

Data Envelopment Analysis as a tool for evaluation of the banking efficiency

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Abstract The article deals with the measurement of the banking sector efficiency. As an introduction to the topic, it discusses the current situation of banks in Slovakia as well as on a global platform. Subsequently it clarifies the need of banking analysis realization and efficiency indicator suitability for this purpose. An explanation of the relevance and benefits of measuring the efficiency of banking segment is followed by the principal terminology specification. It is completed with delimitation about similarities and differences within each term. The next section is addressed to the methods for efficiency quantification. This part states parametric and non-parametric approach and the most often used practices in this field. The attention is dedicated to the two most frequently applied methods, parametric method Stochastic Frontier Approach (SFA) and non-parametric method Data Envelopment Analysis (DEA). Thereby the foundations were given for examination of the main objective of the article - DEA method. Findings are thus ensued by the most extensive section that describes Data Envelopment Analysis technique. It analyzes in detail the utilization, way of realization, calculation practice, benefits, limitations, application and interpretation.

Key words Data Envelopment Analysis, efficiency, banks, inputs and outputs

1. INTRODUCTION

Financial markets are characterized by significant fluctuating trend nowadays. Financial institutions' adequate posture thus appears to be particularly necessary in connection with monitoring of financial flows on the revenues and expenditures side. The identification of weaknesses seems highly important. This point is relevant not only for evaluation of the situation inside the institution as such but also for comparison with operating environment - competitors. The assessment should lead to the appropriate measures adoption with the financial conditions optimization aim.

Looking at the Slovak banking sector (Národná banka Slovenska, 2015), previous year 2014 was characterized by profitability stagnation. The positive effects (e.g. retail loans growth) were compensated by the negatives (e.g. cost increases to charges, operations and credit risk, retail loans profitability reduce). Annual banks profit has consequently remained almost unaltered.

First, it is favorable that conditions did not deteriorate, on the other, profit fixation is not a final desired state. The goal to enhance the profitability of banks is not valid only for the Slovak banking sector. The other efforts are topical as well. Banks are very sensitive to changes arising from uncertain and variable global situation. They react immediately and intensely. The stability attainment is the key to success. Decisive indicators stabilization is the first step that can provide subsequent growth. It is necessary to identify problems and realize analysis of the situation. The most appropriate instrument in this regard is the efficiency quantification.

2. EFFICIENCY MEASURING

Realization of the banking sector efficiency measurement is relevant considering the aim to demonstrate the performance of referred individual banks. The effort is to uncover the potential upturn. Determining the level of efficiency offers the opportunity to obtain interesting information both for the banking segment regulator and for bank managers.

Efficiency is one of the economic activity indicators. The efficiency characteristic (Stavárek and Šulganová, 2009) is based on the microeconomic bank model perspective in banking field. It also relates to the costs arising from its operations and management. The term efficiency means impossibility to produce additional outcome unit without reduction in the production of another one within existing resources from the economic theory point of view.

Scientific papers addressed to the measurement of the banks efficiency are considering the relative efficiency the most often.

Dealing with the question of efficiency, the production function (Majorová, 2007) is solved in principle. It represents the most appropriate relation between inputs and outputs. The purpose is to achieve outcome maximum for the total given inputs. In the context of efficiency evaluation, the efficiency frontier is an equivalent in some specific sense.

As stated above, the efficiency is related to the production frontier. However, the term efficiency (Stavárek, 2003) can not be identified with productivity or profitability. Productivity represents the ratio of output produced by the capacity of inputs used. Profitability is based on the amount of profit. Profitability analysis focuses more on the

connection between revenues and expenditures. What is significant, the calculation of profitability as well as productivity does not include other units' indicators. The contrary efficiency clearly defines performance level of each unit in the relation to the performance of other units.

3. METHODS FOR QUANTIFICATION OF THE EFFICIENCY

The efficiency assessment from the empiric point of view is based on two major approaches:

- parametric (econometric),
- non-parametric (linear-programming).

