Expert Systems with Applications 39 (2012) 11494–11502

Contents lists available at SciVerse ScienceDirect

Expert Systems with Applications

journal homepage: www.elsevier.com/locate/eswa

Measuring the true managerial efficiency of bank branches in Taiwan: A three-stage DEA analysis

Jonchi Shyu [a,*], Terri Chiang [b,1]

[a] Dept. of Business Administration, National Taiwan University of Science and Technology, 43 Kee-Lung Road, Section 4, Taipei 106, Taiwan, ROC
[b] Graduate Institute of Finance, National Taiwan University of Science and Technology, 43 Kee-Lung Road, Section 4, Taipei 106, Taiwan, ROC

ARTICLE INFO

Keywords:
Three-stage data envelopment analysis
True managerial efficiency
Bank branches
Environmental variables
Stochastic frontier approach
Malmquist productivity index

ABSTRACT

This paper aims to explore the true managerial efficiencies of the branches of a case bank in Taiwan. With 123 branches of the case bank comprising the sample, the study finds that, after the adjustment of environmental factors and statistical noise, managerial efficiency values from a three-stage data envelopment analysis (DEA) varies significantly from the traditional DEA model. This finding suggests that environmental variables have significant effect on branch efficiency. Moreover, scale inefficiency is the major cause of operating inefficiency in the case bank, and most branches are operating at the stage of increasing return to scale. With regards the branches' business scope, those that operate loan and wealth management services have better managerial efficiency than those that focus on wealth management only. In terms of deposit amount, branches with a higher deposit amount generate better managerial efficiency. Finally, the results for regional location show no significant effect on branches' managerial efficiency in Taiwan.

1. Introduction

Since the government approved the establishment of privately owned banks in 1991, the number of banks in Taiwan has grown rapidly from 25 in 1991 to 53 (domestic and foreign banks) by the end of 2000. The banking industry has been gradually moving far from government protection and regulation, entering the period of overbanking. Banks are engaged in a highly homogeneous business; hence, they normally employ price competition strategies to win the market, gradually narrowing the interest spread. Moreover, overbanking and the lower quality of financial institutions' loans rapidly increase the non-performing loan ratio, causing a continuous decline of the return on net worth in Taiwan. Prior to the implementation of the opening policy on new private bank establishment, the average return on net worth for most of Taiwan's financial institutions was above 20%. When the opening policy became effective, the average return dropped below 10%. The return on net worth was only 5–6% in 2008. The gradual narrowing of deposit/loan interest spread has diminished the high profit margins of traditional banking firms in Taiwan.

In response to the effects of overbanking problem arising from the existence of too many financial institutions, the government passed the Financial Institutions Merger Act in November 2000. The Taiwan Financial Asset Service Corporation and Assets Management Company were established that same year. In 2001, the Financial Holding Company Act was passed, allowing conglomerate mergers and cross-ownership; thus, the banking industry effectively moved operations toward universal banking. By 2008, 14 financial holding companies were already established in Taiwan.

The main source of a bank's profits comes from its branches, which comprise the foundation of a bank. The business operations of its branches can determine a bank's success, and the number of branches is often regarded as a symbol of its strength. In 2008, there were 37 domestic banks in Taiwan, with 1927, 419, 809, and 36 branches in the northern, central, southern and eastern regions. The distribution of banks in Taiwan is noticeably overcrowded, and the scale of branches seems too small for optimal operation. Under dramatic changes in Taiwan's financial environment and great competition, all the domestic banks in Taiwan must aim for the efficient operation of bank branches.

To improve operating efficiency, the case bank merged with another bank several years ago, and has been developed to become a financial holding company. Aside from the deposit business, the main business scope of the case bank's branches can be divided into two types: wealth management service only and wealth management service and loan business. In other words, the main difference lies in additional loan operations to generate business revenue. At present, the case bank measures the operating performance of its branches using the achievement rate of key financial

* Corresponding author. Tel.: +886 2 27301083; fax: +886 2 29386821.
E-mail addresses: jonchi.shyu@msa.hinet.net (J. Shyu), terri.chiang@sinopac.com (T. Chiang).
[1] Tel.: +886 2 2183 5173.

0957-4174/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.eswa.2012.04.005

indicators. Although the calculation is simple and easy, a single indicator provides limited interpretation. Moreover, a cross analysis between different indicators is difficult to conduct. At the same time, the target achievement rate is mainly based on past performance. There is no assessment regarding whether or not the branches can properly utilize existing resources to achieve the desired output or employ technology and innovative capabilities to improve the branch's performance. In addition to the supervision of the branches in achieving their targets, more importantly, management at headquarter should identify the reasons for failure to achieve future targets. Such reasons include the branch managers' effective use of input resources to accomplish the desired output, the proper scale of branches, and the management's facilitation of improvements in branch efficiency.

