfies strong disposability property of inputs and outputs. $L^t\ (y^t)$ is bounded from below by the input isoquant (a constant returns to scale (CRS) production boundary), that is:

$$\text{Isoq}L^t\left(y^t\right)=\left\{x^t : x^t \in L^t\left(y^t\right),\ \ \lambda x^t \notin L^t\left(y^t\right) \text{ for } \lambda<1\right\}.$$

Define the input distance function of period *t* as following:

$$D^t\left(y^t, x^t\right)=\sup_{\theta}\left\{\theta : \left(x^t/\theta\right) \in L^t\left(y^t\right),\ \ \theta>0\right\}.$$

Hence, define the technical (or productive) efficiency (TE) in period *t* as following:

$$\text{TE}^t\left(y^t, x^t\right)=1/D^t\left(y^t, x^t\right). \qquad (1)$$

In general, TE＜1, indicates that the DMU under assessment, comparing with other DMUs, is productively inefficient since its production is based on excessive input usage. TE=1, indicates the DMU is fully productively efficient.

It is well known that TE can be further decomposed into the pure technical efficiency (PTE) and scale efficiency (SE) (Banker et al. 1984):

$$\text{TE}=\text{PTE}\times\text{SE}. \qquad (2)$$

In general, as TE, PTE or SE＜1, indicates that the DMU under assessment, comparing with other DMUs, is pure technically inefficient or scale inefficient.

Following the above DEA models, many theoretical studies as well as applications are surveyed (Emrouznejad, De Witte 2010; Emrouznejad, Yang 2018). At present, the DEA models and development with applications in banking and finance areas can be seen. See, for examples, Emrouznejad and Anouze (2010), Hada and Tamang (2014), Wanke et al. (2016, 2017), and Zhu et al. (2017).

3.2. Two input-output models and solving

In the banking sector, Avkiran (1999), Sathye (2003) measured the productive efficiency (PE, i.e. TE) of banks in Australia and India by using DEA approach, respectively. Two input-output models, i.e., Model A and Model B, in their studies, have been constructed and used to show how efficiency scores vary with change in inputs and outputs. Following the same study direction, Zhu et al. (2004, 2012) studied the TE of Chinese main CBs by using the similar input-output DEA models, respectively; Recently, Hada et al. (2017) conducted a study on the productive efficiency between Nepal and China banking industry in year 2012 and 2013.

In this paper, following the previous scholars' work, two models, i.e., Model A and Model B, are provided and used:

	Model A	**Model B**
Inputs	Interest expense Non-interest expense	Deposits Staff numbers
Outputs	Net interest income Non-interest income	Net loans Non-interest income

Data used in this study is gathered from Bankscope database and annual reports of the banks from 2012 to 2013. Through data cleansing, we have got the samples of 100 Chinese CBs and 53 Indian CBs in 2012 and 2013. Chinese samples consist of 5 state-owned CBs, 12 joint-stock CBs, 54 city CBs, 15 rural CBs and 14 foreign CBs in China. Indian samples consist of State Bank of India and its 5 associates, 19 nationalized CBs, 19 private sector CBs, 4 foreign CBs in India (Citibank, HSBC, Standard Chart Bank and Bank of America) and 5 other type CBs in India.

The DEA problems are solved in the paper using the computer software DEA-Solver. The operational efficiency given is calculated in the input-oriented measure.

4. Results

The DEA results of the analysis are discussed in the following. Table 1 shows that by using the two DEA models, the mean operational efficiency score of all 153 sample CBs in 2012 and 2013, respectively.

Through Table 1, we see that the mean technical efficiency (TE) scores of the whole 153 banking samples collected from both of China and India, obtained by using both Model A and Model B, are slightly increased from 2012-2013. The mean scale efficiency (SE) scores are always relatively higher than the mean pure technical efficiency (PTE) scores.

