Risk-based decompositions of the meta profit efficiency of Taiwanese and Chinese banks ☆

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ABSTRACT

This study measures the profit efficiencies of Taiwanese and Chinese banks with the assumption that both types could operate under the metafrontier. To consider the risk consideration of banks, we include equity capital as a quasi-fixed input and develop the risk-based measures of the meta Nerlovian profit efficiency. We further decompose meta profit efficiency and gap into technology and allocative efficiencies and gaps. We use 34 Taiwanese banks and 70 Chinese banks in 2011 to empirically measure profit efficiency and its decompositions. Empirical results show that the Chinese state-owned banks perform the best in meta profit efficiency, followed by Chinese joint-equity banks and Taiwanese state-owned banks. These three types of banks are performing better than the other types of banks in Taiwan and China. We also find that Taiwanese private banks perform better in profit and technical efficiencies versus Chinese city banks.

1. Introduction

Numerous studies on bank performance evaluation have attempted to use frontier approaches for technical efficiency (TE) measurement where banks are compared against each other as measured by the distance to a given frontier. The data envelopment analysis (DEA) is the frontier methodology and has been widely used to assess banks' performance. Despite it is suggested that profit efficiency can better evaluate the profitability performance of a bank than traditional measures such as financial ratios and others, however as compared to technical efficiency, estimations of profit efficiency with DEA are rather limited in the banking literature (Fethi and Pasiouras [1]). One potential reason is the difficulty in collecting reliable and transparent information for output prices. While most papers assess profit efficiency of banks under the assumption that all assessment units have the same production technology, a large number of structural factors, such as social and regulatory structure, embodied in banking intensity could result in heterogeneous production technology. As a result, among all assessment banks, some decision making units (DMU) employ one kind of technology, while the other DMUs might adopt another. Ignoring such technological heterogeneity of bank operation might lead to biased estimation of bank efficiency. Some recent researches such as Bos and Schmiedel [2] and Huang et al. [3] have applied the metafrontier framework of O'Donnell et al. [4] to evaluate a bank's operational efficiency, in which technical efficiency, cost efficiency and profit efficiency present the differences between operating technologies. Although the metafrontier provides a good framework for cross-country or cross-regime bank comparisons, most of previous researches have focused on the metafrontier measurement of technical and cost efficiencies as well as their corresponding efficiency gaps. In fact, most of these studies have either not provided a complete decomposition analysis on metafrontier profit inefficiency, particularly on the allocative inefficiency gap, or failed to incorporate the effects of risk, which is pertinent for banking efficiency policy, in measuring the matafrontier profit efficiency. To our best knowledge, there has been none aimed at the decomposition of banking profit efficiency under the risk-adjusted metafrontier. Therefore, we emphasize the importance of technology heterogeneity in the measurement of profit efficiency by developing a new decomposition integrating

risk-adjusted based on metafrontier DEA technology. Based on proposed framework, we propose a risk-adjusted method to decompose the profit performance of banks which come from different countries (groups) and operate under the metafrontier. The proposed model is a general model which can be applied to any cross-country efficiency comparisons for banking or financial industry. In this paper, the proposed model is applied to exploring the profit performance of Taiwanese and Chinese banks.

The DEA has been widely used to assess the production efficiency of banks, but the popular models of DEA, CCR, and BCC have faced some limitations when examining profit, because outputs and inputs cannot be adjusted at the same time when analyzing the profit of a DMU. The difficulty can be overcome by the directional distance function (DDF) of Chambers et al. [5], who calculated technical efficiency by measuring the maximal degree required for output expansion and input contraction. This property just meets the requirement of profit analysis when price data are available. Thus, Juo et al. [6] and Juo [7] used the slack-based measures and DDF, respectively, and followed the framework of Grifell-Tatjé and Lovell [8] to decompose the profit change of Taiwanese banks so as to simultaneously consider outputs and inputs.

Measuring profit efficiency often encounters the problem of negative or zero profit, which prevents the use of regular DEA models. Nerlove [9] dealt with this issue by measuring the difference between the maximal and observed profits, but that paper has the weak property of unit dependence-that is, the degree of the profit difference is affected by currency units and is biased when making a comparison across countries. Chambers et al. [10] proposed the Nerlovian profit efficiency indicator, named after Nerlove, which expresses profit inefficiency in terms of a normalized profit difference. The Nerlovian profit inefficiency can be further decomposed into allocative and technical components. Studies based on the Nerlovian profit measurement include Färe et al. [11], Koutsomanoli-Filippaki et al. [12], Smith et al. [13], Yuan et al. [14], Koutsomanoli-Filippaki et al. [15], Mulwa and Emrouznejad [16], and Leleu [17].