The representation of the econometric methods is mainly by Stochastic Frontier Approach (SFA), Distribution Free Approach (DFA) and Thick Frontier Analysis (TFA). The second group is constituted especially by Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH).

The practices SFA and DEA are the best known and the most widely used in the empirical works of domestic as well as foreign authors. The diversity of the choice from the top frequent measurement methods in the efficiency context is shown in Figure 1.

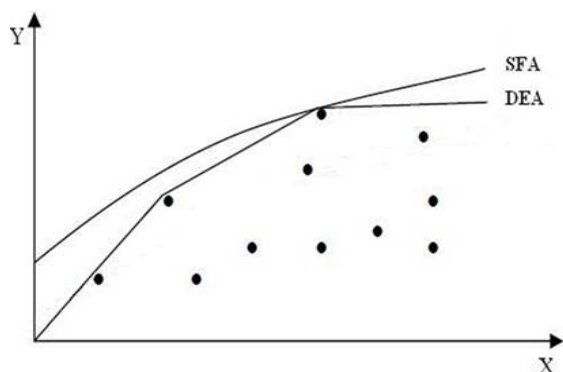


Figure 1 Graphical depiction of approaches differences for determining the efficiency frontier

Source: own adaptation from Stavárek (2005)

The scheme illustrated above deals with a simple model composed of one input and one output. It clearly demonstrates the dissimilarities in defining efficiency frontier based on identical data set by individual approaches.

Fundamental differences (Stavárek, 2005) between parametric and non-parametric methods are seen in regard to preconditions carried out at random errors, the production technology characteristics and the statistical noise. The strengths and weaknesses result from these divergences for each approach.

The research results of many studies have brought the knowledge that choice of the methodological procedure does not affect resulting conclusions ultimately, i.e. the parametric and non-parametric method results are comparable. It is, however, necessary to note that minimal variations may occur.

In view of the calculations realization together with software programming and the number of process grades, the use of DEA method is less complicated than method SFA. However, if the different benefits and disadvantages of each technique take account, they should be perceived (Král' and Roháčová, 2013) as complements not substitutes.

4. DATA ENVELOPMENT ANALYSIS TECHNIQUE

Data Envelopment Analysis is method with broad-spectrum utilization. It has been introduced in many areas in practice. The reason is reflection of any subjects' types performing the same or even similar activity.

Mentioned approach (Koróny and Hronec, 2012) is placed in the different segments - banking, construction, education, tourism, engineering and the like. It occurs on the one hand in the private sphere and on the other hand in the public domain. Such entities (Dlouhý et al., 2007) can be for instance universities, hospitals, industrial enterprises and not least bank affiliates.

DEA (Grmanová, 2013) is one from a group of methods used for comparing the efficiency of multiple inputs to multiple outputs transformation. This approach applies linear programming. Each evaluated subject obtains efficiency rate implementing a mathematical model. By using this efficiency rate, the conversions of multiple inputs to multiple outputs can be compared. It is a relative measure which depends on the transformation in the context of the whole group of rated entities. One of the main DEA method objectives is to complete the ranking table by the degree of the considered units' efficiency.

Whereas the several inputs and outputs species of the unit valuation can be considered (Staničková and Melecký, 2011), Data Envelopment Analysis is one of the multi-criteria decision making techniques.

Multi-criteria decision (Repiský, 2005) entails the various options assessment through multiple criteria by resolving subject. Objectification of the decision making process depends on a number of evaluation aspects. For the small evaluation criteria and alternatives number applies the entity doing a verdict can regard the intuition. However, a larger criteria quantity and complex situation requires formalized procedures. A suitable one is weights delimitation of evaluation criteria and the aggregation of partial assessments in complex analysis.

