TECHNICAL EFFICIENCY AND PROFITABILITY OF SERVICES IN BANKING: AN APPLICATION OF MANAGERIAL DECISION-MAKING MATRIX

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Abstract

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The paper is a part of an on-going study of the performance assessment of Slovak bank branches. With aim to assess better the performance of the bank branches from different angles, the efficiency-profitability managerial decision-making matrices is used. The efficiency analysis adopts the SBM non-oriented model under the standpoint of production approach. Efficiency scores together with the profit indicators of each bank branch enable to gain a comprehensive picture of network performance. DEA results suggest that there is considerable space for an improvement of the bank branches efficiency. Moreover, between the efficiency and the profitability a medium correlation was found.

Keywords: DEA, SBM, bank branches, production approach, efficiency-profitability matrix.

INTRODUCTION

Permanent changes in external and internal environment force commercial banks to continually change their strategy, vision, business and financial plans and thus the production process. The enhanced assessment of the performance of commercial bank branches is therefore vitally important. In this contribution, the decision-making matrix which is based on the principles of BCG matrix is employed to demonstrate the production process of the bank branches. The contribution methodologically follows the efficiency-profitability matrix applied in the article of Camanho and Dyson (1999) and original approach is enriched by additional valuable aspect which is the spatial division of individual branches. The selected combinations of assessment take into consideration the objective of research formulated by the management of the one of the largest commercial banks in Slovakia. The researched decision-making matrix thus includes the score of technical efficiency and the indicator of the profitability of employees.

The score of technical efficiency of commercial bank branches is defined as the value of the rate of Pareto-Koopmans technical efficiency for each individual branch of a commercial bank and is obtained by applying non-radial SBM (slacks-based measure) model designed by Tone (1997). The value of this indicator captures the degree of efficiency derived from the slacks, which are an expression of technical inefficiency in the production process and are the difference between inputs and outputs of specific analysed branches and virtual branches, which are technically efficient. Inefficiency can occur on the side of inputs as well as on the side of outputs regardless of whether non-oriented models, input-oriented models or output-oriented DEA models are applied. In this contribution the indicator of technical efficiency of branches will be denoted by a phrase "technical efficiency" and abbreviation TE.

The profitability of employees is an indicator, which characterizes the profitability of analysed commercial bank branches, since in the numerator is the net interest and non-interest revenue of

commercial bank branches and denominator includes the average registered number of employees of individual branches. There are many modifications for specifying the profitability indicator, thus, in this contribution the variant measuring the productivity of employees is used. Employee profitability is from the viewpoint of shareholders, and thus bank's top management decisive and it dominantly influences the overall efficiency of invested shareholder's capital. Therefore it is necessary to take into account this indicator for overall evaluation of commercial bank branches. In this contribution the indictor characterizing profitability of individual branches is denoted as "employee profitability" and use abbreviation EP.

In this paper, the managerial decision-making matrix is used with aim to assess better the performance of the bank branches from different angles. The efficiency analysis adopts the SBM non-oriented model under the standpoint of production approach. The efficiency scores together with the profit indicators of each individual bank branch enable to gain a comprehensive picture of network performance.

The paper is organized in five sections, the first of which is introductory and the last is concluding. The second section provides an overview of some relevant studies on the topic, e.g. assesing bank and bank's branches performance. The third methodological section is accompanied by the fourth section which presents the results and includes their interpretation.

An overview of the literature

Among the wide spectrum of modeling techniques in the banking sector Data Evelopment Analysis (DEA) is one the most successfully used operational research technique in assesing bank performance Fethi and Pasiouras (2010, p. 90). Because the data availability of data and the measures that matter to a bank, as an entity, or to a branch, as a unit, different approaches must be taken when studying banks as the decision making units (DMUs) as opposed to the cases where the bank branches are the DMUs.

