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The Combined Use of Balanced Scorecard and Data Envelopment Analysis in the Banking Industry

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Abstract

Background: Starting from the limitations of different single-method approaches to measuring the organizational efficiency, the paper is focused on covering both the financial and non-financial factors of this concept by combining two methods, namely the Balanced Scorecard (BSC) and Data Envelopment Analysis (DEA). **Objectives:** The main goal of the research in the paper is to show that certain deficiencies in the independent application of each method are eliminated by combining these methods. **Methods/Approach:** The paper combines two methods, BSC and DEA, to measure the relative efficiency of all branches of a bank in Serbia. **Results:** Results confirmed that the combined use of the named methods facilitates measurement of organizational efficiency by using both financial and non-financial indicators.**Conclusions:** The paper shows that it is possible to achieve synergetic effects in the evaluation of organizational efficiency in the banking sector if BSC is applied first, to define goals within four perspectives, and then four DEA models are developed to measure efficiency in each perspective.

Keywords: Balanced Scorecard, Data Envelopment Analysis, organizational efficiency, combined methods, decision support systems
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Introduction

The modern business environment is characterized by high competition and frequent changes, which greatly hamper the performance management process, measuring organizational efficiency and effectiveness increasingly challenging. Companies are being faced with the need to address all the relevant types of performance, so new measurement models are emerging.

Broadly speaking, efficiency represents the requirement to achieve the highest outputs with the lowest possible inputs. It is traditionally measured by the financial indicators. The most common criteria for assessing the efficiency are profit, return on investment and the profit ratio (Domanović & Bogićević, 2011). In addition to the return on investment (ROI), both ROE (return of equity) and ROS (the rate of return on sales) are often used as the relevant profitability indicator (Kalas & Rakita, 2017). Although financial indicators have an indispensable role in measuring the business performance, the precision and objectivity of its numerical expression do not allow for the inclusion of all relevant factors that affect efficiency. Inter alia, various organizational elements affect efficiency differently. Research shows that organizational structure, and the control systems, in particular, are important antecedents of *organizational efficiency* (Ostroff & Schmitt, 1993). The non-material factors can be covered by non-parametric sets of methods, models, and techniques, i.e. Data Envelopment Analysis (DEA), Balanced Scorecard (BSC), Stochastic Frontier Analysis (SFA) and other.

Starting from the complexity of contemporary organizations, each method has its limitations and it is difficult to cover all the important aspects of organizational efficiency by using a single method approach. Their deficiencies create a space for their combined use (Mingers & Brocklesby, 1997). We start from the previous research which has shown that it is useful to combine the BSC with DEA method (Wang, Li, Jan & Chang, 2013; Amado, Santos and Marques, 2012; Asosheh,Nalchigar & Jamporazmey, 2010; García-Valderrama, Mulero-Mendigorri, and Revuelta-Bordoy, 2009; Macedo, Barbosa & Cavalcante, 2009; Chen, Chen & Peng, 2008; Eliat, Golany & Shtub, 2006) because their combination creates a conceptual framework which enables the assessment of decision-making units from multiple perspectives, by encompassing both financial and non-financial data. However, there is still no single model with a clearly defined sequence of steps in the application of these two methods to encompass the multidimensionality of the efficiency concept (Bošković & Krstić, 2018, p. 83).

The subject of research in the paper is the combined use of the BSC method and the DEA method for measuring organizational efficiency. The research aims to show that the combined use of these methods eliminates some of their shortcomings in measuring organizational efficiency. The paper points out the positive and negative sides of the combined use of the methods.

Background

Before developing the combined BSC-DEA model, the key features of BSC and DEA methods, as well as the assumptions, conditions, and possibilities of their synergistic use are explained and discussed.