Previous studies on the managerial efficiency of bank branches (Camanho & Dyson, 1999; Hartman, Storbeck, & Byrnes, 2001; Lin, Lee, & Chiu, 2009) have not considered the different characteristics with which bank branches operate (e.g., branch size, years of operation, business type). The above studies assume that the difference in bank branch efficiency mainly comes from management decisions, rather than specific environmental conditions. In fact, bank branches have different characteristics. Hence, their favorable (unfavorable) operating environments or good (bad) luck can call for less (more) input in maintaining output levels. Ignoring these types of circumstances may result in biased efficiency estimates and misleading policy applications (Avkiran & Rowlands, 2008). In addition, without adjustment for the different branches' characteristics, some good managers are likely to be penalized for low performance scores due to factors beyond the managerial control, whereas poor managers can be rewarded for operating in favorable environments. Hence, the main contribution of this study is the provision of more valuable strategic suggestions for bank branches, including selections for business scope as well as the proper deposit amount and regional location, based on the true managerial efficiency obtained by the three-stage data envelopment analysis (DEA) model with consideration of environmental variables and statistical noise. The findings can help bank branches understand the real causes of poor operating efficiency and make improvements accordingly. At the same time, the Malmquist productivity index (MPI) can also provide explanations for the reasons why some branches underperform and a way by which to improve productivity at different time periods. Therefore, the present study can provide banks with a set of methods to measure the managerial efficiency of bank branches effectively as well as offer management a reference for the assessment of its branches' true operating efficiencies.

2. Literature review

Literature related to efficiency studies can be traced back to Farrell (1957), who treated the production frontier as the basis for efficiency assessment. Additionally, he used the concept similar to linear programming for solving simultaneous equations in algorithm. Farrell (1957) decomposited overall efficiency into two parts: (1) technical efficiency (TE), which deals with the relationship between input and output, and (2) allocation efficiency (AE), which is related to the optimal combination of input elements. If the restrictions on production technology are relaxed, then the scale efficiency (SE) can be assessed further to learn whether or not the company is operating at an optimal scale.

Charnes, Cooper, and Rhodes (1978) first proposed the DEA model that extended Farrell (1957) concept of "single input, single output" to an efficiency assessment model of "multiple inputs, multiple outputs" in order to fit modern complex production procedures. The extended model is commonly known as the CCR model. Similar to Farrell (1957) model, the CCR calculates TE under the assumption of constant return to scale.

In practice, not all DMUs operate under the same scale because they may be in the state of increasing or decreasing return to scale. Hence, the inefficiency obtained by the calculation of the CCR model may be partially caused by the inappropriate scale of the DMU itself. Therefore, Banker, Charnes, and Cooper (1984) modified the concept and scope of the CCR model and proposed the modified CCR model, also known as the BCC model. The BCC model extends the production possibility set to variable returns to scale (VRS), and introduces the concept of the distance function proposed by Shepherd (1970). Under the VRS production technological assumption, the BCC model disintegrates the TE under constant return to scale (TE^{CRS}) into pure TE (PTE or TE^{VRS}) and SE. PTE and SE represent the causes of technology inefficiency due to production technology and inappropriate scale of the DMU, respectively.

Using data from 1993, Schaffnit, Rosen, and Parado (1997) selected 291 branches of a major bank in Ontario, Canada as the research subjects in their work. The DEA and the assurance region model were subsequently applied for analysis. To be in line with the managerial targets of the bank, the selection of the input and output variables focused on the performance of the bank personnel in transactional and sustaining activities. The findings suggest that the most efficient branches had better performances in profit and service quality. Meanwhile, the location of branches, such as rural or urban areas, had a considerable influence on performance. Camanho and Dyson (1999) selected 168 branches of a Portuguese bank and applied the DEA approach to obtain TE, PTE, and SE of its branches. TE and the profit indicators of the bank were then integrated into an efficiency–profit matrix for further analysis. The empirical results suggest that branch efficiency was positively correlated with profit. With respect to scale (number of employees), most branches were in the stage of inefficiency due to the increasing return to scale. Hence, strategies to expand business activities should be made to facilitate growth. At the same time, headquarter should identify benchmark branches and propose improvement targets for the others.

Meanwhile, Hartman et al. (2001) selected 50 savings bank branches in Sweden, which they then classified into three types, namely, head office, medium-sized branches, and small branches. The research was conducted during the first six months of 1994 and 1995. The empirical results suggest that the small branches were the most efficient, followed by the medium-sized branches, and finally the head office. In addition, during the two-year research period, the small branches were undoubtedly the most efficient units in terms of resource allocation. Although the head office had inferior efficiency in 1994, their ability to choose the right mix of resources seemed to have improved by 1995. Giokas (2008) selected 44 all-function branches of a Greek bank in 2002, and applied two methods to investigate their branch managerial efficiency. DEA was used to study production efficiency, transaction efficiency, intermediation efficiency, and the respective relationships of the three efficiencies with profitability. Subsequently, the loglinear deterministic frontier method was applied for analysis. Efficiency measured using the two methods varied, because each used different input variables (i.e., three input variables for DEA and one input variable for the Cobb–Douglas frontier method). However, both methods identified the inefficient branches for management reference.

Lin et al. (2009) applied the traditional DEA model to measure the branch efficiencies of 117 branches of a Taiwanese bank, which were divided into five groups according to size. Based on the empirical results, the following suggestions were proposed: (1) the efficiency values and ranking obtained by the DEA could serve as a reference for the appraisal, promotion, and reward of branch management performance; (2) branch scale and efficiency quality