From 196 studies analysed by Fethi and Pasiouras (2010), 151 used the DEA methods to evaluate the technical efficiency or performance of banks and only 30 studies evaluated the efficiency of bank branches. This prompted Paradih and Zhu (2013) to elaborate an overview of 80 studies published from 1985, which evaluated the efficiency and performance of banks branches. The decisive majority of them is devoted to the efficiency of branches of commercial banks in individual countries, only two of them include international comparison. The most numerous is the group of studies (38 %), which is devoted to the methodological refinements of DEA methodology, the second group in terms of frequency (33 %) aims to improve managerial decision making. Other studies are devoted to asses the impact of environmental variables, change in technology of the production process of branches, different size of branches and so forth. Methodological improvements of DEA application are seen by Paradi and Zhu in (1.) multidimensional evaluation of performance of branches, (2.) the application of not homogeneous inputs and outputs, an implementation of

I: *Empirical studies on the production process of the banks or bank branches of the Visegrad group which applied DEA methodology (in the alphabetical order)*

Comparative studies	
Grigorian and Manole (2002)	CCR, BCC
Kenjegalieva *et al.* (2009)	BCC
Stavárek (2006)	CCR, BCC
Tomová (2006)	BCC
Vincová (2006)	CCR, BCC
Technical efficiency of banks in one of the countries of the Visegrad group	
Boďa (2015)	SBM
Stavárek and Řepková (2012)	CCR, BCC
Wozniewska (2008)	CCR, BCC
Zemanová (2007)	CCR
Zimková (2014)	SBM
Technical efficiency of bank branches in one of the countries of the Visegrad group	
Jablonský *et al.* (2004)	DEA
Kočišová (2012)	CCR, BCC
Ševčovič *et al.* (2001)	Additive model
Zimková (2015)	SBM

Notes: CCR – model of Charnes, Cooper and Rhodes, BCC – model of Banker, Charnes and Cooper, SBM – model of Tone.

undesirable inputs and outputs, (3.) the use of general models with interval data. Studies devoted to improving managerial skills are focused (1.) on incorporating decision-making processes into assessing the efficiency of branche, (2.) on reducing cultural and qualitative differences across branches and (3.) on fulfilling the requirements of managers of branches and managers of banks' headquarters.

Table I summarizes studies, which are devoted to measuring efficiency of the production process of banking in the countries of the Visegrad group, i.e. in the Czech Republic, Poland, Hungary and in the Slovak Republic, or in these countries individually, and which used non-parametric methods of research of efficiency in the production process. The alphabetic list of studies is divided into three categories: comparative research studies, which included one or more countries of the Visegrad group, research studies, which are devoted to the relative efficiency of commercial banks of one country of the Visegrad group, and research studies, which are devoted to the relative efficiency of branches of a commercial bank that operates in one of the countries of the Visegrad group.

Most comparative studies, as well as most studies assessing the technical efficiency of banking sector within one country use radial DEA models named according to their authors as CCR (Charnes, Cooper and Rhodes) and BCC (Banker, Charness and Cooper). Only Boďa (2015) and Zimková (2014, 2015) use in their studies undirected non-radial SBM (slacks-based measure) model designed by Tone (1997). Undirected SBM model enables to optimize both aspects of the production process, thus not to discriminate the inputs and outputs of the production process.

MATERIALS AND METHODS

DEA is designed for evaluating DMUs that perform similar tasks and for which measurement of inputs and outputs are available (Thanassoulis, 2005). Conceptual views of efficiency of banking industry differ. Individual theoretical concepts concur that commercial banks are agents of a transformation process and that during this process they transmute a set of inputs into a set of outputs. These inputs and outputs are linked in operations of banks/bank branches through a production function, which specifies the maximum attainable outputs at the given level of inputs.