Balanced Scorecard

Starting from the static and retrospective character of the traditional, financial performance measures, it is necessary to consider other significant indicators of success, with a greater focus on the business dynamics and the creation of long-term value. In contemporary strategic management, performance criteria must be linked to the strategy. The process of managing the strategy is pluralistic, and the success of its implementation is not reflected in the financial effects only. It is necessary to observe the problem situation from various perspectives, taking into account all the important objectives and performance criteria.

These ideas led to the development of a BSC method, found by Robert Kaplan and David Norton in the early 1990s. This concept is based on the premise that companies can no longer achieve a viable competitive advantage by relying solely on material resources, but more effort is needed to build intangible assets and intellectual capital (Domanović, Jakšić & Mimović, 2014). Kaplan and Norton (1992) found that BSC enables the integration of different indicators derived from the strategy. It means retaining the financial indicators of past activities, but also adding the indicators of future activities. This is done explicitly by translating the strategy into tangible targets and indicators. In this way, the activities of the company are directed towards achieving the defined goals to create a unique value, following the strategy, which differs, from the competitors.

The BSC includes four perspectives that provide answers to important strategic questions. The *Customers Perspective* or *Marketing Perspective* answers the question of how customers see the company. The *Internal Processes Perspective* is aimed at providing an answer to the question of where (in which activities) and how to achieve excellence. The *Learning and Growth Perspective* should provide an answer to the question of how to continue to innovate and create value, while the *Financial Perspective* pays more attention to meeting shareholder needs.

All of these perspectives are presented in the *Strategy Map*, which describes and connects those (Kaplan & Norton, 2001 according to Domanović, 2016). The Strategy Map shows the ways for achieving strategic goals in each perspective, whereby goals from one perspective directly contribute to the next perspective. It starts with a *Learning and Growth Perspective*, including goals such as employee competence, strategy awareness, and technology infrastructure. The next perspective isthe *Internal Business Processes Perspective*, in which "employees apply their competencies, develop an awareness of the strategy and use technological infrastructure" (Domanović, 2016, p.151). The *Customers Perspective* includes goals such as, for example, customer satisfaction, which finally contributes to the objectives from the *Financial Perspective*, such as profit, sales revenue, growth rates, etc.

Although each perspective focuses on different aspects of the strategy, they should not be observed separately. The strength of the BSC method is reflected in the fact that it enables the integration of different measures and the emphasis on the relationships between different dimensions and performance of the same system (Amado et al., 2012). In this regard, the DEA method can provide significant support.

Data Envelopment Analysis

DEA "deals with the evaluation of the performance of Decision-Making Units (DMU) performing a transformation process of several inputs several outputs" (Bouyssou, 1999, p. 974). DEA is based on linear programming and enables analysis of the efficiency of DMUs by considering combinations of different input and output variables.The efficiency of the observed DMUs is "the ratio of the weighted sum of outputs to a weighted sum of the inputs" (Galagedera & Watson, 2015, p. 2962)). The efficiency calculated by this method is relative. Unlike the typical statistical methods, DEA compares each DMU only with the best of all DMUs. A DMU is relatively efficient if: it cannot increase any of its output without increasing one of its inputs or reducing one of its remaining outputs and if it cannot reduce any of its inputs without increasing one of its outputs or increasing one of its remaining inputs (Šporčić, Martinić, Landekić & Lovrić, 2008; Krstić, 2014). Besides, the condition for each DMU is that the ratio of the weighted sum of outputs and the weighted sum of inputs is less than or equal to 1.

DEA model is based on the following formula (Cooper, Seiford & Zhu,2011):

$$max h_0(u,v) = \sum_r u_r y_{r0} / \sum_i v_i x_{i0} \quad (1)$$

In the observed DMU, the variables are u_r and the $v_i$while y_{r0} and x_{i0} represent the values of outputs and inputs, respectively.

