Research Journal of Finance and Accounting
ISSN 2222-1697 (Paper) ISSN 2222-2847 (Online)
Vol.4, No.12, 2013 www.iiste.org

Efficiency of Macedonian Banks: A DEA Approach[5]

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Abstract
The purpose of this paper is to estimate the efficiency of the banking sector of Republic of Macedonia for the period 2008-2011. Technical, pure technical and scale efficiency of 15 Macedonian banks have been measured using Data Envelopment Analysis (DEA), both CCR and BCC model. Intermediation approach has been applied in order of measuring banks efficiency in transforming the deposits into investments and credits with intermediation of labor. The results from the analysis indicate an increase of the average efficiency from 2008 to 2010 and an efficiency decrease in 2011. The scale efficiency follows the same trend. The study implies that the main source of inefficiency is due to scale inefficiencies. Regarding group of banks, the group of large banks has a highest pure efficiency scores but the greatest scale inefficiency. The group of small banks is technically the least efficient.
Keywords: data envelopment analysis, Macedonia, bank efficiency, scale efficiency, technical efficiency, pure technical efficiency

1. Introduction

One of the most important principles in any business is the principle of efficiency; where the best possible economic effects (outputs) are attained with a little economic sacrifice as possible (inputs). Efficiency can be defined as the demand that the desired goals are achieved with the minimum use of the available resources (Martic et al., 2009). In our modern society there are a number of methods for efficiency measurement based either on the traditional approach or using IT. Efficiency measurement methods can be divided into three main categories: ratio indicators, parametric and nonparametric methods.

Ratios rank among the simplest methods. Their drawback is that they evaluate just a handful of indicators and cannot influence overall corporate efficiency. Nonparametric methods include Data Envelopment Analysis (DEA) and the Free Disposal Hull (FDH). They are used to measure technical (technological) efficiency i.e. the ability of a business unit to minimize the inputs at a given level of outputs, or to maximize outputs at a given level of inputs. The parametric methods include the Stochastic Frontier Approach (SFA), Thick Frontier Approach (TFA) and Distribution Free Approach (DFA) and they are used for economic efficiency measurement. Economic efficiency is a broader term than technical efficiency. It covers an optimal choice of the level and structure of inputs and outputs based on reactions to market prices in order to minimize costs or maximize profit. (Vincova, 2005)

All these methods have been used for measuring the efficiency of the financial institutions. Berger & Humphrey (1997) reported on 130 studies of bank efficiency. Since 1997 many research papers and articles have been published on the above mention topic. Efficiency in financial institutions should be an issue of public concern, because more efficient financial institutions are considered to be safer and sounder and with a better quality of the loan portfolio (Tripe, 2009). Because of the banks' efficiency effect on the financial stability, the efficiency should be a subject of permanent measurement and constant improvement.

The purpose of this paper is to estimate the efficiency of the banking sector of the Republic of Macedonia using Data Envelopment Analysis (DEA). Using both CCR and BCC input-oriented models, the relative efficiency of the Macedonian commercial banks has been measured for the period 2008-2011 (separately for each year and each bank). Intermediation approach has been applied in order of measuring the efficiency of the Macedonian banks in transforming the deposits into investments and credits with intermediation of labor.

The efficiency of the banking sector of the Republic of Macedonia according to our knowledge has not been a subject of scientific research. Only one study investigating this issue has been found while preparing this paper. It is an IMF study by Giustiniani and Ross (2008) that measures the efficiency of Macedonian banks for the period 1997-2005. The authors also use DEA method, intermediation approach, both CCR and BCC model. Scale inefficiency has not been a subject of their research.

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[5]The attitudes expressed in this research paper present the personal perception of the writers on the subject and in no casecan be related to the official positions of the institutions where the authors work.

