

RANKING OF BANKS IN SERBIA¹

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Abstract: It is often very difficult to rank entities characterized by more than one indicator. In the case of banking sector, especially in transition countries, it would be important to determine the relationship among the banks, regarding their efficiency and relevant characteristics. The results obtained in two different ranking processes are presented, discussed and compared in this paper. The first procedure is based on Data Envelopment Analysis, mathematical programming technique that can be applied to assessing the efficiency of a variety of entities, using variety of data. The second procedure is based on I-distance, a multivariate statistical method for ranking entities. Both methods allow the use of several criteria, and they both give one single index which can be considered as a rank. The complementary use of the two methods provides more realistic picture of the tendencies in the banking sector and the combination of the results obtained in two processes provides a useful background for more comprehensive evaluation of the banks efficiency.

Keywords: Data Envelopment Analysis, I-distance, ranking, banks.

1. INTRODUCTION

Banks play a vital role in the economy of any country and the evaluation of their overall performance is very important. The most common way of measuring financial

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performance and quality of banks management is calculation of financial ratios and their comparison with benchmarks. If numerous criteria (profits, liquidity, asset quality, risk level, management strategies etc.) are considered simultaneously, the process can be very complex. Different statistical methods that include regression form or production function form are often used for this purpose, as well as the non-parametric operational research method, named Data Envelopment Analysis (DEA). DEA recently became a leading method for measuring and comparing performance of different entities, especially banks [3].

The use of DEA and multivariate statistical method I-distance will be presented here. In the set of DMUs (decision-making units), DEA gives measure of DMU's efficiency by comparing performance of DMU with efficient entity. On the other hand, in I-distance ranking process, rank is determined as the distance from referent DMU, defined at the beginning of the analysis, usually virtual one with average, minimal or maximal values for all the variables.

Current state of banking system in Serbia is described in chapter 2. of the paper. Chapter 3. introduces methodologies. Description and the results of ranking procedures by DEA and I-distance methodologies are given in chapter 4. Ranks obtained by both methods for each bank are given and compared. Sources of inefficiency and possible reasons for different ranks are analyzed and some conclusions are made.

2. BACKGROUND

Serbian industry passed through long recession period in the 90s. Banking industry was faced with decreasing of performance, undeveloped financial market, absence of an appropriate legal framework, etc. In the last 7 years, comprehensive changes in industrial sector, legal system and institutions, and, consequently, in the banking system, have occurred. Positive trends have been recorded from 2003, especially in the better-structured financial balance reports [12]. During the previous years, banking system was recovered and became one of the strongest industry development drivers. However, banks in Serbia operate under very restrictive conditions set up by the National Bank of Serbia, strong competitiveness and process of reforms and privatization of their clients. However, it is very interesting that the banking sector has been increasing very fast, in spite of all difficulties.

One of the most important changes in banking sector was made when the new Law on Banks was introduced in November 2005. That law has been in full implementation from October 1, 2007. The procedure of strict banking control, based on the same consolidate parameters, has been introduced according to the new law terms and provisions.

It is clear that the banking sector in Serbia has been passing through the period of turbulence, changes of the ownership structure caused by privatization, organizational structure changes inside the bank institutions, as well as the changes due to the law requirements. In those circumstances, it is very difficult to set up stable benchmarks and rank the banks.

3. METHODOLOGY REVIEW

As mentioned above, in order to evaluate and rank banks in Serbia according to their efficiency, we have used one non-parametric (Data Envelopment Analysis) and one parametric method (I-distance). The methods are briefly described in this chapter.

3.1. Data Envelopment Analysis

DEA is quickly emerging as a leading method for performance evaluation, in terms of the number of published research papers, as well as in the number of applications [5]. DEA was introduced in 1978 by Charnels, Cooper and Rhodes [4]. Their model, known as the CCR model, was named after its founders. DEA is an extension of Farrell's [6] single input and output method of measuring efficiency. This approach allowed measuring the efficiency and productivity of an organization in terms of a single input that produces two separate outputs, or two inputs used to produce a single output. Relative efficiency ratio of observed DMU is calculated in relation to other units. Efficiency frontier is created as a set of best performers. This approach, however, has a limited application since it works only for two inputs/outputs simultaneously. The DEA CCR model overcomes this limitation as it allows the consideration of more than two inputs/outputs simultaneously.

