



Efficiency evaluation of banks in China: A dynamic two-stage slacks-based measure approach



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ABSTRACT

Operational processes of banks in China can be divided into productivity and profitability stages. Within this, non-performing loans can be treated as a carry-over variable, an undesirable output of the profitability stage in the previous period but an input to the profitability stage in the current period. Using this framework, this paper proposes a dynamic two-stage slacks-based measure model to evaluate the efficiencies of Chinese banks. Based on the proposed model, the measures of stage, period and period stage efficiencies are defined. The proposed approach is applied to evaluate the operational efficiency of banks in China during 2008–2012. Key findings are that banks in China show both technical and scale inefficiency during 2008–2012, which results from the inefficiencies of both the productivity stage and profitability stage; city-owned commercial banks are more overall technically efficient than state-owned commercial banks and joint-stock commercial banks although state-owned commercial banks show best practice for pure technical efficiency, and city-owned commercial banks perform better than joint-stock commercial banks for pure technical efficiency.

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1. Introduction

As an important financial intermediation and payment channel, the banking industry is a typical service sector. It plays an increasingly vital role in a nation's economy. Since the financial reforms were initiated in 1978, the banking industry of China has developed considerably and its financial markets have experienced dramatic changes including deregulation, corporate governance reform, non-performing loans disposal, risk management and performance enhancement. China has established a much more mature banking system than before, and the banking system has been considered to be more market oriented. The system comprises of a number of commercial banks including the four state-owned commercial banks (commonly referred to as the "Big Four" banks), i.e., Bank of China (BOC), Agriculture Bank of China (ABC), China Construction Bank (CCB) and the Industrial and Commercial Bank of China (ICBC), and many joint-stock commercial banks (JSBs), e.g., China Merchants Bank, China Minsheng Bank and China CITIC Bank. By 2012, the "Big Four" banks were all ranked in the top 10 list of the world's largest banks in terms of market capitalization [1]. Market capitalization of the whole banking system in China has exceeded the total gross domestic product (GDP) of the country. To be specific, the total market capitalization is about 2.5 times of GDP (Statistical Year Book of China, 2012). Nevertheless, the Chinese banking system still

confronts some problems, e.g., the relatively small market share of JSBs, over-employment and the comparatively low competitiveness of the state-owned commercial banks [1]. Furthermore, since China joined the World Trade Organization (WTO) in 2001, its financial markets have gradually opened to foreign competitors. Many foreign banks have entered China's financial market. Many of them have been granted the permission to conduct RMB business. In this circumstance, the banking environment in China has become increasingly competitive. In other words, the competitions among Chinese banks, along with the competitions between domestic banks and foreign banks, have become fierce [2]. Hence, in order to increase its competitiveness, it is necessary to improve the operational performance of the banks in China.

To enhance the operational efficiency of the banks in China, it is necessary to obtain a thorough understanding of the operational process of the banks. Generally, a commercial bank accepts money deposits from the public, then issues various loans or makes financial investments to fund the developments of various businesses and trades, and consequently gains profits. This operational process can be regarded as a two-stage process as shown in Fig. 1.

As depicted in Fig. 1, a bank's business operational process can be divided into two stages. According to Yang and Liu [3], the first stage is usually described as the productivity stage, which covers various inputs such as operating costs and interest cost to attract deposits from the public; and the second stage, commonly called the profitability stage, utilizes the deposit to gain various incomes, e.g., interest and operation income. Since the deposit is both an output of the first stage and an input of the second stage, it has

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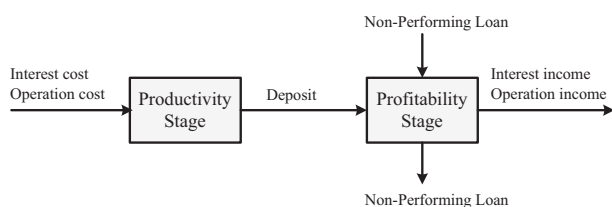


Fig. 1. The operational process of Chinese banks.

great impacts on the operational performance of both stages. During a given time period, a non-performing loan (or bad loan) is an undesirable output of the profitability stage. It is also an undesirable input to the profitability stage in the subsequent time period. The rationale for this is summarized as follows.

First, in the practice of the Chinese banking system, a non-performing loan is generated in the profitability stage when the loan issued by the bank cannot be paid back to the bank during the given time period. It harms the bank business and affects returns directly. In this circumstance, a higher proportion of non-performing loan means lower operational efficiency of the bank. Thus, it can be seen as an undesirable output in this stage [4].

Second, as indicated by Fukuyama and Weber [5] and Akther et al. [6], the non-performing loans produced in one time period are carried over to the subsequent period as an undesirable input. Then, in the subsequent period, the non-performing loans will be disposed of or offset by the incomes gained in the profitability stage, and new non-performing loans may also be generated. As Tone and Tsutsui [7] argued, non-performing loans are an undesirable carry-over variable in financial institutions.