The DEA method is one of the most significant in evaluating the performance of non-profit organizations, where financial criteria are not crucial. It is also useful to include the multidimensional nature of organizational efficiency in enterprises. Some of the areas in which the method is often applied are higher education (e.g. Mimović & Krstić, 2016), information technology (e.g. Seol, Lee, Kim & Park, 2008), electricity industry (Chen, Lu & Yang, 2009), healthcare (e.g. Rabar, 2010), tourism (e.g. Rabar & Blažević, 2011), banking (e.g. Casu & Molyneux, 2003; Chen et al. 2008), etc. There are many different DEA models, which vary in orientation, type of return to scale, projection to the efficiency and sensitivity of the input data. The first model was the CCR (Charnes, Cooper and Rhodes, 1978) model, which assumes a constant return to scale. It was developed relying on Farrell's model for measuring efficiency (Farrell, 1957), and later models were developed based on it. There is also a BCC model, which is most appropriate for measuring technical efficiency, and it assumes variability of return to scale (Banker, Charnes & Cooper, 1984). On the other hand, depending on the goal, there are the input-oriented model, output-oriented model, and non-oriented models. The input-oriented model aims to minimize inputs with given outputs, while the goal of an output-oriented model is to maximize outputs with given inputs (Seol et al., 2008, p.232).

The assumptions, conditions and the synergistic use of BSC and DEA methods

This paper starts from the assumption that the shortcomings of individual use of the observed methods represent the basis for identifying the prerequisites and conditions of their combined use. Therefore, it is necessary to identify the key advantages and disadvantages of both the DEA and BSC, as well as the areas in which they can be complemented.

Firstly, BSC is not just a method for measuring performance, but it is also a strategic management tool, that allows the connection of the strategy with the objectives and performance measurement criteria. BSC is a method that is oriented towards the future and enables the assessment of future performance, not just evaluation of the results achieved in the past. Given that the DEA is based on an estimate of the efficiency achieved in the previous period, this is a key advantage that the BSC provides in their joint application. Besides, the BSC enables the observation of a problem situation from multiple interdependent perspectives and the understanding of the interactive relationship between the elements of these perspectives, while the DEA provides summarized performance indicators by using one model to transform multiple inputs into multiple outputs and therefore does not allow the complexity of a problem to be processed adequately.

Despite the numerous advantages, various authors have identified certain deficiencies of the BSC. Some of the key defects relate to the fact that the BSC does not specify a way to make a balance between the different perspectives, does not specify the way to measure performance and does not allow the identification of inefficient units (Amado et al., 2012). On the other side, DEA, as a hard system approach within the field of operational research, provides a higher level of precision and objectivity in management problems research. Although the BSC is a comprehensive method that allows a holistic approach to performance evaluation, it

is not completely free from subjectivity and does not allow for such a high level of precision in measurements, as the DEA method does. The strength of the mathematical expression of the DEA method, based on linear programming, allows a comparison of DMUs, which represents its main advantage in organizational efficiency analysis.

Therefore, the combined application of these two methods can overcome some limitations of their individual application. The BSC enables identification of the cause-and-effect relationships between inputs and outputs within different perspectives of organizational performance and is a useful framework for applying the DEA in organizational efficiency measurement. The BSC facilitates the consideration of the relevant criteria and the choice of inputs and outputs, which should be covered by the DEA. Among the first studies, in which the possibility of combining these two methods has been identified, is the one by Rouse, Putterill, and Ryan (2003). However, the literature has not identified one best, universal way to integrate BSC and DEA yet.

Initially, the models usually involved the use of one DEA model, with outputs from all four BSC perspectives (Rickards, 2003; Eilat et al. 2006; Chen & Chen, 2007; Macedo et al. 2009; Min et al. 2008). Some studies proposed to apply the BSC method first and then develop the DEA model using the indicators defined in the BSC model as inputs and outputs (e.g. Rickards, 2003). Other studies developed a DEA model first and used its results as inputs for the development of a BSC, intending to improve performance (e.g. Rouse et al. 2002). However, such a combination does not overcome an important disadvantage of the DEA method. Namely, it leads to unique performance measures, without the possibility of comparing results from different BSC perspectives and their interrelations. Therefore, recent literature suggest that the BSC should be applied as a framework that provides an insight into the contribution of different parts of the organization to the business success, after which four interactive DEA models should be developed for each BSC perspective (Valderrama et al. 2013; Amado et al., 2012; García-Valderrama et al. 2009). In each DEA model, inputs and outputs should be used, which correspond to different perspectives, keeping in mind the connection between the observed inputs and outputs. One of the first papers, in which the combined BSC-DEA model was applied in this way, is a study by the authors García-Valderrama et al. (2009), which relates to performance measurement in research and development activities, in the chemical and pharmaceutical industry in Spain.