Main objective of DEA models is to calculate efficiency of all DMUs in the observing set. Efficiency, in the terms of economy, is defined as:

$$\text{Efficiency} = \frac{\text{Output}}{\text{Input}} \quad (3.1.1.)$$

Inputs generally refer to resources, such as: labor, raw materials and capital. Outputs are items produced from the inputs, as a result of the process performed within the DMU. The aforementioned efficiency equation becomes more complicated when multiple inputs and outputs are considered. In that case, efficiency is defined as:

$$\text{Efficiency} = \frac{\text{Weighted Sum of Outputs}}{\text{Weighted Sum of Inputs}} \quad (3.1.2.)$$

Determination of the weights requires very strong assumptions to be met. Each DMU may utilize its inputs and outputs differently and selected weights can significantly affect the results of the efficiency calculation. Following that idea, CCR model authors [4] considered weights as variables. CCR model lets each DMU to choose the most appropriate set of weights in order to become as efficient as possible in comparison with the other units in the observing set. Efficiency ratio is scaled between 0 and 1, and all efficient units have the same ratio equal to 1. CCR model assumes constant return to scale, which means that a change in the amounts of the inputs leads to a similar change in the amounts of the outputs. DEA has been further extended since the introduction of the CCR model. One of the most significant extensions of the original CCR model was the development of the BCC model in 1984 by Banker, Charnes and Cooper [3]. The BCC

model allows the efficiency measurement of DMUs with a variable returns to scale and is able to distinguish between technical and scale inefficiency. Technical inefficiency is calculated by measuring how well the unit uses its inputs to create outputs, while scale inefficiency identifies whether increasing, decreasing, or constant returns to scale exist. Basic DEA models allow ranking among inefficient DMUs, while all efficient units have the same index of efficiency equal to 1. In order to make a difference between efficient units and allow their ranking, Andersen and Petersen introduced super efficiency measuring model [1]. That model will be used in the research presented here.

Suppose that DMU_{*j*} (*j* = 1, ..., *n*) uses inputs *x_{ij}* (*i* = 1, ..., *m*) to produce outputs *y_{rj}* (*r* = 1, ..., *s*). Output-oriented dual version (inputs are fixed at their current levels and outputs are maximized) of Andersen-Petersen's super-efficiency DEA model is following:

$$(\max) \phi_k = \phi_k - \varepsilon \left(\sum_{i=1}^m s_i^- + \sum_{r=1}^s s_r^+ \right) \quad (3.1.3)$$

st.

$$\sum_{\substack{j=1 \\ j \neq k}}^n \lambda_j x_{ij} + s_i^- = x_{ik}, \quad i = 1, \dots, m \quad (3.1.4)$$

$$\phi_k - \sum_{\substack{j=1 \\ j \neq k}}^n \lambda_j z_{rj} + s_r^+ = 0, \quad r = 1, \dots, s \quad (3.1.5)$$

$$\lambda_j, s_r^+, s_i^- \geq 0; \quad j = 1, 2, \dots, n, \quad r = 1, 2, \dots, s, \quad i = 1, 2, \dots, m, \quad Z_k - \text{unrestricted} \quad (3.1.6)$$

The optimal values of efficiency scores ϕ_k are obtained by solving the linear model (3.1.3)-(3.1.6) *k*- times (once for each DMU in order to compare it with other DMUs). Efficiency score ϕ_k is 1 for all efficient units and greater than 1 for inefficient units (while efficiency score ϕ_k is less than 0 for inefficient units if input oriented model is used). By excluding inputs and outputs of DMU_{*k*} from constraints (3.1.4) and (3.1.5), ranking of efficient units is enabled and intensity factors have values $\phi_k \leq 1$. All inefficient units are enveloped by production frontier, consisted of efficient DMUs, and for each of them an analyst could find benchmark (real-efficient or virtual-composite peer unit lying on efficiency frontier). Variables λ_j are dual weights which show DMU_{*j*} (*j* = 1, 2, ..., *n*) significance in definition of input-output mix of hypothetical composite unit (peer unit).

DEA offers many advantages over traditional efficiency measurement approaches. Some of the differences are the following:

- DEA provides a single unambiguous measure of performance,
- DEA can handle multiple inputs and outputs, in different measurement units,
- DEA is focused on DMUs best practice, and

- DEA results can be used in determination of the forthcoming actions in managing the observed DMU. DEA can offer recommendations by calculating a virtual DMU efficiency for each DMU under evaluation.

DEA is widely used for measuring performance in financial industries. The review of applications from 1987 to 1997 for performance measurement of financial institutions is given in [3]. DEA is used in 70 out of 131 applications, mostly in USA (53 out of 70 applications).

There are two main approaches in measuring banks performance:

- Production approach (a bank or a bank branch uses resources for making transactions and selling financial products) and
- Intermediary approach (a bank or a bank branch collects money and converts it into loans or use it to make profit).

If we focus on DEA applications in countries in transition, many applications in South-East Europe, India, Turkey, etc, can be found. In [7] the authors compare cost efficiency among 289 banks in 15 post-communist countries using intermediary approach. Results show that foreign banks are more competitive and have better results in the cost efficiency than domestic banks. In [8] the authors evaluate efficiency of the Polish banks. They concluded that better results were obtained when the banks were divided into two groups, domestic and foreign. Using the intermediary approach, their performance was evaluated. Jermić and Vujčić [11] compared banks efficiency in Croatia during the transition period from 1995 to 2000. The trend of efficiency ratio was positive, due to the ownership structure changes. At the beginning of the observed period, there were 1 foreign and 53 domestic banks. At the end of the period, there were 20 foreign and 20 domestic banks. Another area of DEA application in the financial sector is a micro-finance [14]. The procedure for efficiency and effectiveness assessment of micro-loan programs in Serbia is given in [15].

3.2. I-distance method

I-distance method is developed by Ivanović [9] during his research on countries and regions ranking, based on development level, in the period from 1950 to 1970. Many socio-economical development indicators were considered and the problem was how to use all of them in order to calculate a single synthetic indicator which will represent the rank.

Selection of indicators is the first and one of the most important steps in the ranking procedure. Statistical methods, such as correlation analysis, can be used in order to define the set of the indicators relevant for the analysis. Calculated I-distance depends on the order of the chosen indicators. It was suggested that the indicators should be ranked according to their importance. The first attribute is the most important, while the last one has the smallest influence.

Let $X = \{x_{1s}, x_{2s}, \dots, x_{ks}\}$ be the set of indicators, ordered by their importance, for the DMU P_s . I-distance for the units P_r and P_s , is defined as follows:

$$D(r, s) = \sum_{i=1}^k \frac{|d_i(r, s)|}{\sigma_i} \prod_{j=1}^{i-1} (1 - r_{ji.12\dots j-1}) \quad (3.2.1)$$

where $d_i(r, s) = x_{ir} - x_{is}$, $i \in \{1, \dots, k\}$ is *discriminate effect*, e.g. difference between values of attribute x_i for P_r and P_s . σ_i is standard deviation of x_i , and $r_{ji.12\dots j-1}$ is partial correlation coefficient for x_i and x_j , ($j < i$).

I-distance is calculated through the following steps:

- Calculate the value of *discriminate effect* of attribute x_1 , (the most significant indicator).
- Add value of *discriminate effect* of x_2 which is not covered by x_1 .
- Add value of *discriminate effect* of x_3 which is not covered by x_1 and x_2 .
- Repeat the procedure for all indicators [4].

Squared I-distance, defined by (3.2.2), is used in order to eliminate negative values of partial correlation coefficients.

$$D^2(r, s) = \sum_{i=1}^k \frac{|d_i^2(r, s)|}{\sigma_i^2} \prod_{j=1}^{i-1} (1 - r_{ji.12\dots j-1}^2) \quad (3.2.2)$$

In order to rank the elements in the observing set using I-distance methodology, it is necessary to fix one unit as a referent. A unit with minimal value for each indicator, or some fictive maximal or average values unit, can be set up as the referent unit. Ranking of the units in the set is based on the calculated distance from the referent unit.

The banks in the countries in transition are passing through some processes of comprehensive changes caused by introducing new organizational structures, changing ownership structure, adjusting to the new market or law requirements, and therefore, it is not enough to include just one measure, as profitability or ROA, into performance measurement system. The banks resources should be considered. The I-distance methodology can be used in order to rank the banks according to their performance, expressed through different indicators, similar to those of the developing countries observed and analyzed in [9].

4. RANKING OF THE BANKS IN SERBIA

In this section we will describe the ranking processes based on the methodologies described in Chapter 3. and applied on data regarding banks in Serbia. The data for 11 business indicators, chosen by experts in economics as the indicators of banks' success have been published in the Report of National Bank of Serbia for the year 2005 [11]. According to this, the observing set consists of 41 banks (DMUs) operating in Serbia in 2005.

4.1. Ranking of the banks using DEA method

As the number of the available indicators was 11, the first step was to reduce that number. The correlation analysis performed on original data has shown high correlation among several indicators. As the result, **total asset, total capital and number of employees** are chosen as inputs and they represent banks capital, available material and human resources. **Interest revenue** and **revenue before taxation** are chosen for the outputs as indicators of banks success.

The goal of a bank is to maximize profit. That goal and our intention to rank the banks make us use output-oriented Andersen – Petersen's DEA model (3.1.3)-(3.1.6).

The ranks are shown in table 5.1. As the result of DEA model application, just 9 out of 41 banks in Serbia were efficient in 2005. Another 7 out of the 32 inefficient banks have efficiency index greater than, but very close to 1. They need to increase their outputs by less than 11% to become efficient. 13 banks have to increase their efficiency by between 11 and 50%, and 12 banks have to increase outputs by more than 50%.

The most efficient bank was AIK Bank with efficiency ratio of 0.165, the second was Raiffeisenbank, with efficiency ratio of 0.66. Both banks are highly ranked based on capital, asset and outputs values. AIK Bank has 138 employees, while Raiffeisenbank bank has 660 employees. The good result of AIK Bank can be explained if we consider that the outputs almost the same as the outputs of Raiffeisenbank bank were achieved by significantly smaller number of the employees.

The third ranked is a relatively small Meridian Bank with relatively small values of inputs, but its profit ratio was second in 2005. The other efficient banks are: Poštanska štedionica, Procredit Bank, Societe General Yugoslav Bank, Hypo-Alpe-Adria Bank, A Bank and LHB Bank.

A numerous banks were assessed as inefficient, such as: Novosadska Banka, Panonska Banka and Continental Bank. Their outputs should be doubled with current available resources if these banks wanted to be efficient. However, these banks were passing through the privatization process in 2005, and their results should be reviewed considering organizational and other changes they passed through. National Bank of Greece, Volksbank and EFG Eurobank have high efficiency ratio (between 2 and 5), while the highest ratio has Jugbanka from Kosovska Mitrovica with inefficiency value of 39,4 (the most inefficient bank).

4.2. Ranking of the banks using I-distance method

Here we will present some results of I-distance method application in banks ranking in Serbia. As it is mentioned in the previous chapter, the number of the available indicators was 11. In order to prepare data for I-distance ranking, the first step was the same as in DEA application procedure i.e. reduction of the number. The correlation analysis performed on original data has shown high correlation between three types of revenue (net operating revenue, revenue before taxation and revenue after taxation). Instead of the three mentioned attributes, only the revenue before taxation was chosen for further analysis. None of the important information was lost in this step. Principal

Component Analysis [10] (PCA) was performed on the data regarding revenue before taxation and the rest eight indicators. PCA is the technique used to check correlation between variables and eliminate redundancy in the data caused by it. The elementary data matrix is reduced so that the number of variables describing DMUs is reduced. New variables are principal components and each of them represents the whole group (highly mutually correlated) of original variables. Principal components are not correlated mutually and the majority of the original data variability is preserved. Each unit then achieves its values for each of those principal components (factor scores). The new matrix still contains almost all information contained in the original data. In the analysis presented here, three principal components were identified:

- Factor 1: **Factor of branching**,
- Factor 2: **Profit factor** and
- Factor 3: **Capital factor**.

Factor scores for the three principal components (in the numbered order) were used in the calculation of the squared I-distance and the banks were ranked. The results are presented in **Table 5.1**.

5. COMPARISON OF THE RESULTS

In spite of different methodological background of DEA and I-distance methods and differences in calculation of the “ranks”, there are many similarities between them. The main advantage of both methods is the possibility of taking multiple heterogeneous indicators into consideration. Both methods utilize one synthetic indicator, which determines the rank of the unit. In addition, there is no need to give a priori inputs and outputs weights in either case.

On the other hand, both methods need some decisions to be made in advance and, in both cases, these decisions can influence the results. Index obtained, as the indicator of the efficiency by DEA is relative and depends on the number of parameters and DMUs in observing set. It means that including or excluding of some parameter or DMU can cause changes of the ranks.

In the case of the I-distance method, it is necessary to rank the attributes by their importance and to define the referent unit, most often virtual one, with minimal or maximal observed value for each criterion. Different order of attributes, as well as different referent unit, can lead to different ranks of DMU.

Ranks obtained by DEA and I-distance methods are given in Table 5.1.

Table 5.1: Ranks of the banks in Serbia 2005

<i>Bank name</i>	<i>Rank I2</i>	<i>Distance I2</i>	<i>Rank DEA</i>	<i>Efficiency ratio</i>
AIK BANK	1	38,68	1	0,16
RAIFFEISENBANK	2	37,73	2	0,66
DELTA BANK	3	34,10	11	1,03
KOMERCIJALNA BANKA	4	26,40	27	1,4
VOJVOĐANSKA BANKA	5	25,04	28	1,48
JUBANKA	6	22,81	33	1,84
POŠTANSKA ŠTEDIONICA	7	16,33	4	0,70
HYPO ALPE-ADRIA-BANK	8	13,24	7	0,90
KULSKA BANKA	9	10,57	18	1,14
MERIDIAN BANK	10	10,12	3	0,68
SOCIETE GENERALE YUGOSLAV BANK	11	9,22	6	0,81
LHB BANK	12	8,83	9	0,99
PROCREDIT BANK	13	8,44	5	0,76
HVB BANK SRBIJA I CRNA GORA	14	8,09	14	1,09
PANONSKA BANKA	15	6,96	36	1,96
METALS-BANKA	16	6,74	13	1,09
NOVOSADSKA BANKA	17	6,61	35	1,95
EKSIMBANK	18	6,24	20	1,19
JUBMES	19	6,18	19	1,15
MB BANK	20	6,15	23	1,26
CONTINENTAL BANK	21	5,80	37	2,14
SRPSKA BANKA	22	5,61	22	1,24
ATLAS BANK	23	5,60	12	1,06
AGROBANKA	24	5,41	34	1,88
UNIVERZAL BANK	25	5,25	10	1,02
NACIONALNA ŠTEDIONICA-BANKA	26	5,14	29	1,49
PRIVREDNA BANKA PANČEVO	27	4,93	31	1,70
CENTROBANKA	28	4,81	25	1,36
ČAČANSKA BANKA	29	4,76	15	1,09
NATIONAL BANK OF GREECE	30	4,69	38	2,28
ZEPTEK BANKA	31	4,20	21	1,20
NOVA BANKA BEOGRAD	32	3,86	16	1,11
ALPHA BANK	33	3,83	26	1,38
PRIVREDNA BANKA BEOGRAD	34	3,80	24	1,35
CREDY BANK	35	3,75	17	1,12
EFG EUROBANK	36	3,69	40	4,01
A BANK	37	3,69	8	0,94
NIŠKA BANKA	38	3,67	32	1,83
JUGBANKA	39	3,64	41	39,42
VOLKSBANK	40	3,44	39	3,09
KOSOVSKO-METOHIJSKA BANKA	41	2,82	30	1,51

As expected, the ranks obtained as the results of two different methods application on the same data are different. The banks are heterogeneous among them and

they are in various stages of transition process, passing through the turbulent changes. More detailed analysis of the results and the ranking procedures can lead to the useful conclusions.

In the I-distance ranking procedure, the solution is based on three principal components. Banks with highest values for all factors are on the top of the list, followed by the banks with high values of **Factor 1.** and **Factor 3.**, and low value of **Factor 2.** **Total asset, Total capital** and **Number of employees** are used as inputs in DEA and they are comparable with **Factor of branching** and **Capital factor.** **Interest revenue** and **Revenue before taxation** are used as outputs in DEA and they are comparable with **Profit factor.** It can be mentioned that lower rank has the DMU with higher value of I-distance and lower value of efficiency ratio.

Big change of I-distance for two consequent banks in Table 5.1 indicates the big differences in their observed performance. Based on that fact, banks can be divided in four groups, as follows.

The members of the first group are: AIK bank, Raiffeisenbank and Delta bank. Comparing DEA and I-distance results (table 5.1) it can be noticed that the same banks are on the first and second place (AIK bank and Raiffeisenbank). Those are the biggest banks by their total capital (AIK bank), total asset (Raiffeisenbank), and relatively high profit. 3rd bank on I-distance list is Delta bank, ranked 11th by DEA due to the fact that Delta is relatively big bank with big total asset and capital, with highest profit value, but with twice more employees than the others. This group of the banks, according to their characteristics, can be named as **Profitable bank giants.**

The second group consists of three banks ranked 4th, 5th and 6th by I-distance method (Comercial bank, Vojvodanska and Jubanka, respectively). Based on DEA results, these banks are very inefficient (27th, 28th, and 33rd, respectively). Common characteristics of these banks are that they are big banks with no profit in 2004 (except Comercial bank with profit ratio of 4.85%). It is very interesting that Delta bank and Jubank were privatized during 2004. Delta Bank sold its stocks, while Jubank was privatized by the government. The government initialized the process of Vojvodanska bank privatization in 2004 and Comercial bank is recently privatized. Hence, DEA results highlight reasons of banks inefficiency during the transition process. This group of banks can be identified as **Zero-profit bank giants.**

The third group consists of the following banks: Poštanska štedionica, Hypo-Alpe-Adria bank, Kulska bank, Meridian bank, Societe Generale Bank, LHB Bank, Procredit Bank and HVB Bank. All of them are characterized by low capital, high asset level and relatively good performance. Consequently, their DEA ranks are better than I-distance ranks. They can be recognized as **Profitable small and middle banks.**

It can be mentioned that among the first 14 banks on I-distance list, there are only 4 banks with DEA ranks higher than 14 (three non-profitable bank giants and Kulska Bank).

The fourth group consists of the rest 27 banks. These banks are placed in the fourth group because of the low value of at least one factor. Therefore, these are the banks with lower potential than the banks in the first three groups. They are **Zero-profit small and middle banks.** The differences in their I-distance values and efficiency ratios are smaller than among the banks in the first three groups. Even though, some differences can be mentioned.

Panonska Bank, Novosadska Bank and Continental Bank have significantly lower DEA than I-distance ranks. These banks did not gain profit in 2004, and DEA identified them to be inefficient. All of them went through the privatization process in 2004.

The banks that made profit in 2005 were ranked higher according to DEA results. They are not evaluated as efficient, but they are placed closely to production frontier. They are: Credy Bank, Univerzal Bank, Nova Bank, Čačanska Bank, Atlas Bank and A Bank (the only efficient one). The other banks from the fourth group have similar DEA and I-distance ranks.

6. CONCLUSION

The main purpose of this paper was to show how two different methods could be used and combined in solving complicated problem of ranking, based on several heterogeneous attributes. The challenge was to do that in the conditions of banking system transition in Serbia. One of the methods (DEA) has already been used in efficiency assessment of similar systems. Efficiency ratio is here considered as the rank, and the results of I-distance method are compared with those obtained in DEA. In I-distance ranking process presented here, nine indicators were analyzed, transformed in three principal components, and all of them influenced obtained rank. It is shown that by the complementary analysis of the results of DEA and I-distance methods we can clarify the reasons of banks inefficiency. In that way, we overcome the lack of DEA method to estimate a unit as an efficient one based on just one good or incomparable indicator. On the other hand, DEA ranks some banks labeled as “bad performers” lower and shows that they are highly I-distance ranked just because of their size. Simultaneous usage of DEA and I-distance methods shows a new quality of obtained results and we can recommend it.

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