In order to determine the technical efficiency of organizational units of the bank branches, the DEA

SBM analysis was applied on the data of 184 branches of the important Slovak commercial bank with aim to assess their technical efficiency in 2014. The criteria for determining significance in the case of this bank are its size and economic importance for the Slovakia. Those criteria belong to significance criteria used the ECB's direct supervision. Thus the bank under research belongs to the important financial institutions supervised by the European Banking Authority. The methodological procedure stands on several characteristic points or assumptions that shape the line of research and they are summarized in brief in the following text. The organizational units considered in the paper are clustered into sets according the size of branches expressed as the average registered number of employees recalculated to full employment. Such an approach was applied in other studies (see e. i. Vodová, 2012, p. 667 or Palečková, 2015, p. 2087).

The choice of inputs and outputs is usually a critical part of analysis, as it involves measuring different aspects of the banking firm. Indeed, it is impossible to fully capture the whole range of banking activities, due to their multiproduct nature. The choice of inputs and outputs in this research was consulted and agreed by the top management of the bank. The selection of input and output variables in SBM model corresponds to the production theoretical principle and it reflects an important requirement of bank representatives, so that DEA model includes those variables, which are directly influenced by directors of branches of a commercial bank. The input side of the production process is therefore the number of employees of a commercial bank branch and the output side is the volume of provided services on December 31th, 2014.

The number of employees of analysed commercial bank branches is defined as the average registered number of employees adjusted to full employment, while this number includes the management and other employees. The subject of this research are three main groups of branches. Branches of type I usually have 20 and more employees. Branches of type II have from 10 to 19 employees. Branches of type III have up to 10 employees. At branches of type I usually works branch director and two of his/hers representatives, at branches of type II and III is employed only one branch director. All are involved into individual stages of the production process in the commercial bank branch. In this contribution the variable employees is denoted by term „employee" and abbreviation E, while this variable in the next text cover management (E_1) as well as other employees (E_2). The volume

II: *Quantitative breakdown of branches of the Slovak commercial bank subjected to the analysis*

Organizational units			
Type of the branches	Branches I	Branches II	Branches III
Number of the branches	19	48	117
Number of employees	0-10	10-20	20+

of generated deposits of analysed commercial bank branches is expressed in thousands of euros. The analysed commercial bank continues to increase the volume of accepted deposits from its customers despite the current situation, when available financial sources are supplied almost interest-free by the central bank. In this paper the volume of accepted deposits is denoted by term „deposits" and abbreviation D. The volume of granted loans of analysed commercial bank branches is expressed in thousands of euros. For the purpose of this research the focus will be on total loans, which include loans to households, firms and the public entities. In this paper the variable volume of granted loans is denoted by term „loans" and abbreviation L. The volume of sold participation certificates by employees of a commercial bank branch is expressed in thousands of euros. This product is an alternative product to the deposit accounts as it provide possibility to invest available sources of clients in period when interest rate on the deposit accounts are close to zero. In this contribution the variable financial participation certificates is denoted by term „certificates" and abbreviation C. As explained above, two inputs and there outputs are recognized in the study and variables are summarized in the Table III.

The profitability of employees is an indicator, which characterizes the profitability of analysed commercial bank branches, since in the numerator is the net interest and non-interest revenue of commercial bank branches and denominator includes the average registered number of employees of individual branches. There are many modifications for specifying the profitability indicator, thus, in this contribution the variant measuring the productivity of employees is used. Employee profitability is from the viewpoint of shareholders, and thus bank's top management decisive and it dominantly influences the overall efficiency of invested shareholder's capital. Therefore it is necessary to take into account this indicator for overall evaluation of commercial bank branches. In this contribution the indictor characterizing profitability of individual branches is denoted as "employee profitability" and use abbreviation EP.

