Efficiency measures of the Chinese commercial banking system using an additive two-stage DEA

Ke Wang a,*, Wei Huang b, Jie Wu c, Ying-Nan Liu d

a School of Management and Economics, Beijing Institute of Technology, 5 South Zhongguancun Street, Beijing 100081, PR China
b Department of Risk Management and Insurance, University of International Business and Economics, Beijing 100029, PR China
c School of Management, University of Science and Technology of China, 96 Jinzhai Road, Hefei, Anhui Province 230026, PR China
d Department of Physics and Astronomy, University of Waterloo, 200 University Avenue West, Waterloo, Ontario N2L3G1, Canada

1. Introduction

The banking industry plays an increasingly critical role in the development of the financial system. The service efficiency and quality provided by banks not only have significant effects on the economic growth of a country but also influence every aspect of people’s daily lives. As the opening of financial markets occurs and technology improvements emerge, the Chinese banking system has achieved rapid development, and synchronously, the competition among the Chinese banks and between the Chinese domestic banks and the foreign banks has become fierce [1,2]. By 2012, the Chinese Big Four commercial banks, i.e., Bank of China (BOC), Agriculture Bank of China (ABC), China Construction Bank (CCB), and Industrial and Commercial Bank of China (ICBC), were all in the top 10 list of the world’s largest banks according to market capitalization. Specially, ICBC and CCB were rated as the top two largest banks in the world. From the perspective of strategic management, it is important for Chinese banks to continuously conduct self-checking of their efficiency, which may contribute to their long-term performance improvement.

The past 3 decades have witnessed significant changes in the Chinese banking system as it has reformed gradually and received tremendous successes in deregulation, corporate governance reform, non-performing loans disposition, risk management enhancement, and performance and efficiency improvement. These changes have been particularly marked over the past decade, which has been characterized a period of fluctuations in the Chinese economy, the real estate investment boom, the widespread global financial crisis that began in 2007, and the unforeseen series of natural disasters in 2008 in China. In addition, domestic banks have had to compete with foreign banks since China joined the World Trade Organization (WTO) in 2001. Particularly since 2006, with a 5-year grace period of WTO elapsing, more essential banking reform has been triggered to impel Chinese banks to confront foreign competition. The Chinese Big Four state-owned commercial banks (SOBs), which dominate...
the Chinese banking market, have conducted joint-equity reforms from wholly state-owned commercial banks to state-controlled joint-stock commercial banks by successfully making their initial public offering (IPO) in the Shanghai and Hong Kong Stock Exchanges. Meanwhile, the joint-stock commercial banks (JSBs), such as China CITIC Bank, China Minsheng Bank and China Merchants Bank, also experienced a period of rapid growth through the strengthening of internal control and risk management, the acceleration of service and product innovation, improvements in corporate governance mechanisms, and the integration of business and management processes. Therefore, it will be of interest to investigate the performance of the Chinese banking system for both bank managers and scholars to gain deeper insight into the efficiency states, changes and differences between the SOBs and JSBs in the Chinese banking market.

Because the banking system is a multiple-input and multiple-output organization, an appropriate multiple criteria evaluation technique is essential to comprehensively and objectively measures its efficiency. Data envelopment analysis (DEA) is a well-known approach for measuring the performance of decision making units (DMUs). This method is also commonly used in the efficiency measures of banking systems. A large number of studies of Chinese bank efficiencies using DEA have been published in Chinese language journals, and there are also many studies in international scholarly journals for non-Chinese readers (e.g., [2–11,50]).

However, despite a wealth of studies investigating bank efficiency in China, it is difficult to extrapolate and obtain clear information on efficiency evaluation and comparison in the Chinese banking system. First, for the same set of institutions during the similar observation period, the extant studies have shown mixed or contradictory results regarding the relative efficiency of the SOBs and JSBs. Luo and Yao [8] and Ariff and Can [4] have shown that the JSBs, on average, have higher technical, cost and profit efficiency than the SOBs. However, Chen et al. [3] and Laurenceson and Qin [5] have shown the opposite. Other studies include Fung and Leung [10], who found that compared with the JSBs, the SOBs have an insignificant advantage on pure technical efficiencies and a significant disadvantage on technical and scale efficiencies; furthermore, Yao et al. [6] indicated that the Big Four are not necessarily less efficient than the JSBs and that two of the four major SOBs actually outperform most of their JSB counterparts.