Therefore, this paper treats non-performing loan as an undesirable carry-over variable in the profitability stage in Chinese banks. It is found that a change in non-performing loan of a bank in one period may have a significant influence on the operational performance of its profitability stage in both the current and consecutive periods, and consequently the overall efficiency of the bank in the two periods.

The abovementioned impacts of the intermediate factor and carry-over factor on the efficiencies of the two serial stages as well as the whole bank in multiple time periods raise three important issues: (1) As a bank is a multiple-input and multiple-output unit, an appropriate multiple-factor evaluation model rather than any accounting or financial ratio is required to correctly assess its operational efficiency. (2) How to simultaneously evaluate a bank's efficiency as well as the efficiencies of its internal two stages? (3) How to treat the dynamic effects of non-performing loan as a carry-over variable when measuring the efficiency of a bank as well as its stages during multiple time periods (i.e., dynamic efficiency)?

A number of previous literature indicate that data envelopment analysis (DEA) has been widely applied to evaluate a bank's efficiency. DEA, firstly introduced by Charnes et al. [8], is a well-established linear programming approach for measuring the relative efficiency of peer decision making units (DMUs) with multiple inputs and multiple outputs. Due to its powerful optimizing ability, DEA has been regarded as an excellent and robust efficiency analysis tool in the banking industry [9,10]. In recent years, there has been a rich body of research on performance evaluation of banks or bank branches using DEA [10,11]. Since this study is related to bank efficiency measurement in terms of bank structure and dynamic efficiency, only the most relevant studies are reviewed here.

The first stream of studies apply traditional DEA models or extend traditional DEA models to evaluate the efficiency of banks, such as multi-dimensional efficiency of bank branches [10], foreign bank efficiency [12], efficiency comparison of Taiwanese banks and foreign banks [13], cost and profit efficiency of Chinese

banks [14], environment impact on bank efficiency [15], bank branch's lending efficiency [16], and adverse effects of loan loss reduction on profitability [17,18]. More details of bank efficiency evaluation can be found in Paradi et al. [11] and Fethi and Pasiouras [19]. All these studies treat the evaluated banks or bank branches as "black-box" in a specific period with a static manner without considering the impacts of the presence of intermediate factors such as deposit and carry-over factors like non-performing loan on the banks' efficiencies.

In an effort to better identify the sources of the inefficiencies of banks, the second stream takes their internal complex structures into consideration when evaluating the banks' efficiencies. Seiford and Zhu [20] proposes a two-stage model to evaluate the efficiency of commercial banks, where the production process of a commercial bank is divided into two serial stages: profitability and marketability. Cook and Hababou [21] develops a multi-component DEA model to investigate sales performance of bank branches. Meepadung et al. [22] introduces a two-stage DEA model to examine the impact of IT-based retail banking services on the efficiency of bank branches. Fukuyama and Weber [5] develops slack-based two-stage DEA models to evaluate the efficiency of banks with serial production processes. Wang et al. [1] introduces an additive two-stage DEA model to explore the efficiency of commercial banks in China, in which banks are separated into two serial stages, i.e., deposit producing and profit earning. These studies have considered the internal structures of the banks when measuring their efficiencies. However, the efficiencies in these studies are calculated for one year or for each year during a particular time span without considering the dynamic efficiencies from a multiple-period perspective.

The third stream is devoted to dynamic effect and dynamic efficiency evaluation of the considered banks. Kao and Liu [23] proposes a relational network model to measure the efficiency of Taiwanese commercial banks during multiple time periods, and the overall efficiency of the time span is a weighted average of the efficiencies in each period. Akther et al. [6] applies slacks-based measure model and directional technology distance function to investigate the banks' inefficiencies by emphasizing the influence of intermediate outputs such as the loans and security investments generated in the previous time period on the efficiencies in the current period.

The abovementioned studies analyze the banks' efficiencies by only considering internal complex structures (i.e., multiple-components and two serial stages) or dynamic efficiency by treating the banks as "black box". None has well documented the issues of the banks' efficiencies by simultaneously taking two-stage structures and dynamic efficiency into account. Hence, the existing bank efficiency measures may not be suitable for evaluating the efficiency of Chinese banks with two-stage process during a multiple time periods, for that the intermediate factors between the internal processes and carry-over factor (non-performing loan) linking with the operations in consecutive time periods are ignored. When a bank is estimated to be inefficient, we cannot identify the causes of the inefficiency, which are sourced from the internal operational stages or the effects of the carry-over factors in the previous time period. Therefore, a more appropriate approach is required to deal with the efficiency evaluation of Chinese banks with two internal stages during multiple time periods.

To reasonably evaluate the operational efficiencies of the banks in China, we in this paper propose a dynamic two-stage DEA model on the basis of slacks-based measure (SBM) approach by simultaneously considering two-stage internal process and dynamic effects of carry-over variable during multiple periods. The main contributions of this study to existing literature are summarized as the following aspects. First, to the best of our knowledge, this study is the first to consider dynamic effects of carry-over non-performing loan on the operational efficiency of banks. To this end, we develop a dynamic two-stage model based on SBM approach to evaluate the

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