BSC-DEA model for measuring organizational efficiency in banking industry

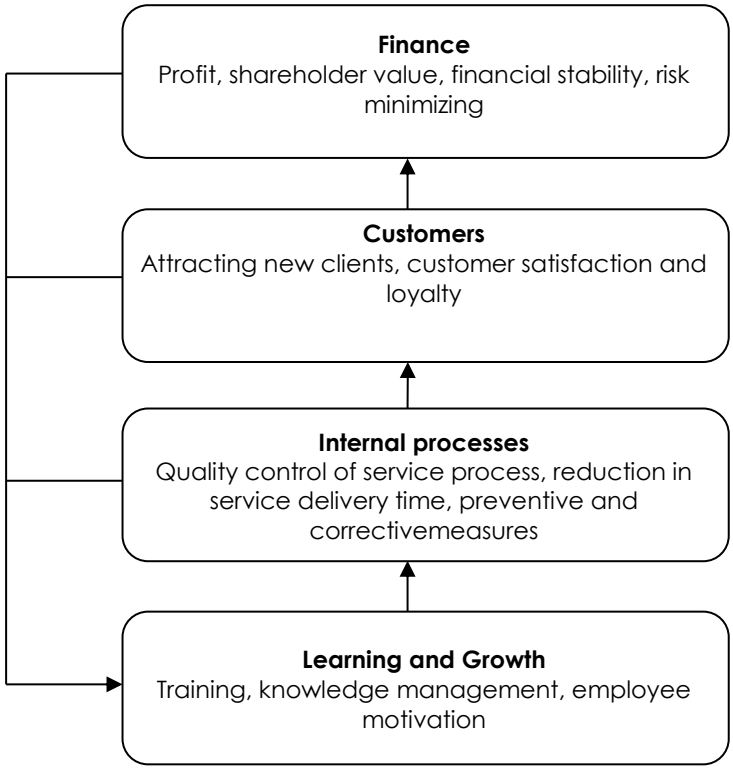
Starting from the previous research (Amado et al., 2012; García-Valderrama et al., 2009), we propose one way of combining the application of BSC and DEA methods for measuring the efficiency of organizational parts of a bank in Serbia (hereinafter: XYZ Bank), whose identity or any sensitive data will not be disclosed. Information about the bank, such as data on vision, mission, strategy, objectives and other planning decisions have been collected through unstructured interviews with the bank representatives.

The focus is on the proposal of the model for measuring the organizational efficiency of all branches of XYZ Bank, which belong to one Regional Center, in order to determine their relative efficiency and formulate recommendations for the future operation of efficient and inefficient observation units following the Bank's strategy. There are 10 branches and they represent decision-making units (DMUs).

The initial phase in the integration of the BSC and DEA method is the formation of a strategic map where the objectives of the XYZ Bank are presented within each of the BSC perspectives (Figure 1).

The next step involves creating a Balanced Scorecard, a strategic management tool that includes strategic goals, critical success factors, and performance indicators of XYZ Bank (Figure 2). All these elements are interactive.