The choice of the SBM model reflects the desire to measure technical efficiency in the sense of Pareto and Koopmans, and this measurement is then accomplished in a more comprehensive way than common or basic DEA models do. Finally, as direct proportional links between inputs and outputs can scarcely be anticipated in the case of bank branch production, it is variable returns to scale that are acceptable as a valid and reasonable assumption. Furthermore, this assumption can easily be verified using the procedure for identification of returns to scale of production units proposed lately for use in an SBM framework (see Boďa, 2014, 2015). All DEA computation were done by DEA-Solver learning version 3.0 (Cooper *et al.*, 2006) and the technical efficiency scores are visualized in Fig. 1-3.

The BSG matrix was proposed in the 70s of the last century for strategic management of firms by Boston Consulting Group and in its original version it represents two dimensions for evaluating the firm's market position. On the horizontal axis it shows the relative market share of firm production in the market and on the vertical axis the market growth, while in the BCG matrix both axes are divided into 2 levels, low and high level, and therefore, in a two-dimensional matrix form 4 quadrants. Individual quadrants are usually labelled in the marketing literature as "question marks", "stars", "cows" and "dogs", while each of these quadrants represents a specific group of production in terms of low and high relative market share of production in the market and low or high market growth. Each quadrant evaluates the costs and revenues related to given production of products with respect to the two monitored criteria and it provides recommendations to management.

III: *Variables used in the technical efficiency analysis*

Variable	Definition	Abbreviation
Inputs		
Number of managers	The average registered number of management employees recalculated to full employment.	E_1
Number of non-managers	The average registered number of other employees recalculated to full employment.	E_2
Outputs		
Deposits	The volume of accepted deposits of analysed commercial bank branches.	D
Loans	The volume of granted loans of analysed commercial bank branches.	L
Profit participation certificates	The volume of sold profit participation certificates by employees of a commercial bank branches.	C

Note: output variables are expressed in thousands of euros.

RESULTS

Figure 1 reveals the results of commercial bank branches of type I in the area of technical efficiency and profitability in regional context. The determination of the tresholds, which divide the branches into successful and unsuccessful in terms of technical efficiency, is the managerial decision and in this case it is the score of technical efficiency of 0.9. Thus, in the first quadrant we have branches, which belong to the most successful in terms of technical efficiency and reach technical efficiency with the score from 0.9 to 1. The criterion of success of branches in terms of generating interest and non-interest revenues by one employee is in this case 300 thousand euro, thus in the upper quadrants of the managerial decision-making matrix we get the most successful branches in terms of profitability.

The upper right quadrant displays the most successful branches, which are the benchmark for the remaining analysed branches of type I in terms of technical efficiency and profitability. Both branches, which are located in the star quadrant, are from Bratislava region – West. In the upper left quadrant is a branch, which reaches outstanding results in the area of profitability, but it has approximately only half of the technical efficiency when compared to the best branches in the analysed group. In the bottom right quadrant are located branches, which are technically efficient, and thus they represent benchmark for other branches in the analysed group in terms of efficient transformation of human resource potential to volumes of offered services. These branches, however, have reserves in generating interest and non-interest revenues per one employee. This concerns branches from the Bratislava region – East and from Trenčín region. In the bottom left quadrant are depicted branches of type I, which have reserves in both analysed areas, in technical efficiency as well as profitability. From managerial point of view, the most challenging are those, which reach the worst results and which are individually evaluated in terms of region at which they operate, their technical efficiency and profitability.

Figure 2 demonstrates results of commercial bank branches of type II in the area of technical efficiency and profitability in regional context. In the upper right quadrant are found branches from both Bratislava regions, which are a benchmark for the analysed group of branches of type II. The bottom right quadrant does not contain any symbol of branch of type II, which indicates managerial reserves of directors of branches of type II. In the upper right quadrant is found a branch from the Košice region, which reaches good results in profitability, but it has reserves in technical efficiency. Most of the branches of type II are placed in the bottom left quadrant, the branches with the lowest technical efficiency and the lowest profitability are mainly branches in Banská Bystrica region and Prešov region.