2. Data Envelopment Analysis (DEA)

Data envelopment analysis (DEA) is a nonparametric method, most popular in operations research and economics for the estimation of production frontier. It is used to empirically measure productive efficiency of Decision Making Units (or DMUs). The efficiency of a DMU is measured relative to all other DMUs with the simple restriction that all DMUs lay on or below the extreme frontier. Unlike statistical procedures that are based on central tendencies, DEA is a process of extremes directed at the frontier rather than at central tendencies. DEA analysis each DMU separately and calculates a maximum performance measure for each unit.

DEA was introduced in 1978 by Charnels, Cooper and Rhodes. Their model, known as the CCR model, was named after its founders. The CCR model is a basic DEA model that presupposes that there is no significant relationship between the scale of operation and efficiency by assuming constant return to scale (CRS) and it delivers the overall technical efficiency. The CRS assumption is only justifiable when all DMUs are operating at an optimal scale. Because in practice DMUs face economies or diseconomies to scale, in 1984 the CCR model was extended by relaxing the CRS assumption. The BCC model was introduced in order of assessing the efficiency of DMUs characterized by variable return to scale (VRS). (Stavarek&Repkova, 2012)

Vincova (2005) defines DEA models as models that evaluate *n* productive units, DMU_s, where each DMU takes *m* different inputs to produce *s* different outputs. The essence of DEA models in measuring the efficiency of productive unit DMU_q lies in maximising its efficiency rate. However, subject to the condition that the efficiency rate of any other units in the population must not be greater than 1. The models must include all characteristics considered, i.e. the weights of all inputs and outputs must be greater than zero. The CCR model can be defined as a linear divisive programming model:

maximize $$\frac{\sum_i u_i y_{iq}}{\sum_j v_j x_{jq}} \tag{1}$$

subject to $$\frac{\sum_i u_i y_{ik}}{\sum_j v_j x_{jk}} \le 1 \quad k = 1, 2, ..., n$$

$$u_i \ge \in \; i = 1, 2, ..., s \quad v_j \le \in \; j = 1, 2, ..., m$$

This model can be transformed into a matrix:

maximize $$z = u^T Y q \tag{2}$$

subject to
$$v^T X_q = 1$$
$$u^T Y - v^T X \le 0$$
$$u \ge \in$$
$$v \le \in$$

The dual model to this can be stated as follows:

minimize $$f = \theta - \in (e^T s^+ + e^T s^-) \tag{3}$$

subject to
$$Y\lambda - s^+ = Y_q$$
$$X\lambda + s^+ = \theta X_q$$
$$\lambda, s^+, s^- \ge 0$$

where $\lambda = (\lambda_1, \lambda_2, ..., \lambda_n)$, $\lambda \ge 0$ is a vector assigned to individual productive units, s^+ and s are vectors of addition input and output variables, $e^T = (1, 1, ..., 1)$ and $\in$ is a constant greater than zero, which is normally pitched at 10^{-6} or 10^{-8}. In evaluating the efficiency of unit DMU_q, model (3) seeks a virtual unit characterised by inputs $X\lambda$ and outputs $Y\lambda$, which are a linear combination of inputs and outputs of other units of the population and which are better that the inputs and outputs of unit DMU_q which is being evaluated. Unit DMU_q is considered to be CCR efficient if the optimum value of the model (3) objective function equals one. In the inefficient units the objective function of the model is lower than one.

Models (2) and (3) are input-oriented – they try to find out how to improve the input characteristics of the unit in order of efficiency increase. There are output-oriented models as well. Such a model could be written as follows:

maximize $$g = \Phi + \in (e^T s+ + e^T s-) \tag{4}$$

subject to
$$Y\lambda - s^+ = \Phi Y_q$$
$$X\lambda + s^- = X_q$$
$$\lambda, s^+, s^- \ge 0$$

In the output-oriented models as well as in the input-oriented, a DMU is considered to be efficient if the objective function of the model is one. But, unlike the input-oriented models, the efficiency score of the inefficient units is higher than one.