Figure 1
The strategic map of an XYZ Bank



Source: Author's illustration

The BSC for the XYZ Bank shows an overview of some of the most important strategic goals, critical success factors, and performance indicators presented through four interdependent BSC perspectives (Table 1). It serves as a framework for the development of the DEA model, which uses performance indicators as inputs and outputs. Following the recommendation of Amado et al. (2012), ratios were used as inputs and outputs. Thus, we used the BCC (Banker, Charnes, and Cooper) model, which assumes the variable return to scale. In particular, four DEA models (one for each perspective) were developed. Each model has two inputs and two outputs. The outputs of the first model were used as inputs for the next model, and so for each of the following. In this way, the interdependence between the BSC perspectives was encompassed. In doing so, the decision-making units should remain flexible, since the weight coefficients for the same factors (outputs that are used in the next model as inputs) can be changed in different models. The proposed DEA models are shown in Figure 2.

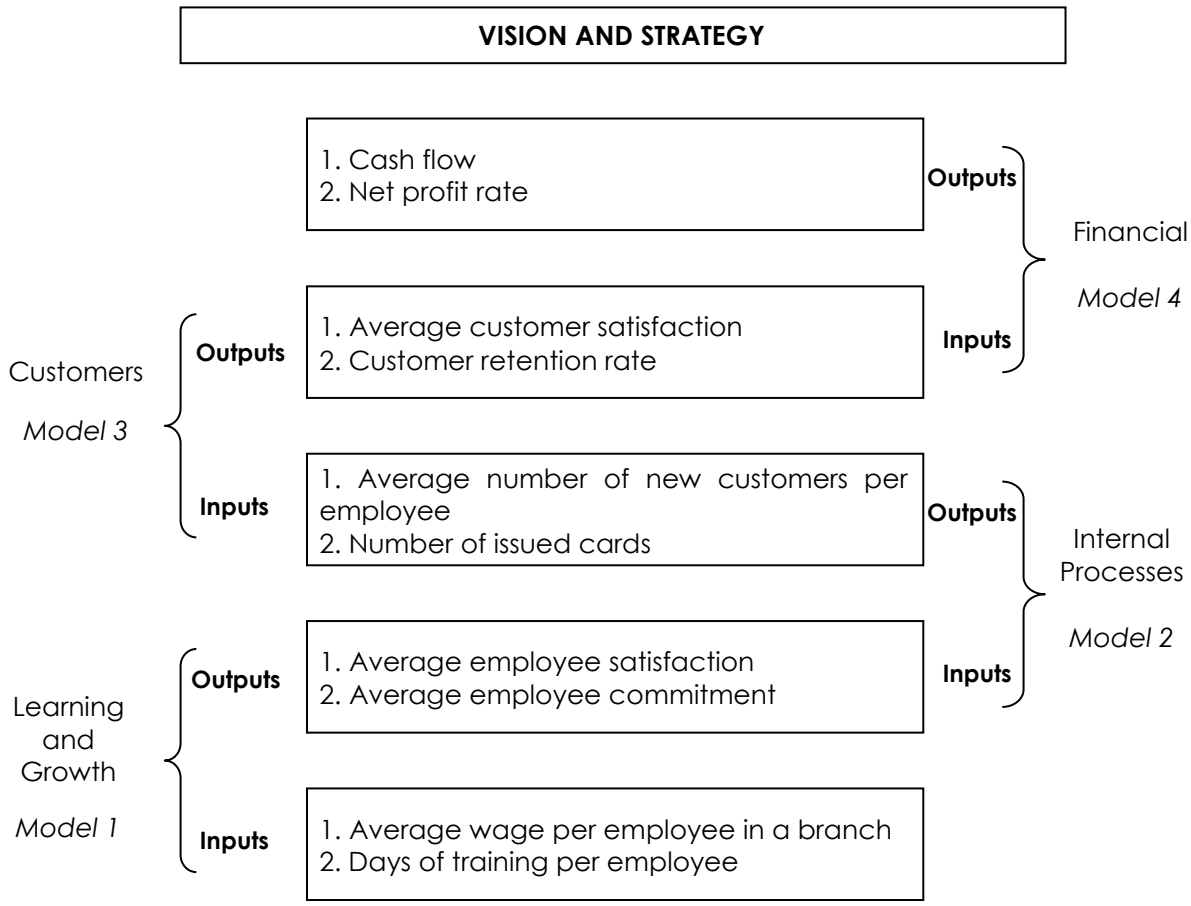
Table 1
BSC of the XYZ Bank

	Strategic objectives	Indicators
Financial Perspective	Creating value for shareholders Maximizing profitability Minimizing risk	Earnings per share (EPS) Economic value added (EVA) Relative profit rate Cash flow Value at Risk (VaR)
Marketing / Customer Perspective	Attract new clients Improve customer satisfaction Create loyalty	Number of new clients in the corporate banking sector per employee Number of new clients in retail banking per employee Customer satisfaction indices Number of client complaints Customer retention rate Relative market share
Internal Business Processes Perspective	Create a high-quality service Reduce the service delivery time Innovation in the provision of services	Number of serviced clients per branch Number of serviced clients per employee Number of mistakes Average time needed for troubleshooting The average waiting time in line at the counter Number of transactions via electronic banking Number of transactions via mobile banking
Learning & Growth Perspective	Effective knowledge management Continuously develop the skills of employees High level of employee satisfaction High level of employee motivation	Managers retention rate Days of training per employee (year level) Average wage costs per employee Employee satisfaction indices

Source: Author's illustration

