PERFORMANCE EVALUATION OF BANKING SECTOR BY USING DEA METHOD

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ABSTRACT
Performance evaluation of financial institutions is crucial for the development and improvement of financial system and the whole national economy. Most of traditionally structured financial systems, particularly those in the post-transition EU countries, are strongly determined by the domination of banking sector and underdeveloped financial markets. Nevertheless, research of banking performance can be further improved as a stimulus for the further development of financial system and to provide important information for creditors, investors and stakeholders. The efficiency of financial institutions has been widely and extensively studied in the recent years. In this paper, the Data Envelopment Analysis (DEA) method is applied. This nonparametric approach has become one of the most commonly used methods in measuring technical and cost efficiency of financial institutions. The purpose of this paper is to determine factors, i.e., inputs and outputs of models which evaluate the relative efficiency of banking sector as well as the relative efficiency of particular banking institutions. The paper emphasizes a number of variables that can be used in DEA models for banking institutions, for example asset value, number of employees, interest and non-interest income, deposits and loans. The main results of the research will be the comparative analysis of different theoretical and empirical scientific research regarding banking sector evaluation especially for the new EU member countries, including Croatia. Although authors present the research achievements of the relative efficiency of banking sector, this can be the basis for further empirical studies of banking sector efficiency measurement.

Keywords: bank efficiency, banks, Croatia, DEA analysis

1. INTRODUCTION
One of the most important functions of management is to evaluate and measure performance of different units or entities operating under the same circumstances or similar conditions in order to identify their shortcomings and devise strategies for business improvements. Performance evaluation of different financial institutions is crucial for the development and improvement of financial system and the whole national economy. Most of the traditionally structured financial systems, particularly those in the post-transition EU countries, are determined by the domination of banking sector and underdeveloped financial markets. Research of banking performance can be further improved as a stimulus for the further development of financial system.
Therefore, performance evaluation of banking institutions or banking sector is the object of this paper. The efficiency of banking institutions has been widely and extensively studied in the recent years. In this paper, the Data Envelopment Analysis (DEA) method is applied. This nonparametric approach has become one of the most commonly used tools in measuring different efficiency models and approaches of the financial institutions. The purpose of this paper is to determine factors, i.e., inputs and outputs of models which evaluate the relative efficiency of banking sector as well as the relative efficiency of particular banking institutions. The paper emphasizes a number of variables which can be used in DEA models for banking institutions, for example, asset value, number of employees, interest and non-interest income, deposits and loans. Finally, the main results of the research will be the comparative analysis of different theoretical and empirical scientific research regarding banking sector evaluation especially for the new EU member countries, including Croatia. Using DEA method, the evaluation of the performance of banking institutions has become a very interesting research topic that can provide important information for creditors, investors, stakeholders and academic researchers as well.