Models (2), (3) and (4) are CCR models i.e. they assume constant returns to scale. These models can be converted to a BCC models with a variable return to scale by inclusion of a condition of convexity $e^T\lambda = 1$. The results of the CCR model are considered as technical efficiency scores, the results of a BCC model are considered as pure technical efficiency scores, and the ratio of the CCR scores to BCC scores gives the scale efficiency score.

Kumar and Gulati (2008) give a very concise elaboration of the concept of technical, pure technical and scale efficiency which we consider to be very important in understanding the DEA method and reading its results. Technical efficiency (TE) relates to productivity of inputs. A technical efficiency of a firm is comparative measure of how well it is actually processes inputs to achieve its outputs, as compared to its maximum potential for doing so, as represented by its production possibility frontier. Thus, technical efficiency of the bank is its ability is to transform multiple resources into multiple financial services. The TE is measured under the assumption of constant return to scale. The pure technical efficiency (PTE) measure is obtained by estimating the efficient frontier under the assumption of a variable return to scale. It reflects the managerial performance to organize the inputs in the production process. On the other site, the measure of scale efficiency provides the management to choose the scale of production that will attain the expected production level. Inappropriate size of a bank (too large or too small) may sometimes be a cause of technical inefficiency. This is referred as scale inefficiency and takes two forms: decreasing returns to scale (DRS) and increasing returns to scale (IRS). DRS (also known as diseconomies of scale) imply that a bank is too large to take full advantage of scale and has supra-optimum scale size. In contrast, a bank experiencing IRS (also known as economies of scale) is too small for its scale of operations and, thus, operates at sub-optimum scale size. A bank is scale efficient if it operates at constant returns to scale (CRS).

3. Model and Input and Output Selection

Selecting appropriate input and output variables is perhaps the most important step in using DEA and there is no consensus as how output and input variables are to be identified as appropriate for use in bank efficiency studies. In general, most studies use two basic DEA approaches for investigating banks efficiency: production approach and intermediation approach. The choice of the approach mostly depends on data availability. The production approach views banks as producers of services for depositors and borrowers, i.e. administering customers' accounts and transactions, cashing cheques and issuing loans, while using some combination of labor and capital as inputs. In this approach it is a number of loan transactions and deposit accounts that should be taken as a measure of bank output and principally it measures the operational efficiency of banks. (Toci, 2009) Because data of number of transactions and number of banks products are not usually available, the production approach for measuring bank efficiency is not widely applied. Most of the banks efficiency DEA studies apply the intermediation approach, which views banks as intermediaries between the surplus units (savers) and deficit units (borrowers). Banks use some inputs, i.e. labor and capital, to transform deposits into earning assets. In the intermediation approach mostly used inputs are: salary expenses, value of fixed assets, amortization, interest expenses, non-interest expenses, capital and deposits; and mostly used outputs are: loans, interest income, non-interest income and investment assets.

This study uses intermediation approach for investigating the efficiency of the banking sector of Republic of Macedonia. When choosing the inputs and outputs of the model few suggestions from Sarkis (2002) have been taken into consideration. First suggestion is about the number of inputs and output compared to number of DMUs. Second suggestion is to reduce the correlated data sets for input/output factors. And the third suggestion is to fix the imbalance in data magnitudes by mean normalize of the data.

Sarkis (2002) emphasizes that the choice and the number of inputs and outputs, and the DMUs determine how good of a discrimination exists between efficient and inefficient units. He gives a review of different authors' opinion about the number of inputs and outputs compared to a number of DMUs in a DEA model. According to Boussofiane at al. (1991) the minimal number of DMUs should be the multiple of the number of inputs and number of outputs. Golany and Roll (1989) establish a rule of thumb that the number of units should be at least twice the number of inputs and outputs considered, while Bowlin (1998) thinks that the number of DMUs should be at least three times of the number of the inputs and the outputs. Dyson at al (2001) recommend a total of two times the product of the number of input and output variables. For example in a 3 input and 4 output model Boussofiane at all recommend using 12DMUs, Golany and Roll recommend using 14 DMUs, while Bowlin recommends 21 DMUs, and Dyson et al. recommend 24. The number of DMUs in the model applied in this study is predefined by the number of banks in the banking system of Republic of Macedonia in 2011. The number of DMUs is 15 i.e. all banks are included in the efficiency analysis except of Macedonian Bank for