The model can be used for measuring the organizational efficiency of the branch offices in order to identify their relative efficiency. The application of the model makes it easier to define the steps and initiatives for maintaining or improving the efficiency level of the observed organizational units following the company strategy. It may be used in other companies in the service sector with minor adjustments as well.

Figure 2
DEA models



* Adverse outputs are the subject of transformation proposed by Dyson, Camanho, Podinovski & Sarrico (2001).
Source: Author's adaptation according to Amado et al. (2012).

Testing the proposed model

In order to test the proposed model on the sample of 10 branches of the XYZ bank, the data was collected through 10 semi-structured interviews with 10 branch representatives (one per branch). The interviews were conducted in April and May 2018. Each interview was strictly focused on specific questions about the data on each of the elements of BSC and the inputs and outputs used in the DEA models (Figure 2). The interviewees provided answers based on the available secondary data from the company's documentation where this was possible (e.g. surveys about employee and customer satisfaction), as well as on their knowledge and opinions where there was no secondary data. The data in all the models refer to the previous period (January 2017 – December 2017). All the employees per branch were included in the calculated averages, which was 5-18 employees, depending on the branch.

The data were analyzed using the software package MaxDEA7 Basic and the results are shown in Table 2. The results show the relative efficiency of the observed branches. As we can see in Table 2, all ten branches demonstrated relatively high levels of performance. The results show that the *Internal processes perspective* (Model 2), in general, requires special attention, with an average score of 87%. Furthermore, there are two problematic DMUs, which have shown the lowest scores in terms of internal processes (Branch 5 and Branch 7). Regarding the *Customer perspective* (Model 3)

and *Financial perspective* (Model 4), there are possibilities for improvement of performance in Branch 10 and Branch 4, respectively. The *Learning and growth perspective* (Model 1) presents the highest levels of performance among these four BSC perspectives, with an average score of 94.30%. The least efficient DMU is Branch 9 with a score of 84.45%, which shows the potential for improvement.

Table 2
Models 1, 2, 3, 4 presenting the relative efficiency of the observed branches