Figure 3 depicts results of branches of type III of the commercial bank in the area of technical efficiency and profitability together with a regional visualization. In the upper right quadrant is only one branch from Bratislava region – East, which is a model for the analysed group of branches of type III. The bottom right quadrant covers more branches of type III from different regions, which indicates better managerial skills of directors in terms of the use of human resources and offering financial services at branches of type III compared to branches of type II. In the upper left quadrant isn't located any branch of type III, i.e. there isn't a branch, which achieves wished results in profitability, and has reserves in technical efficiency. Moreover, most branches of type III are placed in the lower left quadrant in which the lowest profitability reveal branches in Banská Bystrica region and Prešov region.

The Pearson correlation coefficient did not explicitly confirm the initial expectations about strong correlation between technical efficiency and employee profitability.

It can be concluded that when evaluating all branches together there exists moderate dependence between technical efficiency and employee profitability, in case of branches of type II it is strong, but in case of branches of type I and III the dependence between technical efficiency and employee profitability is moderate.

IV: *Pearson's correlation coefficient between the criteria of assessment of commercial bank branches*

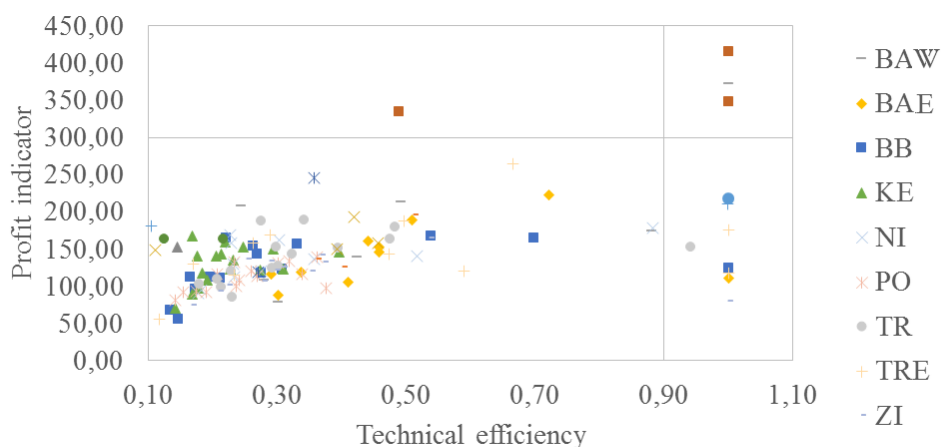| Branches of type I – III			Branches of type I			Branches of type II			Branches of type III		
	TE	EP		TE	EP		TE	EP		TE	EP
TE	1		TE	1		TE	1		TE	1	
EP	0.55	1	EP	0.66	1	EP	0.74	1	EP	0.43	1