Development Promotion AD Skopje[6]. According to the literature recommendation the maximum total of the number of inputs and outputs should vary between 5 and 7.

The first step in choosing the inputs and the outputs that will be applied in this study is examining the correlation between the commonly used inputs and outputs in DEA bank efficiency studies that use the intermediation approach. The correlation analysis in the Macedonian banking system has been made on the following inputs: interest costs (IC), commission costs (CC), labor costs (LC), amortization (A), other administrative costs (OAC), fixed assets (FA) and total deposits received (TDR). The results of the analysis are presented in table 1.

Table 1. Selected inputs correlation analysis

	IC	CC	LC	A	OAC	FA	TDR
IC	1.000						
CC	0.782	1.000					
LC	0.928	0.790	1.000				
A	0.950	0.809	0.968	1.000			
OAC	0.981	0.774	0.937	0.962	1.000		
FA	0.858	0.772	0.954	0.921	0.872	1.000	
TDR	0.965	0.818	0.967	0.954	0.957	0.929	1.000

Source: Authors[7]

Table 1 presents very strong correlation between all the inputs analyzed except the commission costs that have a weaker relationship with the other inputs. Sarkis (2002) emphasizes that eliminating the highly correlated inputs will have an insignificant effect on the efficiency scores. Taking that into consideration we choose two inputs for our analysis: total deposit received and labor costs. According to Sarkis recommendation the commission costs should have been included as an input in the analysis but we have excluded it as an insignificant variable, since we want to measure the efficiency of the banks basic function of converting deposits into loans.

Regarding the output selection, we have taken into consideration the following outputs: interest revenues, non-interest revenues, investments and loans to banks and customers. The correlation analysis has suggested strong correlation between interest revenues and loans to banks and customers and weak correlation between investment, non-interest revenues and loans to banks and customers. We have chosen two outputs: loans to banks and customers and investment. Non-interest revenues are excluded from the analysis as an insignificant variable. The results from the output correlation analysis are presented in table 2.

Table 2. Selected outputs correlation analysis

	Interest Revenues	Non-interest Revenues	Investments	Loans to Banks and Customers
Interest Revenues	1			
Non-interest Revenues	0.916771	1		
Investments	0.545068	0.468886	1	
Loans to Banks and Customers	0.991288	0.908092	0.524162	1

Source: Authors[8]

The model that we have chosen has two inputs, two outputs and 15 DMUs and as such is suitable for efficiency measurement according to every above mentioned literature recommendation. After the inputs and the outputs are selected Sarkis (2002) recommends mean normalizing of the data in order of reducing their imbalance. The first step of that process is to find the mean of the data set for each input and output. The second step is to divide each input or output by the mean for that specific factor. Before efficiency scores calculation we have followed Sarkis recommendation and mean normalized the data on inputs and outputs applied in our model.

[6]Macedonian Bank for Development Promotion is not included in the analysis because of its specific function. Its main objective is to promote export through providing credit and other forms of support. It is state-owned bank and is not involved in deposits collection.

[7]The analysis is made upon data for every particular bank included in the analysis for period from 2008 to 2011.

[8]The analysis is made upon data for every particular bank included in the analysis for period from 2008 to 2011.

4. Efficiency and empirical results

Using both CCR and BCC input-oriented models, the relative efficiency of the Macedonian commercial banks has been measured for the period 2008-2011 (separately for each year and each bank). Intermediation approach has been applied in order of measuring the efficiency of the Macedonian banks in transforming the deposits into investments and credits with intermediation of labor. As a statistical basis for input and output data, the balance sheet and financial statements of Macedonian banks were used. Table 3 presents descriptive statistics for inputs and outputs applied.

