Analysis of Business Efficiency

Subjects: Economics

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Measuring efficiency and identifying the sources of potential inefficiency in particular are very important steps in improving the competitive position of the enterprises in their continuous development, sustainability, overall behavior in the current corporate environment and security aspects.

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1. Corporate Efficiency–Theory Background

Efficiency is an important criterion of evaluating business results, one of the main goals of the implementation of economic and financial activities of the enterprise. The definition of efficiency is quite challenging, as there are many opinions and approaches to the issue. Some authors [1][2][3][4] define business economic efficiency. By those authors, efficiency consists of two basic components, namely *technical efficiency*, reflecting the ability to achieve maximum output from the set of inputs and *allocation efficiency*, reflecting the ability to use inputs in optimal proportions with respect to their prices and production technology. Pritchard [5] defines efficiency as the degree to which the enterprises use their limited resources to produce final products and services. The term also refers to the relation of outputs to certain standards and expectations. Azimi [6], Bulinska-Stangrecka and Bagieńska [7] define efficiency as a functional characteristic of business activity. It expresses the overall rationality of its activities as a dedicated system that works only on the basis of purposefully secured links with the environment [8]. Trivedi [9] defines business efficiency as the degree to which an enterprise rationally allocates its limited resources to achieve predetermined goals after taking the constraints of the internal and external environment into account. By Callender [10], Repnikova et al. [11], Nikonorova et al. [12] efficiency is described as a purposeful process of meeting the ever-growing needs of the society at the maximum possible level.

The basis of the concept of the efficiency is the “effect” in terms of a result and a consequence. A common effect for all the enterprises is related to the products and services provided referred to as the outputs, which are the result of the consumption of production factors that make up the inputs. Based on the above, efficiency is expressed as the ratio of outputs to inputs. Economic theory defines efficiency as a state where it is not possible to produce another product or service at a given resource without having to limit the production of another product or service. The production unit thus moves to the limit of production possibilities, which does not lead to waste. In the real world, it is necessary to accept the assumption of the existence of waste, as in the current market economy there are efficient and inefficient production units [13].

The more efficiently an enterprise works, the more efficient it is in the implementation of its production on national and global markets. Achieved higher efficiency helps the enterprise in better, and cheaper implementation of its strategic activities, compared to the competitors, which in turn leads to gaining a competitive advantage and improve the sustainability of the enterprise [14]. The key to improving efficiency is the analysis of mechanisms in the case of specific factors affecting efficiency and taking measures in an orderly manner depending on the effects [15]. Pakhnenko et al. [16] notice that the management of sustainable development of the enterprises requires the improvement of methodological approaches to their evaluation of effectiveness. The problem of assessing the economic efficiency of the corporate activities therefore lies primarily in the definition of appropriate criteria, and approaches, as addressed in the following subchapter.

2. Approaches to Measuring Business Efficiency

Measuring efficiency, and identifying the sources of potential inefficiencies, is rather an important step in improving the competitive position of the enterprises and their overall behavior in a competitive environment. At present, there is a wide range of methods and procedures by which it is possible to measure the efficiency of the activities of production units. The following reports the most important approaches to quantifying efficiency:

- The ratios—by [16], the ratios are the most common method of efficiency evaluation, as their relatively simple quantification is based on the current financial statements. Their biggest drawback is that they focus only on a limited number of factors that do not have a sufficient impact on the overall efficiency of the production unit. However, they are useful for the basic orientation of the operation of the monitored unit. For a more detailed analysis of efficiency, it is then necessary to use more complex tools of economic analysis based on mathematical modelling.

- Parametric methods—a group of parametric methods is stochastic in nature, i.e., they contain at least one random component. The aim of the methods is to distinguish inefficiency from the effects of random errors, related to a higher reliability of the final results. Their disadvantage is that the given methods define a specific functional dependence, which determines the shape and course of the efficiency limit. If these assumptions do not correspond to reality and the functional dependence is not defined correctly, the final results may be damaged by specific errors and the final results are distorted. The methods quantify economic efficiency, such as stochastic frontier approach, distribution free approach, thick frontier analysis, corrected ordinary least squares.

- Nonparametric methods—a group of nonparametric methods is of a deterministic nature, i.e., they do not contain any random component. Therefore, it is not possible to effectively eliminate the negative consequences of accidental errors, measurement errors or incomplete data in the quantification of efficiency. With these methods, the assumptions for production technology are not as strict as with parametric methods, therefore a higher degree of freedom is permissible for the examined units. Compared to parametric methods, this group quantifies not economic but technical efficiency. The group includes methods such as DEA, free disposal hull, stochastic data envelopment analysis [17].

As reported by the above-mentioned authors, the parametric approaches are generally regression techniques that assume the existence of a special functional form for a boundary and thus determine the inefficiency against this criterion. Nonparametric methods evaluate the inefficiency relative to all units in the sample. The most important difference between deterministic and stochastic methods is their attitude to the random component. The deterministic approaches assume that any deviation from the border is caused only by inefficiency. On the other hand, the stochastic approaches attach weight to the deviation from the border not only of inefficiency, but also of the existence of randomness. The results are comparable when applying both approaches, but there may be minimal differences. However, other methods are often used in the literature to measure efficiency (mostly economic), such as mathematical programming, econometrics, and simulation methods.

3. Data Envelopment Analysis and Its Use

At the most general level of understanding, the DEA method is used to quantify the technical efficiency of comparable production units producing certain outputs, for the production of which they consume certain inputs. The units are, for example, school facilities, hospitals, banking institutions, public and state administration facilities, national economies, and economic sectors.