2. DIFFERENT APPROACHES AND METHODS OF EVALUATING THE BANKING SECTOR

Various methods which evaluate the performance of banking industry or banking institutions can be found in literature. Generally, they can be divided into two major segments: traditional financial indicators and relatively new methods which can be nonparametric (DEA method) or parametric (SFA method). The most commonly used traditional ratios or indicators include Return on Assets (ROA) and Return on Equity (ROE), liquidity, loan portfolio quality, cost, balance sheet structure, capital adequacy, etc. (Gavurova et. al., 2017). For example, evaluating the performance of South Africa’s commercial banking sector during the period 2005-2009, Kumbirai and Webb (2010) examine the following three performances: a) profitability performance (Return on assets (ROA), Return on equity (ROE) and Cost to income ratio (C/I)); b) liquidity performance (Liquid assets to deposit-borrowing ratio (LADST), Net loans to total asset ratio (NLTA) and Net loans to deposit and borrowing (NLDST)); and c) asset credit quality (credit performance) (Loan loss reserve to gross loans (LRGL)). Also, some of the authors use traditional ratios, particularly ROA and ROE to assess the performance of banks (e.g. Said, Tumin, 2010; Bičo, Ganić, 2012). Disadvantages of traditional financial ratios are the complicated comparability of bank entities due to their different characteristics (size, specialization, etc.) and significant differentiation of financial results, which make it difficult to create reference comparable groups. For that reason, new techniques efficiency assessment have emerged. The most famous and the most commonly used methodology is surely Data Envelopment Analysis. DEA is a reliable and suitable method for assessing the relative efficiency of comparable units that use similar business technology and operate in similar conditions. As a nonparametric method, it does not require knowledge of functional relationship between inputs and outputs, as opposed to other approaches to efficiency assessment, for example, with regression analysis method. In addition to reliability, simplicity and flexibility, its advantages are especially reflected in the following two characteristics (Mantri, 2008): 1) it is assumed that there is a connection between selected variables, i.e., inputs and outputs of the model, which does not require analytical determination, but it should be confirmed; 2) variables of a model may be expressed in different units of measurement. This method is often used in assessing the efficiency of financial institutions, especially banks. While evaluating the efficiency of banking institutions by applying the DEA method, several types or models of the DEA (Othman et al., 2016) can be determined. The basic DEA model is the CCR model (named according to authors: Charnes, Cooper and Rhodes) based on constant returns to scale (CRS) assumption, and efficiency defined as the ratio of output to input (Charnes, Cooper, Rhodes,
Another commonly used DEA model based on the assumption of variable returns to scale (VRS) with piecewise linear efficiency frontier is the BCC model (named according to authors: Banker, Charnes and Cooper) (Banker, Charnes, Cooper, 1984). Also, those may vary according to the choice of path projection of an inefficient unit on the efficiency frontier in order to improve efficiency (models that are oriented on the reduction of input or increase in output). Although efficiency determination is carried out under static conditions, i.e., at a given point in time, the dynamic component of efficiency is also often analysed in research, i.e., change in efficiency over time, the so-called “window analysis” (Maradin, Cerović, 2014). DEA methodology allows comparison of selected units/entities with the best ones in the sector, i.e., with entities achieving the highest level of efficiency. Also, it is important to point out that, with this methodology, it is also possible to determine the sources of banking institutions’ inefficiency and to have an impact on their elimination. This methodology provides the regulatory authorities, which are responsible for stable and efficient operation of the banking sector, with the opportunity to establish appropriate mechanisms or measures to improve efficiency of the aforementioned sector. There are a few different approaches which can be used for defining the input-output relationship in financial institution behavior using DEA method:

a) the production approach views banks as a producer of products and services using labour and other resources as inputs and providing deposits, loans and other services (in value or number of transactions) as outputs;

b) the intermediation approach studies the intermediary role of banks in order to examine banks’ efficiency in collecting deposits and other funds from customers (inputs) and then lending out money in various forms of loans, mortgages, and other assets (i.e., investments);

c) the profitability approach examines the process banks’ usage of its inputs (expenses) in order to produce revenues (Paradi, Rouatt, Zhu, 2011; Tuškan, Stojanović, 2016).

The next section presents the results of the research of relative efficiency in banking sectors of different EU countries using DEA method.