Table 3. Descriptive statistics for inputs and outputs

		2008	2009	2010	2011
Inputs					
Total Deposits Received	Mean	12,753,034	13,651,307	15,340,990	16,552,102
	Med	5,285,897	6,334,889	6,192,127	5,611,377
	Stdev	17,118,565	19,105,521	20,908,340	21,741,072
Labor Costs	Mean	241,119	262,304	267,429	270,933
	Med	128,260	141,205	151,325	180,672
	Stdev	253,759	274,729	274,414	258,582
Outputs					
Loans to Banks and Customers	Mean	10,678,864	10,796,215	11,468,824	12,321,025
	Med	5,439,775	5,166,850	4,386,932	5,650,580
	Stdev	14,020,094	14,514,218	14,943,744	15,721,748
Investments	Mean	994,552	1,207,006	1,499,145	656,932
	Med	79,408	431,167	467,126	167,060
	Stdev	2,238,582	2,029,425	2,442,070	996,194

Source: Authors

The results from the CCR model (table 4) indicate a significant growth in the efficiency score of Macedonian banks in the period 2008-2010 and a decrease of efficiency in 2011.The average efficiency in 2008 was 0.596 which may be interpreted as the average bank could produce around 40.4% more outputs with the given level of inputs to match its performance with the best-practice banks in the sample. The average efficiency has risen to 0.779 in 2010, and has dropped to 0.697 in 2011. Sparkasse banka is the most efficient bank in the observed period with average efficiency score of 0.92, and Centralna Kooperativna banka is the most inefficient bank with average score of 0.295. The number of efficient units per year is relatively small i.e. only one bank is efficient in 2008, two in 2009 and 2011 and three in 2010.[9]

[9]Efficient banks are those with efficiency score of 1.

Table 4. CCR model-efficiency scores

	2008	2009	2010	2011	Mean
Alfa banka	0.625836	0.687839	0.644687	0.595795	0.638539
Centralna Kooperativna banka	0.135117	0.358147	0.497964	0.190512	0.295435
Eurostandard banka	0.763477	0.697062	0.868706	0.669672	0.749729
Halk banka	0.794497	0.847063	0.919541	0.958282	0.879846
Kapital banka	1	1	0.57652	0.614742	0.797816
Komercijalna banka	0.514632	0.662506	0.68039	0.605166	0.615674
NLB Tutunska banka	0.74079	0.712686	0.780744	0.690775	0.731249
Ohridska banka	0.416903	0.84522	1	0.761928	0.756013
Postenska banka	0.269274	0.339678	0.438327	0.50413	0.387852
Procredit banka	0.656724	0.812817	1	1	0.867385
Sparkasse banka	0.686307	0.993336	1	1	0.919911
Stopanska banka Bitola	0.660068	1	0.894183	0.586733	0.785246
Stopanska banka Skopje	0.576028	0.677421	0.763235	0.733613	0.687574
TTK banka	0.567163	0.725406	0.85383	0.760481	0.72672
Unibanka	0.540142	0.618883	0.774208	0.787364	0.680149
Mean	0.596464	0.731871	0.779489	0.69728	

Source: Authors

Figure 1 presents the average efficiency of Macedonian banks grouped by size[10]. The figure indicates lowest efficiency of the small-size banks and highest efficiency of the middle-size banks.