The entity is generally referred as homogeneous production unit in DEA theory. It represents a set of units (Jablonský and Dlouhý, 2004) defined by the production of identical or equivalent effects - unit outputs. To generate the effects, production units use up a certain amount of input which is minimized inherently. The efficiency measuring is therefore realized through mentioned units (individual subjects) also known as decision making units (DMUs).

Benefit of Data Envelopment Analysis is that it takes into account more than one factor involved in the efficiency of the entire unit (inputs and outputs position simultaneously). Factors can be specified in different units which is an advantage compared to quantify the efficiency through ratio indicators, for example.

Organization efficiency, performance and productivity are derived from diverse characteristics given in the not uniform measure units. Even a situation of identical unit expression entails their very difficult aggregation. DEA is therefore also suitable for non-economic efficiency evaluation because input factors have not to be in financial terms. From the banking point of view, it is possible to combine financial and non-financial data.

In the context of the ratio indicators mentioned above (Svitálková, 2014), the most common are ROI (Return on Investment), ROA (Return on Assets), ROE (Return on Equity). There exist naturally another financial ratios and quality indicators from the fundamental finance analysis platform.

A further negative aspect of these standard performance indicators is regard on the comparison of a large results number to make conclusions about bank efficiency. The indicators based on ordinary reports are nevertheless very popular and frequently used in managerial practice. It should be noted that they involve just a particular part of the banking information needed to get an integrated efficiency reflection.

Data Envelopment Analysis technique presumes the important prerequisite for units performance increasing is the homogeneous production units' efficiency assessment and the identification of inefficient sources (Klieštík, 2009).

DEA enables (Fiala, 2011) to assess the banks efficiency one-to-one in compare with the others. It is further feasible to cogitate about comparison with whole set of banks. After their division to effective and ineffective ones the source of inefficiency can be identified. Consequently, it is possible to make reduction arrangements or to increase inputs/outputs. The effective bank exemplar may be established.

The application of Data Envelopment Analysis method for evaluation the banks efficiency (Jablonský, 2007) is listed in the following steps:

1. a set of admissible solutions consisting of bank inputs and outputs combinations is constructed to an individual problem,
2. the set is determined by efficient frontier containing the efficient banks (the efficient bank is one that there do not exist some other bank/banks achieving the same output with using less inputs respectively reaching higher production for the same amount of inputs),
3. weights system is used for the aggregation purpose,
4. homogeneous set of banks is specified and each bank is significant with some inputs and outputs amount - the calculation of resulting efficiency degree is realized with involving the individual weights (weights have meet the condition that their value must be larger than 0),
5. scale of the bank efficiency is maximized according to condition that efficiency degree of other banks is lower respectively at most equal as the value 1, in other words as 100%.

Similarly to the other methods, DEA analysis disposes with some recommendations for its use. This applies particularly to the two basic characteristics which should be correctly determined:

- extent of the estimated data set,
- quantity of inputs and outputs.

If the analysis includes unsubstantiated many inputs and outputs in view of the DMUs number (Ševčovič et al., 2001), the majority of them will show up artificially as effective. Empiricism resulting from the large-scale calculations leads to conclusion that optimal number of all used inputs and outputs does not exceed one third of the analyzed units' number.

5. CONCLUSION

Ratio indices are a suitable tool for the partial business activities analysis. For banks, it is the loan portfolio quality, liquidity degree, profitability, cost ratio and others. However, the creation, calculation and application of the one integrated efficiency indicator appears to be the best solution compared with many different indicators usage for the evaluation of complex economic bank operation. Data Envelopment Analysis offers such attitude. To

measure the efficiency of banks, it is the most frequent non-parametric method. By identifying efficient banks and thus also inefficient ones, this approach offers the possibility to find a gap for improvement. Bank functioning inefficiently may eventually become effective by means of implementing various rationalization measures. DEA involves some predicaments, as well. Nevertheless, it represents very appropriate respond to the efficiency questions and through it to the comprehensive bank performance.

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