3. EMPIRICAL REVIEW OF THE RELATIVE EFFICIENCY IN THE EUROPEAN BANKING SECTOR

Many studies have been conducted in evaluating relative efficiency of banking sectors or banking institutions in the European countries using DEA methodology. The DEA model was first modified by Sherman in order to measure banks’ performance in 1984, and since then, was extensively used by banking industry to measure banks’ operational efficiency (Sherman, Zhu, 2006). Only the most significant studies are mentioned in this section. Novickytė and Droždz (2018) examine the efficiency of seven DMUs (banks) in Lithuania (a low interest rate environment) during the 2012–2016 period by applying input-oriented DEA method with CRS and VRS assumptions. The research sample consists of six commercial banks operating in Lithuania; seven branches of foreign financial institutions are included in the sample as one aggregated bank (financial data of foreign bank branches). Five alternative models with different input-output combinations were developed, based on production, profitability and intermediation approaches, as follows: 1) deposits as input and operating profit as output, 2) labour expenses as input and loans as output, 3) deposits and debts to banks and other credit institutions as inputs and profit before tax as output, 4) deposits as input and loans as output, 5) deposits as input and net interest income as output. The Lithuanian bank’s efficiency analysis based on the VRS assumption illustrates that local banks demonstrated better results. The technical efficiency analysis based on the CRS assumption shows other results: the banks owned by the Nordic parent group and the branches have higher pure efficiency than local banks and are successful in working at the right scale. It is stated that the large Lithuanian banks (subsidiaries) applied a more appropriate business model than small (local) banks operating in
Lithuania. Moreover, the profitability and efficiency of banks in Lithuania are marked higher if compared to other banks operating in the EU. Bucevska and Hadzi Misheva (2017) investigate the relevance of structure-conduct-performance (SCP) hypothesis versus the efficiency hypothesis in explaining bank performance by analysing 127 commercial banks from six Southeast European countries (Slovenia, Croatia, Serbia, Bosnia and Herzegovina, Montenegro, and Macedonia) during the period 2005–2009. In order to account for the dynamic nature of bank profits, it uses a GMM estimator in testing the determinants of bank profitability. The estimation results suggest that profits persist to some extent, indicating that the deviation from a perfectly competitive market structure is marginal. In addition, the findings suggest that efficiency is significantly and positively associated with profitability, whereas the industry concentration variable is insignificant in explaining profitability, indicating support in favour of the efficiency hypothesis. Moreover, among the bank-specific control variables, only size is reported insignificant, and the rest of the variables affect bank profitability in the anticipated manner. The results suggest that neither inflation nor economic growth has an impact on bank profitability. In their study, Serrano Cinca, Mar Molinero and Fuertes Callén (2016) analyse the selection of inputs and outputs in the context of financial institutions in the DEA methodology. There are various views of what constitutes inputs and outputs in a financial institution. The study uses multivariate statistical techniques (33 regressions were performed) in order to explore point of various combinations in which inputs and outputs are equivalent, and to explore the point at which efficiency score obtained by a given institution changes under the various combinations of inputs and outputs. This helps in the search for the best specification, and can direct other specification search tools such as the bootstrap. Although the methodology is applied to the particular case of American banks efficiency, it could be a starting point in the selection of inputs and outputs of financial institutions in future studies. Tuškan and Stojanović (2016) analyse and compare efficiency results in the banking industry during the period 2008–2012 on a sample of 28 European banking systems using two different approaches: financial indicators and the DEA methodology. In the indicator-based approach, they used chosen accounting ratios (Return on Assets - ROA, Return on Equity – ROE and Cost to Income Ratio - CIR) and the descriptive statistics methodology to conduct analysis. In the DEA approach (output-oriented DEA models), interest expenses and total operating expenses as input data, and interest income and total operating income as output data are used for measuring efficiency using CRS, VRS and window analysis of DEA method. Given the aforementioned, the profitability approach (analysis of bank profit efficiency) is used. The results of the different ways of measuring efficiency suggest that the DEA methodology can be a useful alternative or complementary analytical tool in detecting early signs of inadequate business strategies, which can lead to the slowdown of business activities or poorer efficiency results. Importantly, this is also true in times of an unstable financial or macroeconomic environment, as it may facilitate the detecting of early signs of a crisis, earlier than by using accounting indicators. In general, the results of both approaches suggest that banking systems in post-transition countries have a higher cost efficiency. Such systems continue to be dominantly financed through long-term deposits and are also exposed to a specific risk. Řepková (2014) examines the efficiency of 11 Czech commercial banks (with regard to mergers and acquisitions of banks) during the period 2003–2012 by applying DEA window analysis SBM (slack based model – non-radial) based on input-oriented model. Two inputs (labour and deposits) and two outputs (loans and net interest income) are used. Labour is measured by the total personnel costs covering wages and all associated expenses, and deposits by the sum of demand and time deposits from customers, interbank deposits and sources obtained by bonds issued. Loans are measured by the net value of loans to customers and other financial institutions, and net interest income as the difference between interest incomes and interest expenses.
In the analyzed period, the average efficiency under CRS reached 70–78% and average efficiency under VRS reached 84–89%. The most efficient bank was GE Money Bank and the least efficient bank was Československá obchodní banka. The large bank group (Československá obchodní banka, Česka spořitelna and Komerční banka) was less efficient than other banks in the banking industry. The reasons of the inefficiency of the large bank group were the excess of deposits in balance sheet and inappropriate size of operation. Jurčević and Mihelja Žaja (2013) identify and compare the efficiency measurement results of 30 banks and 19 insurance companies using DEA method and accounting indicators in the period before and after the onset of recent economic crisis (2005-2010) in the Republic of Croatia. For each bank, the inputs were interest expenses, non-interest expenses and other expenses (labour-related and capital-related administrative expenses and other expenses from bank’s business activity); outputs were interest incomes, non-interest incomes and other incomes from business activity. The main difference in results between DEA approach and accounting approach was shown in the accounting approach efficiency measurement scores lag during the crisis period. DEA efficiency scores had the lowest values in the 2007 for insurance industry, and in 2008 for banks but with visible lower values already in 2007. The lowest ROA and ROE accounting ratios in the 2009 can be explained by the fact that although financial institutions tend to operate more efficiently during crisis period in view of expense and income results, accounting ratios cannot achieve such good levels during crisis periods as during periods of expansion due to the deteriorated market conditions and restrictive business policy. Memić and Škaljić-Memić (2013) analyse and compare the efficiency of 26 commercial banks in the territory of Bosnia and Herzegovina by using financial ratio measures combined with the DEA method during the period between 2008 and 2010. Two entities of Bosnia and Herzegovina (Federation of Bosnia and Herzegovina, and Republika Srpska) are observed separately because of the peculiarity of the institutional and legal regulations of the banking sector in Bosnia and Herzegovina. Five financial ratios (Return on Assets, Return on Equity, Net Interest Margin, Profit/Loss per employee, Efficiency Ratio) were chosen to reflect efficiency as well as profitability dimensions of banks’ performance. It can be concluded that the overall efficiency of banking sector has improved over the observed period between 2008 and 2010, even though the profitability has declined significantly. Moreover, there is no significant difference between performance of banks in different entities of Bosnia and Herzegovina, and between small and large banks. The research (Wozniewska, 2008) was carried out in the biggest commercial banks operating in Poland during the period 2000–2007, computed by means of financial indicators and DEA method. The value-added approach (the production approach) has been chosen using different variables in the DEA model – net fixed assets and the total number of employees as inputs, and the volume of loans, deposits and non-interest income as outputs. The results achieved by both methods show an increase of the efficiency of banks’ performance in the second part of the observed period. Moreover, empirical results show that the efficiency measures give similar, although not identical, outcomes of Polish commercial banks’ performance. These results are complementary to each other and suggest that the DEA method is really valuable and worth applying in bank practice. Jemrić and Vujčić (2002) measure the relative efficiency of banks in the Croatian market according to size, ownership structure, date of establishment and quality of assets in the period from 1995 until 2000 (individually for each year) using both DEA models, i.e., the CCR and BCC models. DEA models were used under two different approaches in estimating the relative efficiency of the banks: 1) operating approach and 2) intermediation approach. These two approaches reflect two different ways of evaluating bank efficiency: one from the perspective of cost/revenues management, and the other, a more technical one, which takes banks as entities using labour and capital to transform deposits into loans and securities. Different sets of inputs and outputs were used for the two approaches in estimating efficiency.
The results of the research can be summarized as follows: averagely, foreign-owned banks were the most efficient; the new banks were more efficient than the old ones; smaller banks were globally efficient, but large banks appeared to be locally efficient when variable returns to scale was applied. There has also been strong equalization in terms of average efficiency in the Croatian banking market, both between and within the peer groups of banks. Regarding particular inputs, the most significant cause of inefficiency among state-owned and old banks vs. foreign-owned and new ones is the number of employees and fixed assets. In terms of size, the most efficient in various specifications are either the smallest or largest banks, and the technically more efficient banks are those that have, on average, less non-performing loans, but this conclusion becomes more obvious only with the gradual consolidation in the banking sector.