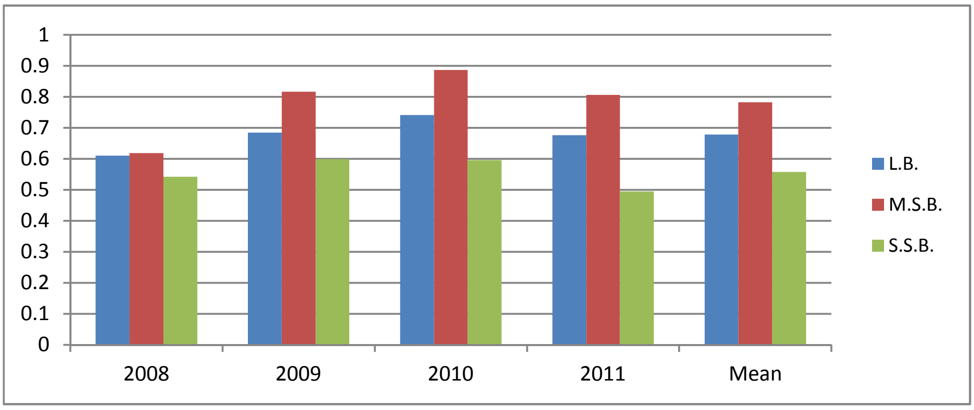

Figure 1. Average efficiency of banks grouped by size (CCR model)

Source: Author

In order of getting a better perspective of the technical efficiency of the Macedonian banking sector we have compared the technical efficiency scores of Macedonian banks for 2010 to those of EU banks calculated by Alzubaidi and Bougheas (2012). Alzubaidi and Bougheas (2012) also use an input-oriented DEA model and intermediation approach for efficiency measurement, but there is a difference in the number and the type of input and output variables applied. Although the effect of that difference on the efficiency scores can not be excluded, we think that the impact on the overall picture is insignificant. Figure 2 shows that the Macedonian banking system compared to the systems of EU countries in 2010 is among the most efficient ones.

[10]Macedonian banks are grouped by size according to the official classification by the National Bank of Republic of Macedonia.

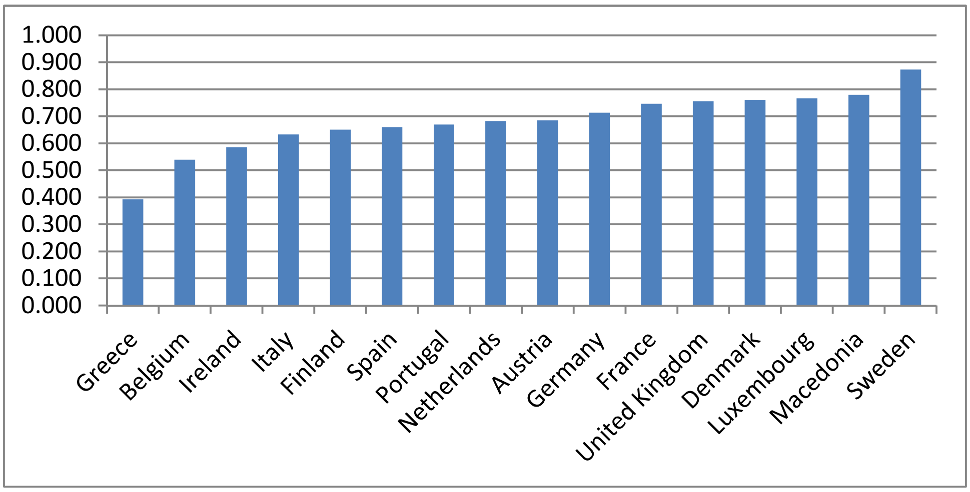

Figure 2. Efficiency scores of EU countries for 2010

Source: Author

When estimating the BCC model (Table 5), the number of efficient banks and the average efficiency for the sector is higher than in the CCR case, implying that the main source of inefficiency is due to scale inefficiencies. The number of efficient units is 4 in 2008, 7 in 2009, 6 in 2010 and 4 in 2011. Capital banka and Stopanska banka Skopje are efficient units during the whole observed period. In general the picture remains the same i.e. the average efficiency of the Macedonian banking system rises from 2008 to 2010 and declines in 2011, but the changes in the efficiency scores during the years are less substantial than those in the CCR case.