Table 1. Mean operational efficiency score

Model A	**2013 TE**	**2013 PTE**	**2013 SE**	**2012 TE**	**2012 PTE**	**2012 SE**
All 153	0.6609	0.7277	0.9146	0.6502	0.7487	0.8712
China All 100	0.7465	0.8052	0.9297	0.7323	0.8208	0.8968
India All 53	0.4993	0.5816	0.8862	0.4953	0.6126	0.8229
Model B	**2013 TE**	**2013 PTE**	**2013 SE**	**2012 TE**	**2012 PTE**	**2012 SE**
All 153	0.6823	0.7526	0.9150	0.6719	0.7431	0.9115
China All 100	0.6914	0.7521	0.9272	0.7057	0.7519	0.9448
India All 53	0.6651	0.7536	0.8921	0.6081	0.7265	0.8488

Source: authors' own elaboration

Comparative analysis could be made. Mean TE score of Chinese CBs is relatively higher than the corresponding score of Indian CBs except PTE score of Model B in 2013 ($0.7521<0.7536$). Using Formula (2): $TE=PTE\times SE$, we can also make factor analysis on TE. In Table 1, that $PTE<SE$ is always true. Thus, the low PTE score brings the low TE score.

In detail, we have Tables 2-4 by using two DEA models. We can make similar comparative analysis through these tables. In Tables 2 and 3, "CH" means China, "CH 5 State" means 5 Chinese state-owned banks, "Joint" means joint-stock bank, "City" means city bank, "Rural" means rural bank, and "Foreign" means foreign bank in China. "IN" means India, "IN 6 State" means State Bank of India and its 5 associates, "National" means nationalized bank, "IN 24 General" means 19 private sector banks and 5 other type CBs in India, and "Foreign" means foreign bank in India. In Table 4, "IN 25 Public" means State Bank of India and its 5 associates, and 19 nationalized banks, "Private" means private sector banks, and "Others" means other type CBs in India.

Through Tables 2-3, we see that, in terms of TE and PTE, the performance of China's 5 state-owned banks is relatively higher than that of State Bank of India and its 5 associates, and China's other CBs; however, in term of SE, the performance of China's 5 state-owned banks is always relatively lower than that of State Bank of India and its 5 associates, and China's other CBs, respectively. However, in terms of TE and PTE, the performance of foreign banks in China is always relatively lower than that of foreign banks in India.

Table 2. Mean operational efficiency score of Model A

Model A	2013 TE	2013 PTE	2013 SE	2012 TE	2012 PTE	2012 SE
CH 5 State	0.8409	0.9741	0.8632	0.7734	0.9816	0.7872
CH 95 Others	0.7415	0.7963	0.9332	0.7301	0.8123	0.9025
CH 12 Joint	0.7252	0.8597	0.8460	0.6460	0.8630	0.7504
CH 54 City	0.7805	0.8155	0.9582	0.7481	0.8120	0.9236
CH 15 Rural	0.7419	0.7893	0.9414	0.7974	0.8652	0.9233
CH 14 Foreign	0.6044	0.6756	0.9023	0.6607	0.7131	0.9293
IN 6 State	0.4297	0.4542	0.9525	0.4145	0.5163	0.8091
IN 47 Others	0.5082	0.5979	0.8777	0.5056	0.6249	0.8247
IN 19 National	0.4732	0.5143	0.9275	0.4531	0.5805	0.7878
IN 24 General	0.4847	0.6157	0.8314	0.4881	0.6076	0.8392
IN 4 Foreign	0.8160	0.8880	0.9189	0.8591	0.9403	0.9127

Source: authors' own elaboration

For Chinese CBs, by using Model B, Zhu et al. (2004) discussed two groups of Chinese CBs for the years 2000-2001, that is, state-owned banks and joint-stock banks, and obtained that the mean TE score of state-owned banks is relatively lower than that of joint-stock banks in 2000 and 2001, respectively. For the years 2012-2013, through Table 3 that is the result by using Model B, we can see that the mean TE score of state-owned banks is still relatively lower than that of joint-stock banks, respectively. However, through Table 2 that is the result by using Model A, we can

see that the mean TE score of state-owned banks is relatively higher than that of joint-stock banks in 2012-2013, respectively, that are the opposite results.