No.	Decision-Making Units	Efficiency			
		Model 1	Model 2	Model 3	Model 4
1	Branch 1	77.78 %	100 %	92.45 %	95,11 %
2	Branch 2	99.52 %	74.70 %	81.60 %	100 %
3	Branch 3	91.89 %	100 %	84.60 %	100 %
4	Branch 4	100 %	100 %	82.26 %	80,36 %
5	Branch 5	95.33 %	71.71 %	100 %	90,88 %
6	Branch 6	100 %	75.93 %	80.80 %	96,36 %
7	Branch 7	100 %	73.21 %	100 %	85,18 %
8	Branch 8	100 %	78.86 %	88.22 %	93,90 %
9	Branch 9	84.45 %	99.49 %	85.80 %	100 %
10	Branch 10	94.02 %	100 %	80.29 %	91,17 %
	Average	**94,30 %**	**87 %**	**87.60 %**	**93.30 %**
	St. Dev.	7,7 %	13.3%	7.5 %	6.2 %
	Maximum	100 %	100 %	100 %	100 %
	Minimum	77,78 %	71.71 %	80.29 %	80.36 %

Source: Authors' work

Conclusion

This paper analyses a possible way of integrated application of the Balanced Scorecard (BSC) and Data Envelopment Analysis (DEA) methods in the banking industry. Based on the key theoretical and methodological features of both methods, the paper presents a practical example which shows that if the BSC method is first applied, as a framework for defining goals and performance measures, and then the four interactive DEA models are developed to evaluate efficiency in each of the BSC perspectives, certain limitations of their individual application will be removed and synergy will be created.

The paper presents an illustration of a possible way of synergistic application of the BSC and DEA methods, the so-called BSC-DEA model for measuring the relative efficiency of the bank's branches. This illustration aims to motivate and support the measurement of organizational efficiency based on the strategy, taking into account not only the material, but also the intangible factors of efficiency in the banking sector. In this way, the paper shows that the application of these methods can be equally effective in profit organizations, not only in the non-profit sector, where the Data Envelopment Analysis method has been applied more often.

However, the paper is different from most other studies in the banking industry (e.g. Macedo et al. 2012; Chen et al. 2008) which used a single DEA model to evaluate the performance of bank branches using indicators from different BSC perspectives. Namely, we have applied four interconnected DEA models, one for each one of the BSC perspectives, by using the outputs of one model as inputs for the following model. This way of combining BSC and DEA was first proposed by Amado et al. (2012) and the results in this study are complementary to theirs, so this paper additionally strengthens the proposition that „*moving away from a unique all-embracing DEA model towards multiple complementary models is advantageous, leading to*

enhanced performance assessment" (Amado et al. 2012, p. 401). The research shows that the BSC-DEA model proposed by Amado et al. (2012) can be successfully applied for measuring the relative efficiency of bank branches.

Practical research implications are reflected in defining the steps for applying the BSC-DEA model in any company in order to identify the relative efficiency of their organizational units. Besides, in this way, it is possible to raise some relevant issues, which may indicate the causes of the inefficiency of the organization and facilitate the identification of the necessity of change. Of course, this approach to combined application of the methods may be adjusted depending on the strategy of each specific company and various situational factors, by creating a specific BSC and choosing different inputs and outputs in DEA models. The paper has confirmed that the model can work in practice.

The limitation of the research relates to the fact that none of the two methods provides complete objectivity in determining the weight coefficients in the DEA method. Therefore, in the future, it is possible to explore whether it is beneficial to combine BSC and DEA with some of the multi-criteria decision-making methods, such as, for example, the AHP method, as a third method. Another possibility of future research is the application of the BSC-DEA method for measuring organizational efficiency in successive time periods to obtain information on the success in managing the efficiency of the analyzed organizations. The research could also be improved by expanding the sample of DMUs and by including more inputs and outputs in the analysis. For example, the BSC could be expanded with a risk management perspective as suggested by Chen et al. 2008.

Besides, it is important to note that the study of XYZ Bank is just an illustration of possible combined use of BSC and DEA. The data was collected from the respondents from the bank itself, who may be subjective or prone to giving socially desirable answers. Data accuracy was not verified using some secondary sources. However, bearing in mind that this is only an illustration of the possible application of two methods, reliability of data is not crucial for conclusions, since the basic goal of the work is not to test the efficiency of this bank, but to show that it is possible to measure the efficiency in the banking sector in general by the combined application of the BSC and DEA methods, while eliminating their shortcomings.

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