4. CONCLUSION

Based on the literature review, this paper analyses both in theory and empirically, the performance evaluation of financial institutions, i.e., the relative efficiency assessment of banking sector as well as the relative efficiency for particular banking institutions by applying the Data Envelopment Analysis method. The efficiency of banking sector or banks is crucial in terms of competition during the transition to a market economy, especially in the post-transition EU countries, and for the development and improvement of financial system and the whole national economy. Nowadays, well-functioning financial markets and banking institutions are usually considered to be a condition favorable to economic growth. Thus, it is necessary to analyse and evaluate banking performance, determine their relative efficiency and eliminate possible sources of inefficiency. Empirical research from a number of authors show different approaches, DEA methods and variables used in efficiency measurement. Approaches such as production, intermediation and profitability approach can be found. DEA methods can be regarding the constant returns to scale (CCR model) or variable returns to scale (BCC model), input-oriented or output-oriented which refers primarily to the evaluation approach, by one year efficiency assessment or during a time period (window analysis), etc. Also, a number of variables which can be used in DEA models for banking institutions, for example asset value, number of employees or labour expenses, interest income, deposits and loans is emphasized. The research of banking performance can provide important information of relative efficiency among the examined entities in the sample, as well as sources and amounts of inefficient banking institutions which are of interest for creditors, investors and stakeholders. Finally, in reviewing the literature, the conclusion is that most studies deal with some slight differences in the relative efficiency measurements of banks over a period of time. Furthermore, this research can be the basis for further empirical study of banking sector efficiency measurement.

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LITERATURE:


