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APPLICATION OF DEA METHODOLOGY IN MEASURING EFFICIENCY IN THE BANKING SECTOR[1]

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Summary

The most important aspect of any business is efficiency. The goal is to achieve greater outputs with lower inputs, or to use the available inputs to the maximum. In this paper, the use of DEA technique will be illustrated in case of measuring operation efficiency of the banking sector in Serbia, which currently has 33 banks. The efficiency of banks will be measured using two models with different input-output indicators, followed by a comparative analysis of the results using the BCG matrix. Banks are ranked according to their efficiency, and the similarities and differences that were observed in the study were commented.

Key words**:** *Banks, DEA, business efficiency, super efficiency, BCG matrix.*

JEL: *C67, D61, G21*

Introduction

The global economic crisis has hit hard the Serbian economy and its effects are visible in the banking sector. Banks in Serbia are in very restrictive conditions set by the National Bank of Serbia, in the conditions of strong competition, along with the processes of reform and privatization of their clients. Important changes in the banking sector were enabled by the adoption of the new Law on banks in November 2005. Its full implementation began on 1 October 2007. The new law outlines procedures for strict control of banking, based on the same or similar parameters for consolidation (Mihajlović et al., 2009).

Numerous authors have dealt with the examination of efficiency of the banking sector by applying different methods in different locations. Given the different approaches and goals,

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authors have used a variety of indicators in their research that have monitored the efficiency of banking sector. However, successful analysis of business requires multi criteria comparative analysis of business performance, so the usage of some of the appropriate parametric or nonparametric methods is recommended. For evaluation of relative efficiency, frequently the nonparametric method DEA (*Data Envelopment Analysis*) is used.

Mohamed (2006) has systematized the numerous approaches in researches of business efficiency of banks in the world using the DEA technique. He has stated that Wu et al. (2006) observed in Canada 142 banks, and monitored the number of employees and costs for input indicators, while for output the following was observed: deposit, income and bank loans. He has further stated that Sakar (2006) in Turkey analysed 11 banks and monitored: input – branch numbers, employees per branch, assets, loans, deposits, and outputs: ROA (return on assets), ROE (return on equity), and interest income (assets), interest income (operating income), and non-interest income (assets). Then in 2002, Mukherjee et al., in India, monitored and analysed 68 banking operations, where the input was: net worth, borrowings, operating expenses, employees, number of branches, and outputs: deposits, net profit, deposit, non-interest income, interest income. Authors Howland and Rowse (2006) observed 162 banks in Canada, where the observed input indicators included: non-sales FTE, sales FTE, the size, the city, the employment rate, and three output indicators: deposits, loans, the average number of products /customers, client loyalty. He also presented in detail many other researches around the world in the aforementioned study (Mohamed, 2006).

On the other hand Milind (2003) carried out the banks efficiency analysis in India on the basis of two models (model A inputs are: interest expenses, non-interest expenses, and outputs: net interest income, net non-interest income, and model B inputs are: deposits, employees, and outputs: net loans, non-interest income).

Authors Fries and Taci (2004) compare the performance of 289 banks in 15 post-communist countries, using an intermediate approach. The results show that foreign banks are more competitive and have better results in cost efficiency than domestic banks. Also, research carried out in Poland by the author Guzowska et al. (2004) shows that better results are obtained if the banks are divided into two groups, domestic and foreign.

In surrounding countries, one of the first studies to appear was the comparison of bank efficiency in Croatia during the transition period from 1995 to 2000 (Jermić, Vujčić, 2002). Trend efficiency ratio was positive, thanks to changes in the ownership structure. At the beginning of the period there was one foreign and 53 domestic banks and in the end there were 20 foreign and 20 national banks.

In Serbia, the first research in this field, using the DEA method, was conducted by Bulajić et al. (2011) and (2011). In this research 30 banks were monitored and their observed indicators were: input – measurement for operational costs engaging capital, measurement for the cost of available capital, measurement of overall risk exposures, and asset value for January 1st in observed year, employees, number of affiliates and bank branches. Considered outputs were: the value of total assets on December 31st in observed year (total assets at beginning of year

plus profit/loss) as a measurement of business performance, total revenues in the period of a year, interest income.

Following the example of Milind Sathye's research (2003), in the present analysis the same input and output indicators will also be used for the purpose of bank ranking in Serbia. Currently, in Serbia 33 banks operate. The goal is to determine which one is the most efficient. Nineteen out of 33 observed banks belong to the private sector. Data were taken from the balance sheets and income statements of banks from the website of the National Bank of Serbia for 2010[5]. According to these data, the highest share of total assets from the balance sheet has Banca Intesa in the amount of 357.163.979.000 dinars, while the lowest share has the Moskovska Bank (3.127.165.000 dinars), because this bank started operation in 2008.

The restructuring process and implementation of reforms led to significant differences in the number of banks that operate since 2003 until today. In fact, at the end of 2003 there were 47 banks, at the end of 2004 - 43 banks were operating, and 40 banks at the end of 2005. Today, there are 33 operating banks. These changes occurred as the result of privatization and bank mergers.

Before taxation in 2010, bank with the largest profit was Banca Intesa (8.5 billion dinars), then AIK Bank Nis (6.2 billion dinars) and Unicredit Bank (3.9 billion dinars). The highest loss had OTP Bank (2.5 billion dinars) and Alpha Bank (1.7 billion dinars).

The largest bank was the Banca Intesa, followed by the Komercijalna Bank, and the largest improvement in ranking list of ten largest banks was recorded for EuroBank EFG[6].

The basics of data envelopment analysis

DEA is specially designed technique for measuring of the efficiency of complex entities with diverse inputs and outputs. Increasingly it is being used for evaluation and improvement the operation of numerous business entities[7], and its use is expanded on evaluation the efficiency of schools, hospitals, bank branches, production facilities, etc. The analysis provides results based on which we can determine how much are some units inefficient compared to efficient units. In this way, it is possible to determine also how much is necessary to reduce the input and/or to increase the output of unit to become efficient. All of these units are called DMU (*Decision Making Unit*). For each inefficient DMU, DEA identifies a set of corresponding efficient units that can be used as indicators for improvement.

DEA provides the construction of linear approximation of efficiency limit that is obtained on the bases of available units. Thus, we observe a set of points and construct the line that wraps them (*envelope*) and that actually represents the limit of efficiency. That limit is the

5 Available at: http://www.nbs.rs/internet/cirilica/50/index.html

6 Available at: http://www.naslovi.net/2011-04-19/beta/dobitak-banka-2010-veci-za-27-odsto/2485562

7 Available at: http://www.decisionsciences.org/decisionline/vol31/31_3/31_3pom.pdf, accessed, June 2011.

maximum of outputs that each decision making unit can achieve with their inputs, and for ineffective units it represents the envelope. There are two approaches:

- wrapping the input from below (the output is achievable with less input),
- wrapping the output from top (with the given input it is possible to produce more output).

This powerful tool can handle multiple inputs and outputs, with no requirements that these inputs and outputs are related (they can be heterogeneous), and one additional positive side of this method is the possibility of mutual comparison of DMUs. Like all techniques, it also has its deficiencies. DEA is suitable for comparison of relative efficiency of DMUs, so it performs mutual comparison of DMUs, but not their comparison with the "theoretical maximum". Due to the standard formulation, DEA makes a special linear program for each DMU[8]. DEA also allows the improvement of inefficient inputs and outputs in order to become efficient. It should be noted that DEA is primarily a diagnostic tool and it doesn't transform the inefficient units to efficient[9].

Basic DEA models

Over the last 30 years, the field of usage of DEA method has been extensively updated. The basic idea for development of DEA method is to enable the efficiency measurement in non-profit sector (education) where there are no exact financial measures. Later, DEA method was applied also in the profit sector. Numerous applications have caused the development of new methods and models, but in this paper, for the purpose of understanding the basics of DEA method, CCR (*Charnes, Cooper and Rhodes*), BCC (*Banker, Charns and Cooper*) and AP (*Andersen Petersen*) model are presented. In the CCR model the boundary includes the linear combination of existing DMUs, while in BCC model this border has convex shape[10].

Andersen and Petersen (1993) proposed ranking model, i.e. measuring of so called super-efficiency (AP model). Using this model, the unit that is examined is not being considered allowing other DMUs to achieve efficiency greater than 1, which allows the ranking of efficient and inefficient units[11]. Specifically, this model shows how much the unit can "get worse" but still be efficient. Those so called superefficient units are those with efficiency of over 100%, and the most efficient is the one which is highest ranked. The units with efficiency less than 100% are inefficient and therefore ranked lower. AP model can be defined using the mathematical expression:

8 Available at: http://mat.gsia.cmu.edu/classes/QUANT/NOTES/chap12.pdf, accessed June 2011.

9 Available at: http://www.decisionsciences.org/decisionline/vol31/31_3/31_3pom.pdf, accessed June 2011.

10 Available at: http://as.nida.ac.th/ornet/conf04/OR-CRN_lecture/sowanee.pdf, accessed August 2011.

11 Available at: http://www.decisionsciences.org/decisionline/vol31/31_3/31_3pom.pdf, accessed June 2011.

$$(Max)h_k = \sum_{r=1}^{s} \mu_r y_{rk} \quad (1)$$

With limitations:

$$\sum_{i=1}^{m} v_i x_{ik} = 1 \quad (2)$$

$$\sum_{r=1}^{s} \mu_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0, \quad j = 1, 2, \ldots, n \quad j \neq k \quad (3)$$

$$\mu_r \geq \varepsilon, \quad r = 1, 2, \ldots, s \quad (4)$$

$$v_i \geq \varepsilon, \quad i = 1, 2, \ldots, m \quad (5)$$

The optimal values of efficiency scores h_k are obtained by solving the linear model (1)-(5) k-times (once for each DMU in order to compare it with other DMUs). Efficiency score h_k is greater or equal to 1 for all efficient units and smaller than 1 for inefficient units. In this way, ranking of units, according to their efficiency, is enabled. The smaller the value of efficiency score h_k, the less efficient is the unit.

Given that the results of DEA model are significantly determined by the input-output indicators and even the minor change is reflected in the end result, in this paper two models (sets of indicators) are considered. That is, of all the mentioned indicators two models are designed (A and B) to be independently considered and developed (Table 1).

Evaluation the efficiency of banks in Serbia

Banks are assessed in two aspects, i.e. two models (model A and model B). The purpose of the first model is to define how much interest and non-interest expenses should be reduced so the bank can achieve the highest interest, i.e. non-interest income. On the other hand (model B), the bank employment aspect is observed, but also deposits that affect the output, i.e. increasing operating income and loans and deposit. Determination the total efficiency of bank through these two models refers to reduction of the inputs in order to achieve higher output, i.e. income.

Table 1. Input and output indicators of used models

Model A		Model B	
Input	**Output**	**Input**	**Output**
- interest expenses - non-interest expenses	- interest income - net non-interest income	- deposits - employees	- loans and deposit - operating income

Besides, the purpose of this analysis, beside the evaluation the efficiency, is bank ranking using both operating criteria. Thus, we are applying the Andersen-Petersen model, assuming the constant return to scale. Given the different size of banks, we assume that hypothesis of variable return to scale would be more appropriate for this kind of research, but it is known from the literature that the solution of the AP model with the hypothesis of variable return to scale is unstable. Since the hypothesis of constant return to scale is stricter, the results are

relevant. If there is a request of comparison of banks by groups, by size of assets, then it's necessary to perform additional analyses using the BCC model.

Data are mathematically processed using software EMS (*Efficiency Measurement System*)[12]. During analysis we concluded that there were *out layers*, i.e. units that had very large scores, thus are excluded from further consideration. For model A the out layers are: Jugobank, Postanska Stedionica and Dunav Bank. For model B these units are: Jugobank, Marfin Bank and AIK Bank. Excluding the out layers the following results were obtained (Table 2).

Table 2. The results of models A and B

DMU	Model A		DMU	Model B	
	Score (%)	Rank		Score (%)	Rank
Jugoslovenska Bank	155.05	1	Dunav Bank	174.60	1
AIK Bank	154.34	2	Volksbank	140.47	2
Volksbank	122.94	3	ProCredit Bank	121.23	3
Crédit Agricole	119.42	4	Poljoprivredna Bank	115.00	4
Banca Intesa	113.07	5	Piraeus Bank	99.87	5
Société Générale	104.90	6	Raiffeisen Bank	99.47	6
Raiffeisen Bank	103.29	7	Hypo Alpe-Adria	98.57	7
Komercijalna Bank	88.88	8	Société Générale	92.76	8
Eurobank EFG	88.28	9	Unicredit Bank	92.67	9
Erste Bank	87.69	10	Opportunity Bank	91.46	10
Unicredit Bank	87.27	11	Vojvodjanska Bank	90.55	11
Marfin Bank	87.08	12	OTP Bank	89.64	12
Cacanska Bank	86.45	13	Eurobank EFG	85.50	13
Poljoprivredna Bank	86.28	14	Jugoslovenska Bank	83.38	14
OTP Bank	85.86	15	Banca Intesa	81.23	15
Credy Bank	84.64	16	Poštanska Stedionica	79.59	16
Srpska Bank	82.98	17	Privredna Bank	75.76	17
Razvojna Bank Voj.	81.13	18	Findomestic Bank	75.05	18
ProCredit Bank	77.87	19	NLB Bank	61.34	19
Univerzal Bank	77.64	20	Erste Bank	56.41	20
Hypo Alpe-Adria	77.41	21	KBC Bank	56.40	21
KBC Bank	74.74	22	Crédit Agricole	53.30	22
Findomestic Bank	74.61	23	Cacanska Bank	51.43	23
NLB Bank	74.57	24	Razvojna Bank Voj.	48.35	24
Vojvodjanska Bank	61.80	25	Srpska Bank	48.26	25
Moskovska Bank	60.47	26	Komercijalna Bank	41.44	26
Piraeus Bank	59.45	27	Moskovska Bank	39.23	27
Opportunity Bank	59.03	28	Alpha Bank	38.42	28
Privredna Bank	55.88	29	Credy Bank	35.52	29
Alpha Bank	51.71	30	Univerzal Bank	31.08	30

Source: Authors calculated this data from defined indicators the balance sheets and income statements of banks in Republic of Serbia;

12 Available at: http://www.wiwi.uni-jena.de/Mikro/pdf/ems.pdf

The table above shows that Jugoslovenska Bank is at the first position with super efficiency 155.05%. This bank has small investments compared to other DMUs, while the outputs are slightly higher. This is a benchmark for other 4 banks. The greatest importance is attached to interest expenses, for inputs, and interest income for outputs. In second place is AIK Bank with super efficiency 154.34%. Next ranked is Volksbank, followed by Crédit Agricole and Banca Intesa.

Penultimate is Privredna Bank, a bank of a public sector with low inputs as well as outputs. The last place takes Alpha Bank with efficiency of 51.71%.

According the results of DMUs analysis of model B (Table 2), Dunav Bank takes first place, with super efficiency 174.60%. The reason for this is low inputs. Majority share of the equity of the Dunav Bank has the company "Dunav osiguranje" (Danube Insurance) a.d.o. Belgrade[13], so it is clear why this bank has low investments. This bank represents the benchmark to other 9 banks. The greatest importance is assigned to deposits (100%) as input, while for output the operating income (importance 1.75).

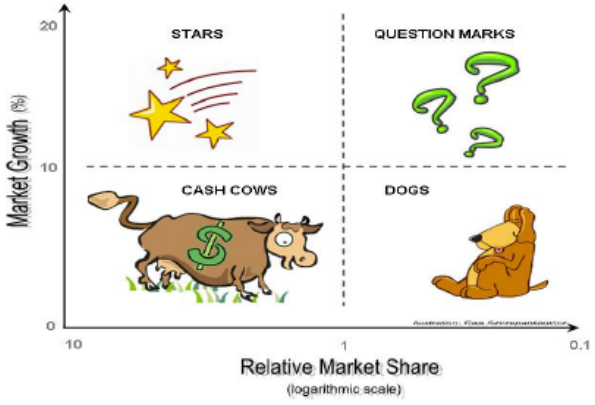
The other three banks that are also superefficient are Volksbank (140.47%, the benchmark to other 25 banks), ProCredit Bank (121.23%, the benchmark to other 17 banks) and Poljoprivredna Bank (115.00%, the benchmark to 9 banks).

The last place takes Univerzal Bank, with efficiency of only 31.08%. This bank has large investment, but low output, which causes the inefficiency of this unit. The benchmarks for this unit are Eurobank EFG and Volksbank.

Comparative analysis of models

In order to visually show the efficiency of banks using both models (A and B), comparative analysis was performed using the BCG (*Boston Consulting Group*) matrix (Figure 1):

Figure 1. BCG matrix



Source: Illustration of BCG matrix taken from website http://mfiles.pl/en/index.php/BCG_growth-share_matrix

13 Available at: http://www.nbs.rs/internet/cirilica/50/index.html, Accessed June-August, 2011.

This is a chart created by Bruce Henderson, whose goal was to help the corporation to analyse the operations of its business units or product lines[14]. The purpose of this matrix is:

- to provide a simple, clear view of the entire current portfolio of the company to the strategist,
- it allows making useful decisions about growth strategy, and eventual elimination of unprofitable parts[15].

The chart is divided into four parts:

- *Stars* – is well placed product with large share on a rapidly growing market, and represents holders of development. Requires large investments in order to maintain that position. If they keep the market share and the market growth slows down, Stars will become Cash Cows. Stars provide the opportunity for quick, loud progress, but not the money.
- *Cash cows* – are units with large market share and slow market growth, these are mature business, the sources of cash. They require much less investment than Stars, but they still need the attention in order to provide the company the constant cash flow. Cash Cows finance everything else, including rising Stars, which will also become Cash Cows, when time comes.
- *Question Marks* – is a problematical area. These units have small share on a rapidly growing market. Their progress requires a serious investment. Question Marks probably have a potential, but the biggest question is whether it pays off to the company to invest into these units.
- *Dogs* – are units that barely manage to remain at zero. They have a small share on the market that barely grows, or that is getting smaller (shrinking). The most common decision made when it comes to the Dogs is to put them to sleep.

The overall objective of this ranking is to help the corporations' analysts to decide which of their units to finance and how much, and which to sell[16]. In table 3 are represented the efficiency indexes and bank ranks from both analysed business aspects. These results were used to form a modified BCG matrix (Figure 2).

Modified BCG matrix (values on the abscissa are arranged from the smallest to the largest in order to provide more logical review of the banks' efficiency) is shown in Figure 2. On the abscissa, the potential values of the efficiency of model A are illustrated, while the ordinate shows values obtained by the solution of model B.

14 Available at: http://en.wikipedia.org/wiki/Growth-share_matrix, accessed August, 2011 and http://en.wikipedia.org/wiki/Data_envelopment_analysis, accessed June 2011.

15 Available at: http://thinkserbia.wordpress.com/2008/12/12/bcg-matrica-osnove-strategije-proizvodnog-portfolija/, accessed August 2011.

16 Available at: http://en.wikipedia.org/wiki/Growth-share_matrix, accessed August 2011.

Table 3. Comparative analysis of models A and B

No.	DMU	Model A	Rank	Model B	Rank
1	Alpha	0.52	27	0.38	25
2	Cacanska Bank	0.90	9	0.51	20
3	Crédit Agricole	1.19	4	0.55	19
4	Credy Bank	0.85	16	0.37	26
5	Erste Bank	0.88	11	0.57	17
6	Eurobank EFG	0.91	8	1.12	4
7	Findomestic	0.75	21	0.78	14
8	Hypo Alpe-Adria	0.86	13	0.99	7
9	Banca Intesa	1.17	5	0.94	8
10	Jugoslovenska Bank	1.55	1	0.85	13
11	KBC Bank	0.75	20	0.56	18
12	Komercijalna Bank	0.89	10	0.47	23
13	Moskovska Bank	0.60	24	0.39	24
14	NLB Bank	0.76	19	0.62	16
15	Opportunity Bank	0.59	26	1.20	3
16	OTP Bank	0.86	14	0.92	11
17	Piraeus Bank	0.60	25	1.01	5
18	Privredna Bank	0.65	22	0.76	15
19	ProCredit Bank	0.78	18	1.21	2
20	Raiffeisen Bank	1.03	7	1.00	6
21	Razvojna Bank Voj.	0.86	15	0.48	21
22	Société Générale	1.05	6	0.93	9
23	Srpska Bank	0.83	17	0.48	22
24	Unicredit Bank	1.27	2	0.93	10
25	Univerzal Bank	0.86	12	0.31	27
26	Vojvodjanska Bank	0.62	23	0.91	12
27	Volksbank	1.25	3	1.40	1

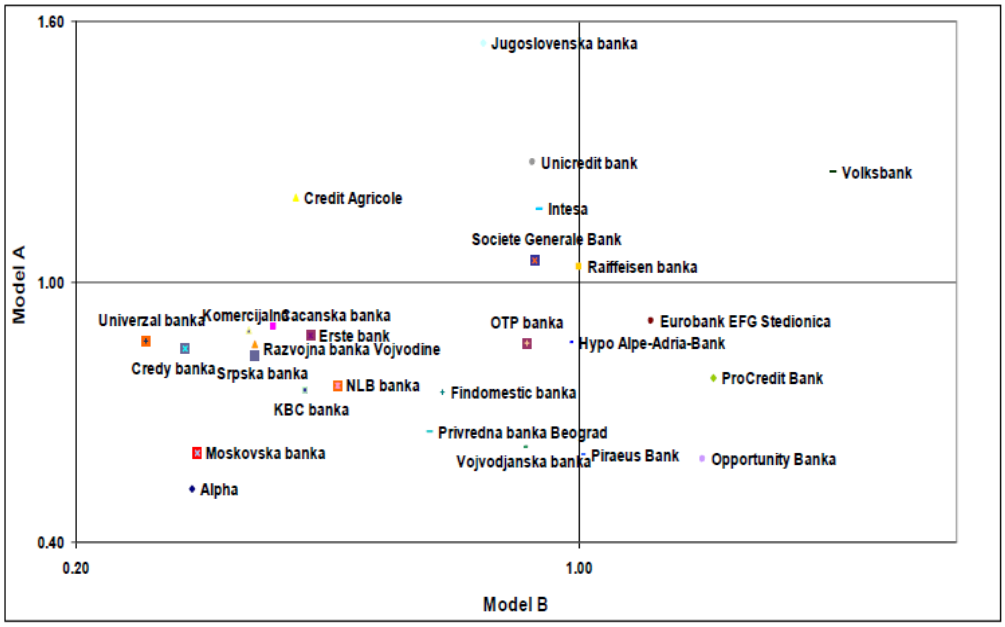
Source: Authors calculated this data from defined indicators the balance sheets and income statements of banks in Republic of Serbia;

As Figure 2 shows, Volksbank is the only unit in the *Stars* group, as this is the only bank that is efficient no matter which operational aspect is considered. For this bank we can say that it efficiently uses the capital and labour for the purpose of making a profit. Figure 3 shows both models, and it is obvious that the Jugoslovenska Bank in model A achieved the best results, while for model B the unit with the greatest super-efficiency is Volksbank.

Raiffeisen Bank is located on the border between *Stars* and *Question Marks* because this bank achieves almost identical results for both models, which is a higher value compared to other DMUs, as we can see in Figure 3. In the *Question Marks* field, there are five banks: Jugoslovenska, Unicredit, Crédit Agricole, Banca Intesa and Société Générale. Primarily, Jugoslovenska Bank has proved as superefficient unit with the highest score for model A, while for model B it has efficiency 83.38%, which makes this bank inefficient for that model. Furthermore, UniCredit Bank does not show good results in these models, so we can say that business politics is not adequate because in both cases this was an inefficient unit. Crédit

Agricole and Banca Intesa took bad positions, especially when it comes to model B, so it is necessary to regulate the inefficiency when using input.

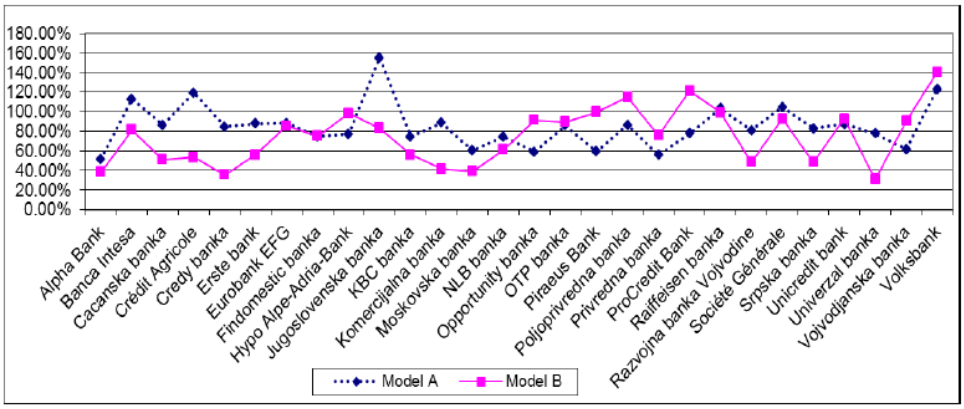
Figure 2. Modified BCG matrix



Source: Data from Table 2.

In the *Cash Cows* field (Figure 2) there are Eurobank EFG, ProCredit Bank, Piraeus Bank and Opportunity Bank. These banks are "mature" branches, and this is confirmed by the graph in Figure 3. This especially refers to ProCredit, Piraeus and Opportunity Bank, particularly when it comes to operational aspect.

Figure 3. Comparative review of models A and B



Source: Data from Table 2.

The *Dogs* group includes the remaining banks, which showed the worst results: Hypo Alep-Adrian-Bank, OTP Bank, Fin domestic Bank, Privredna Bank, Vojvodjanska Bank, Cacanska Bank, Komercijalna Bank, Erste Bank, Development Bank of Vojvodina (Razvojna Banka Vojvodine), Univerzal Bank, Credy Bank, Srpska Bank, NLB Bank, KBC Bank, Moskovska and Alpha Bank. This conclusion is also made by Figure 3, because these banks were inefficient by all criteria.

Conclusion

The use of DEA method to analyse the efficiency of banks allows identification of the market leaders, the banks that accompany them and those that are very inefficient. Mathematical models that were described and applied in this paper clearly indicate their important role in operational analysis of banking sector of one country at specific period of time. DEA is applicable to a comparative analysis of banks and their grouping according to performance in various aspects of business. Based on the analysis, the bank management could direct the bank development in order to improve the business. Besides, efficient banks can be seen as benchmarks whose results can be observed as target values.

According to given data and obtained results, the following can be concluded: based on model A, the superefficient banks are Jugoslovenska Bank, AIK Bank, Volksbank, Crédit Agricole, Banca Intesa, Société Générale and Raiffeisen Bank. The first two banks (Jugoslovenska Bank and AIK Bank) are the banks of the public sector. It is obvious that they have small investments because they are financed by the state budget. The remaining banks are private banks, so it is clear that the outcome will be like this, bearing in mind the Milind Sathye's study, where the exact same combination of inputs and outputs was used and concluded that the private banks of foreign owners do business better and more efficiently.

Considering the data obtained using the model B, it can be concluded that the superefficient units are Dunav Bank, Volksbank, ProCredit Bank and Poljoprivredna Bank. Once again, among the most efficient banks there are two banks from the public sector - Dunav and Poljoprivredna Bank. Like in model A, in this model the Volksbank appears also as a superefficient unit.

Finally, we have done a comparative analysis and the outlayers were eliminated from both models, so as a result Volksbank got the most important place in the matrix. The disturbing fact is that most of the banks were so inefficient that the management had to consider their "putting to sleep", speaking in BCG matrix manner. However, a certain percentage (15%) of tested banks belongs to "mature" group, which represent the source of cash flow and they were all the banks of the private sector. Only 19% of banks belong to *Question Marks* group, which means that their progress requires a serious investment.

For this kind of analysis, two aspects have been considered that directly determine business accomplishment of a bank - costs and revenues, but also the employment structure. Some of these banks have shown very different results according to these models, depending on whether it is a bank of the public or private sector, i.e. foreign bank. During this research, the

number of branches has not been considered, and this is a very important indicator when it comes to operation performance of a bank, because if there are branches also in rural areas, for bank that means more profit because of its prevalence throughout the country.

The success for the banks represents a constant influx of new clients, so management has a job to devote itself to the improvement of the bank operation, in order to gain more money and thus become a superefficient unit.

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PRIMENA DEA METODOLOGIJE U MERENJU EFIKASNOSTI U BANKARSKOM SEKTORU

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Rezime

Najvažniji aspekt svakog poslovanja jeste efikasnost. Cilj je da se uz što manje ulaze postignu što veći izlazi, ili raspoloživi ulazi maksimalno iskoriste. U ovom radu ilustrovaće se primena DEA tehnike u oceni efikasnosti poslovanja bankarskog sektora Srbije, koji trenutno broji 33 banke. Izmeriće se efikasnost banaka pomoću dva modela sa različitim ulazno-izlaznim indikatorima, a potom i uporedna analiza dobijenih rezultata pomoću BCG matrice. Banke su rangirane prema svojoj efikasnosti i komentarisane sličnosti i razlike koje su se iskazale.

Ključne reči: *Banke, DEA, efikasnost poslovanja, superefikasnost, BCG matrica.*

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