This paper adopts this Nerlovian profit measurement under the metafrontier framework so as to compare the profit efficiency between banks in Taiwan and China. We first obtain the maximal profit (the meta profit frontier) in the Nerlovain profit indicator herein at a given price vector and the meta production technology in order to exclude the heterogeneity of various groups with different production technologies. Similar to the concept of the technology gap, this study further decomposes the distance between the meta profit frontier and a group-specific profit frontier into gaps of technology and allocative efficiencies.

Previous research studies have also aimed at examining the risk effect on a bank's profit efficiency performance. Since bank managers may pursue objectives other than profits, such as less risk, it is important to consider the effects of risk such as bank equity capital on profit inefficiency. Berger and Mester [18] showed the significant impacts of financial equity capital on a bank's profit efficiency estimates. Färe et al. [11] also included a risk-based capital requirement constraint in the evaluation of a bank's profit efficiency and found it has a significant effect on profit efficiency estimates. Koutsomanoli-Filippaki [15] found that when a bank may be more risk averse than others and may hold a higher level of equity capital, its efficiency could be biased if equity capital is ignored. Therefore, in this study we further include this equity capital treatment into our metafrontier evaluation framework for profit efficiency. This addition may be important in our study since a bank's risk supervision and equity capital requirement have been well appreciated and enforced following the Asian financial crisis in 1997. To the best of our knowledge, so far there have been no papers aimed at using DEA to compare the risk-adjusted profit

efficiency of banking industry in terms of meta-technology. Moreover, banks with different ownerships are expected to have different profit performances resulting from government policy deregulation and market restrictions. In our opinion, this might provide managers with sound information to design managerial policies that are more effective in improving banks' profit efficiency and its components. In order to examine bank profit performance with respect to ownership, we also present the difference in risk-adjusted profit inefficiency among different subgroups in Taiwan and China. The analysis is applied to the decomposition of profit efficiency in 104 banks, including 34 Taiwanese and 70 Chinese banks.

Compared to the previous literature, we make four contributions to the application of profit analysis. First, this study is the first to analyze the profit inefficiency source of Taiwanese and Chinese banks under the meta-technology. Second, the decomposition of the meta profit inefficiency, which is risk-adjusted using equity capital as a quasi-fixed input, has never been considered before in the literature. Therefore, it supplements and fills the gaps left in the aforementioned studies by Färe et al. [11] and Koutsomanoli-Filippaki [15]. Third, the profit inefficiency gap, induced by either technology gap (*TG*) or allocaitve inefficiency gap (*AG*), is first found in this study. Especially, there has been none in the literature aimed at *AG* which denotes a DMU's potential profit increase (decrease) due to the improvement (deterioration) in misallocation of output/input when using the meta-technology instead of its own group technology. Fourth, all the above measured are applied to exploring different types of banks.

The remainder of this study is organized as follows. Section 2 presents the background of Taiwanese and Chinese banks. Section 3 develops the DDF models with a quasi-fixed input to decompose the change in banks' profit. Section 4 implements the decomposition of the meta profit efficiency. Section 5 presents the variables and data descriptions. Section 6 deals with the empirical results. The conclusions follow in Section 7.

2. The background of Taiwanese and Chinese banks

Despite thousands of Taiwanese firms having invested billions of dollars of their business funds in China since the political separation of the two in 1945, until only recently there had been no official cross-strait agreement allowing Taiwan's financial sector to provide necessary and immediate financial services for Taiwanese businessmen in China. In 2010, Taiwan and China enacted the cross-strait financial supervision memorandum of understanding (MOU) for the banking, insurance, and securities sectors, followed by the establishment of the Economic Cooperation Framework Agreement (ECFA) between the two in June 2010 for further finalizing the conditions for cooperation. MOU and ECFA are expected to create mutual benefits for the banking industries in the two countries. Encountering the problems of over-banking and small operational scale, Taiwan's banking industry aims at enlarging the scale of investment and financial activities in China's huge market to increase local firms' profitability. To speed up the development of financial markets and increase banks' international competitiveness, China's banking industry may also take this opportunity to adopt better operating technology as well as learn from the rich experiences of financial liberalization in Taiwan.

Furthermore, to accommodate this new cross-strait financial development, the Taiwan government amended "Regulations Governing the Banking Activity and the Establishment and the Investment by Financial Institution between the Taiwan Area and the Mainland Area" on September 7, 2011 so as to effectively