Table 5. BCC model-efficiency scores

	2008	2009	2010	2011	Mean
Alfa banka	0.957057	0.741303	0.659865	0.626529	0.746189
Centralna Kooperativna banka	0.150685	0.358856	0.67859	0.24477	0.358225
Eurostandard banka	0.945758	0.710261	0.951014	0.718832	0.831466
Halk banka	1	0.850671	0.936207	0.975758	0.940659
Kapital banka	1	1	1	1	1
Komercijalna banka	0.88891	1	0.92528	0.848936	0.915782
NLB Tutunska banka	1	1	1	0.952623	0.988156
Ohridska banka	0.632736	1	1	0.851586	0.871081
Postenska banka	0.313014	0.352217	0.651954	0.797052	0.528559
Procredit banka	0.978838	0.932515	1	1	0.977838
Sparkasse banka	0.932994	1	1	1	0.983249
Stopanska banka Bitola	0.830624	1	0.912634	0.618968	0.840557
Stopanska banka Skopje	1	1	1	1	1
TTK banka	0.82272	0.779782	0.875936	0.786284	0.816181
Unibanka	0.764849	0.738336	0.77992	0.795821	0.769732
Mean	0.814546	0.830929	0.891427	0.814477	0.837845

Source: Author

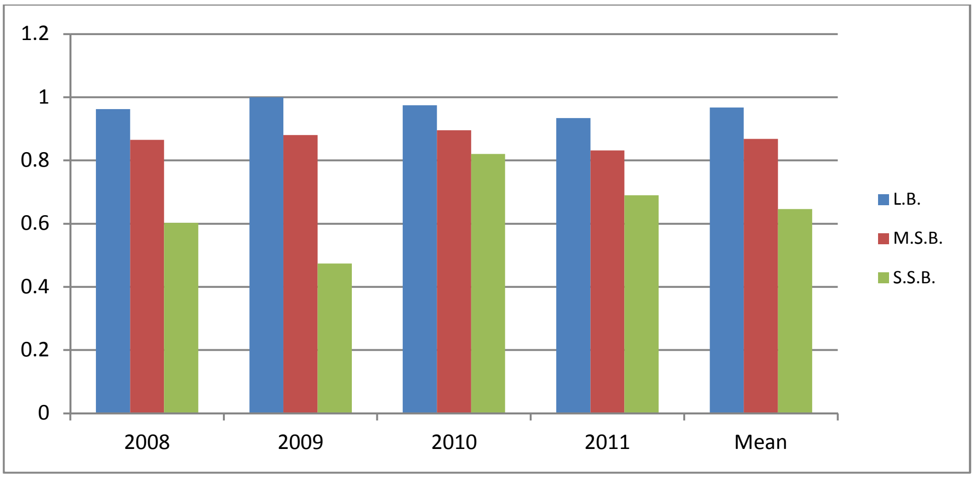

Figure 3. Average efficiency of banks grouped by size (BCC model)
Source: Author

The average efficiency of banks grouped by size estimated with the BCC model (figure 2), shows a different picture than the CCR estimation. The group of small banks is the most inefficient one in this model as well, but it is interesting that the group of large banks has around 42% higher efficiency score compared to a CCR model, which puts this group on the first place as the most efficient one, placing the group of middle-size banks on the second. This situation also implies greatest scale inefficiency in the group of large banks.