Table 3. Mean operational efficiency score of Model B

Model B	2013 TE	2013 PTE	2013 SE	2012 TE	2012 PTE	2012 SE
CH 5 State	0.7342	0.9537	0.7655	0.7234	0.9542	0.7545
CH 95 Others	0.6891	0.7415	0.9357	0.7047	0.7412	0.9548
CH 12 Joint	0.8414	0.9269	0.9086	0.8672	0.9377	0.9257
CH 54 City	0.6447	0.6814	0.9533	0.6562	0.6810	0.9677
CH 15 Rural	0.7148	0.7582	0.9392	0.7150	0.7632	0.9374
CH 14 Foreign	0.7025	0.7962	0.8874	0.7415	0.7813	0.9488
IN 6 State	0.6790	0.7406	0.9316	0.6101	0.7166	0.8714
IN 47 Others	0.6633	0.7553	0.8871	0.6078	0.7278	0.8459
IN 19 National	0.6455	0.7467	0.8718	0.5936	0.7488	0.7983
IN 24 General	0.6641	0.7392	0.9076	0.5917	0.6794	0.8859
IN 4 Foreign	0.7427	0.8928	0.8364	0.7723	0.9178	0.8323

Source: authors' own elaboration

For Indian CBs, by using Model A and Model B, Sathye (2003) discussed three groups of Indian banks for the year 1997, that is, publicly owned, privately owned and foreign owned, and obtained that the mean efficiency score of Indian banks compares well with the world mean efficiency score and the efficiency of private sector banks as a group is, paradoxically lower than that of public sector banks and foreign banks in India. However, through Table 4 in this paper, we can see that the TE score of private sector banks in India as a group is always higher than that of

public sector banks; however, always lower than foreign banks in India in 2012 and 2013, respectively.

Table 4. Mean operational efficiency score of Indian banking industry

Model A	2013 TE	2013 PTE	2013 SE	2012 TE	2012 PTE	2012 SE
IN 25 Public	0.4627	0.4999	0.9335	0.4439	0.5651	0.7929
IN 19 Private	0.4826	0.5560	0.8913	0.4990	0.5733	0.8913
IN 5 Others	0.4927	0.8423	0.6037	0.4468	0.7378	0.6413
IN 4 Foreign	0.8160	0.8880	0.9189	0.8591	0.9403	0.9127
India All 53	0.4993	0.5816	0.8862	0.4953	0.6126	0.8229
Model B	**2013 TE**	**2013 PTE**	**2013 SE**	**2012 TE**	**2012 PTE**	**2012 SE**
IN 25 Public	0.6536	0.7452	0.8861	0.5976	0.7411	0.8159
IN 19 Private	0.6944	0.7261	0.9587	0.6256	0.6679	0.9435
IN 5 Others	0.5489	0.7889	0.7133	0.4627	0.7231	0.6670
IN 4 Foreign	0.7427	0.8928	0.8364	0.7723	0.9178	0.8323
India All 53	0.6651	0.7536	0.8921	0.6081	0.7265	0.8488

Source: authors' own elaboration

5. Conclusion

China and India are two of the world's oldest civilizations and have co-existed in peace for millennia. In this paper, we make comparative analysis of operational efficiency between Chinese and Indian CBs in 2012 and 2013 by using DEA

approach. Two DEA output-input models, i.e. Model A and Model B, have been used to show how efficiency scores vary with change in inputs and outputs.

We have that mean technical efficiency score of Chinese CBs is always relatively higher than the corresponding score of Indian CBs in 2012-2013, respectively. In terms of technical efficiency and pure technical efficiency, the performance of China's 5 state-owned banks is higher than that of India's State Bank of India and its 5 associates, and China's other CBs, respectively; however, in term of scale efficiency, the performance of China's 5 state-owned banks is relatively lower than that of State Bank of India and its 5 associates, and China's other CBs, respectively. In terms of technical efficiency and pure technical efficiency, the performance of foreign banks in China is always relatively lower than that of foreign banks in India. The performance of private sector banks in India as a group is always relatively higher than that of public sector banks in India; however, lower than that of foreign banks in India.

The next step of this study could collect more samples and use Malmquist index method to conduct further study on efficiency, efficiency changing and productivity, in order to conduct further competitive power analysis on both of banking industries of China and India.

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