Second, for the efficiency change in the Chinese banking system, the prior research also shows inconsistent results. Yao et al. [6] indicated that the total factor productivity (TFP) of all banks experienced a significant annual rise during the 1998–2005 period; however, the study of Chen et al. showed that the technical and allocative efficiency of the Chinese banks decreased gradually from 1997 to 2000 [3]. Furthermore, Luo and Yao [8] noted that most of the listed Chinese commercial banks (the SOBs and JSBs) that they evaluated achieved higher efficiency levels in their IPO years, but the efficiency of half of these banks decreased after the IPO years during the 1999–2008 period.

Third, most studies analyzing efficiency in the Chinese banking system only consider the operational process to be a black box, and only the initial inputs and the final outputs are the focus of investigation, but the complicated operational process inside of the black box is typically ignored. Much less information is disseminated in the existing research literature with regard to process-specific guidance on improving the efficiency of the Chinese banks compared with the findings available for banks in other nations.

The main goals of this study are to help fill these gaps in the literature. First, we consider the production process of banks to be a network structure and apply a newly developed two-stage DEA model [12,13] to divide the entire system’s efficiency into several efficiencies of linked sub-processes. Second, we measure the two-stage overall efficiency of the Chinese banks over the recent 2003–2011 period to identify the source of the banking inefficiency and to provide a more detailed explanation of the changes and differences in efficiency for the Chinese banks. Third, we investigate whether the Chinese banking market reform improved the efficiency of the Chinese banking system, whether the SOBs outperformed the JSBs (or the reverse) during the reform period, whether the reform specifically improved the efficiencies of the Big Four SOBs, and what the determinants of the efficiency of the Chinese banking system may be and how these factors affected the efficiency changes and differences.

This study makes two main contributions to the literature. First, to our knowledge, this study is the first to develop this type of two-stage approach to investigate the efficiency effects of ownership type in the study of the Chinese bank sector. This research extends the literature on banking efficiency evaluation and inefficiency identification by developing the two-stage DEA model. Second, the paper not only provides reliable and up-to-date information on the efficiency of the Chinese banking industry but also assists us in understanding how to improve banking efficiency, hence offering important guidance for policy design and implementation in the future development of the industry.

The remainder of this study is organized as follows. Section 2 presents background information on the recent change in Chinese financial market and the reform of the Chinese banking system. In Section 3, we review some of the research literature on bank efficiency in China. The two-stage DEA model and related techniques are illustrated in Section 4. Section 5 interprets the data sources, describes the variables, and presents the hypotheses. The empirical results and discussions are provided in Section 6. Lastly, Section 7 concludes this study.

2. Chinese financial market changes and banking system reforms

As a developing country and transitional economy, China and its financial market have changed dramatically during the last 3 decades. The financial reform of the Chinese banking system was divided into three stages by the China Banking Regulatory Commission. During the 1978–1993 period, Chinese financial system began the first round of reform in which the monopolistic position of the People’s Bank of China (PBC, which is now the central bank of China) was removed with the establishment or reestablishment of four specialized banks that took over the commercial banking business from the PBC. These four wholly state-owned specialized banks, commonly named the ‘Big Four’, were Bank of China (BOC), Agriculture Bank of China (ABC), China Construction Bank (CCB), and Industrial and Commercial Bank of China (ICBC), which operated, respectively, in foreign currency transactions, providing credits to the rural sector, fixed-assets investment in construction sector, and commercial and industrial business [11]. At that time, the Big Four were not fully profit-oriented banks but still carried political obligations and were occasionally hampered by government intervention. Therefore, these banks accumulated a great number of non-performing loans (NPLs) because of the implementation of the policy to support weak state-owned enterprises [48]. Over-employment was another problem for the Big Four because

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1 To our knowledge, few studies have evaluated the efficiency of the banking system by utilizing a network DEA approach (e.g., [15–17,49]), and we find only one study that measured risk management-related performance of the Chinese banks under a network DEA framework [2].
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