Table 6. Scale inefficiency scores and returns to scale specification by group of banks

	2008	2009	2010	2011
Scale inefficiency [1-(CCR/BBC)]	0.256	0.107	0.128	0.143
Large banks	0.368	0.316	0.240	0.276
Medium size banks	0.246	0.059	0.012	0.033
Small size banks	0.109	0.014	0.276	0.261
Banks operating at IRS (%)	0.00%	13.33%	60.00%	60.00%
Large banks	0.00%	0.00%	0.00%	0.00%
Medium size banks	0.00%	0.00%	62.50%	62.50%
Small size banks	0.00%	50.00%	100.00%	100.00%
Banks operating at DRS (%)	93.33%	73.33%	20.00%	26.67%
Large banks	100.00%	100.00%	100.00%	100.00%
Medium size banks	100.00%	87.50%	0.00%	12.50%
Small size banks	75.00%	25.00%	0.00%	0.00%
Banks operating at CRS (%)	6.67%	13.33%	20.00%	13.33%
Large banks	0.00%	0.00%	0.00%	0.00%
Medium size banks	0.00%	12.50%	37.50%	25.00%
Small size banks	25.00%	25.00%	0.00%	0.00%

Source: Authors

Table 6 confirms that the scale inefficiency is the highest in the group of large banks during the whole observed period. During the whole period the large banks are operating in decreasing return of scales which means that the large banks are "too large" and their downsizing will lead to an efficiency increase. Comparing the CCR and BCC results for every particular bank leads to a conclusion that the only problem of Stopanska banka Skopje during the observed period is the diseconomy of scale. Komercijalna banka Skopje among the three banks from the group of large banks shows the greatest inefficiency in inputs organizing.

The lowest scale inefficiency has been detected in the group of medium size banks. This group of banks has a high scale inefficiency score in 2008, when all medium size banks are operating in DRS. After 2008 the number of medium size banks operating in DRS has reduced and that reduction was followed by a significant reduction of the scale inefficiency. The group of medium size banks among the two other groups of banks in the banking system of Republic of Macedonia has a biggest portion of banks operating in CRS. We can conclude that the scale of production is not a source of medium size banks inefficiency.

While the biggest problem of the group of large banks is their oversize and the biggest problem of the medium size banks is inputs organizing, our analyses show that the small size banks seem to have the both problems. Actually, there is a great efficiency difference among the banks in this group. The scale inefficiency is especially high in 2010 and 2011, when all small banks operate in increasing return of scale, which leads to a conclusion that enlarging of the banks operations will lead to an efficiency increase.

5. Conclusion

This paper endeavors to evaluate the extent of technical, pure technical and scale efficiency of the Macedonian banking sector for the period 2008-2011. The efficiency has been measured using both CCR and BCC input-oriented DEA models. The results from the analysis indicate an increase of the average efficiency from 2008 to 2010 and an efficiency decrease in 2011. The scale efficiency follows the same trend.When estimating the BCC model, the number of efficient banks and the average efficiency for the sector is higher than in the CCR case, implying that the main source of inefficiency is due to scale inefficiencies. The average technical efficiency of Republic of Macedonia in 2010 of 0.779 compared to the average technical efficiencies of the EU countries puts Macedonia on the second place among the most efficient countries.

The greatest scale inefficiency has been detected in the group of large banks. The large banks are operating at decreasing return of scales during the whole observed period and downsizing of their operations will lead to a significant efficiency increase. This group of banks has the highest pure efficiency scores implying greatest performance of this group in input organizing in the whole banking system. Stopanska banka Skopje is the most efficient bank in this group and Komercijalna banka Skopje is the least efficient one.

The inefficiency problem of the middle size bank is of technical nature and does not lie in the scope of production. Actually, the size of the middle size banks operation seems to be the most appropriate one in Macedonian banking market. Sparkasse bank is the most efficient bank in this group.

The group of small banks is the least efficient one in the banking system of Republic of Macedonia. There are great differences among the particular banks in this group regarding the efficiency scores and the source of inefficiency. Larger scale inefficiencies have been detected in 2010 and 2011 implying that the small banks are operating at sub-optimum scale size.Centralna Kooperativna banka is the least efficient bank in the whole banking system of Republic of Macedonia experiencing both technical and scale inefficiency. Kapital bank is technical efficient during the whole observed period but highly scale inefficient in 2010 and 2011.

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