The initial ideas of assessing technical efficiency is traced back to the second half of the 20th century. Debreu 1951 [18] developed a basic methodology for analyzing the technical efficiency of units. This methodology was able to accept several input variables, creating a generally applicable and comprehensive measure of efficiency. The author’s approach was modified a few years later for the case of multiple outputs and formulated as a problem of linear programming by [19]. Since the above-mentioned authors introduced the DEA method to the world, it has become a popular subject of research in many empirical studies, and its popularity has continued to grow progressively in recent years. However, its applicability is not limited exclusively to the analysis of the efficiency of the production units, the scientists are increasingly looking for its application in other areas. A review of world empirical studies concerning the DEA method and trends in its future development is reported by [20]. Due to the fact that the DEA method is the subject of research of a huge number of research studies, this paper focuses on the studies carried out in areas related to spa treatment, as much as possible (especially the course and results of the production process).

By Dénes et al. [21], in order to introduce the application of the DEA method in various areas of economic life, it was necessary to define a designation for the analyzed unit, within which the inputs are transformed into the outputs. The term *Decision Making Unit* was thus introduced. The applicability of the DEA method is justified and correct only if all DMUs perform the same or similar activity. Only then is it possible to identify a common group of inputs and outputs that are relevant to the analysis. Let us suppose that there is a set of homogeneous production units: U_1, U_2, …, U_n. In measuring the efficiency of the enterprises, each of the units produces r of the outputs and at the same time consumes m of the inputs. Then, $X = \{x_{ij}, i = 1, 2, …, n; j = 1, 2, …, m\}$ is the input matrix and $Y = \{y_{ik}, i = 1, 2, …, n; j = 1, 2, …, r\}$ is the output matrix. By [13], the efficiency of the unit is generally expressed by the following:

$$eff\ (U_q) = \frac{\text{weighted sum of outputs}}{\text{weighted sum of inputs}} = \frac{\sum_{k=1}^{r} u_k\, y_{qk}}{\sum_{j=1}^{m} v_j\, x_{qj}} \quad (1)$$

In the formula, v_j, j = 1, 2, …, m are the weights matching the j-th input and u_i, k = 1, 2, …, r are the weights matching the k-th output. DEA models maximize the efficiency measure of the analyzed unit U_q, expressed as the ratio of the weighted outputs and the weighted inputs, provided that the efficiency rates of all other units are less than or equal to one. Input and output weights must be greater than zero at the same time to include all considered characteristics in the model.

There are different DEA models, based on different classifications. The *input-oriented DEA models* analyze the efficiency of the enterprises based on the input variables. The enterprises with optimal value of the purpose function reaching one are considered efficient. With a value of less than one, the enterprises operate inefficiently, reporting the need to reduce inputs in such a way that an inefficient enterprise becomes efficient. The *output-oriented DEA models* answer the question, to what extent the outputs should be increased without changing the level of inputs, i.e., they perceive efficiency as the ability to produce the maximum number of the outputs for a given input. Due to the limited scope of the paper, sample empirical studies dealing with the application of input and output-oriented DEA models are discussed, exclusively in the field of hospitality and healthcare, as the authors of the paper analyze the spa facilities as a special type of enterprise, that have not been the subject of any efficiency studies using the DEA models so far. It is assumed, that their activities are included in both of the above-mentioned areas, although priority attention should be paid mainly to the provision of spa health care. The following authors applied input-oriented DEA models in hotel facilities in their studies [22][23]. Many authors [24][25][26][27][28] deal with health-care facilities. The application of output-oriented DEA models in hotel facilities is under discussion [29] as well as the application of models in healthcare facilities [30][31][32][33].

In general, the most important DEA models also include the CCR model [34], formed as an acronym for the surnames of its authors (sometimes referred to as the CRS model). The model assumes constant returns to scale, and it expects that the change in outputs/inputs is the same as the change in inputs/outputs. There are also the models based on the assumption of variable returns from the scope, such as the BCC model [34], which is essentially a modification of the CCR model and its name is also an acronym for the surnames of its authors. The model assumes that the level of outputs/inputs does not have to change in the same proportion as the level of inputs/outputs—it can increase, decrease, and remain constant. In terms of the form of technical in/efficiency, which the model is able to achieve with its degree of efficiency, the BCC model is classified as a radial DEA model. In the areas of hospitality and healthcare the authors analyzed, which DEA models (CCR or BCC) are used most often. In the hotel industry, the application of the CCR DEA model is preferred by [35]. On the other hand, the use of the BCC DEA model is considered more appropriate by the authors [36][37][38]. Models (CCR and BCC) subsequently investigated possible deviations. Regarding health-care facilities, Lo Storto and Goncharuk [39] prefer the application of the CCR DEA model. On the other hand, Sendek et al. [40] consider the use of the BCC DEA model to be more relevant. As in the case of hotel facilities, also in the facilities providing primary health care, Lacko et al. [41], Papadaki and Staňková [42], Szabo et al. [43] report that it is more appropriate to apply DEA models with constant and variable returns to scale and subsequently analyze and compare the results of the achieved efficiency score in detail.

Radial DEA models reflect the degree of efficiency pointing to the need for proportional reduction of inputs, and the expansion of outputs so that the unit becomes efficient—e.g., CCR model, BCC model, and radial DEA models for calculation of super-efficiency. Non-radial DEA models explore the possibilities of disproportionate changes in inputs and outputs in order to achieve efficiency, such as the model of [44], the SBM model of [45]. It is a model deriving technical efficiency from the size of input and/or output chutes, depending on the orientation. The author of this model also summarizes its basic properties, which are the scale invariance with respect to the units of measure used and also the fact that the optimal solution of the SBM model monotonically decreases with the increase of each slip in the inputs and outputs.

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