Source: author.
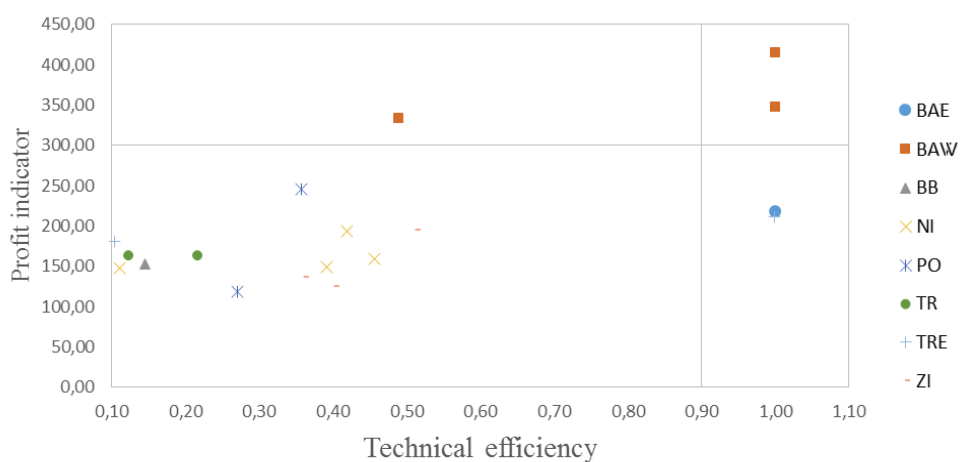
1: *Matrix of technical efficiency and profitability of branches of type I*
Notes: BAE = Bratislava – East, BAW = Bratislava – West, BB = Banská Bystrica, TR = Trnava,
TRE = Trenčín, NI = Nitra, PO = Prešov, TR = Trenčín, ZI = Žilina
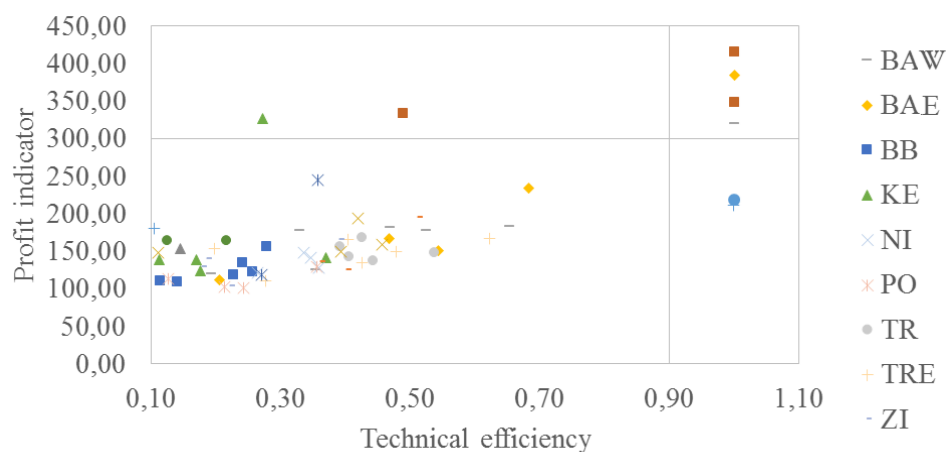
2: *Matrix of technical efficiency and profitability of branches of type II*
Notes: BAE = Bratislava – East, BAW = Bratislava – West, BB = Banská Bystrica, TR = Trnava,
TRE = Trenčín, NI = Nitra, PO = Prešov, TR = Trenčín, ZI = Žilina

3: *Matrix of technical efficiency and profitability of branches of type II*
Notes: BAE = Bratislava – East, BAW = Bratislava – West, BB = Banská Bystrica, TR = Trnava,
TRE = Trenčín, NI = Nitra, PO = Prešov, TR = Trenčín, ZI = Žilina

CONCLUSION

Banks play a vital role in a country's economic development and growth. In addition to their large economic significance, the existence of an increasingly competitive market highlights the importance of evaluating the banks' performance in order to continuously improve their functions and monitor their financial condition.

DEA became a main stream analytical tool in bank branch studies in recent years. In this paper, the assumption of variable returns to scale is formed (which, of course includes a specific case of constant returns to scale) and combined with a non-oriented SBM model in evaluating the organizational units of the bank branches on a comparative basis. The technical efficiency score together with the profitability indicators visualized in the light of spatial aspect provide to the bank's management valuable information which enables to take a proper decisions in the practise. Identifying score of technical efficiency and profitability indicator for each analysed branch by type of branch and by region enabled classification of individual branches within bank's internal rating. Moreover, identifying the inefficient production units by DEA allows to obtain specific quantitative data on the side of inputs and outputs of the production process, which have to be improved in order to reach technical efficiency of these branches. Determining the returns to scale of each branch of the commercial bank is an important information in terms of managerial decision-making about its economic future.

The application of the efficiency-profitability matrix with a spatial aspect of the analysed branches allowed us to combine the technical and financial sides of the production process and thus to fulfil the aim of this contribution, to provide the comprehensive picture of bank's branch network performance.

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