Efficiency of commercial banks operating in Federation of Bosnia and Herzegovina using DEA method

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Abstract

The main objective of this research is to measure the efficiency of commercial banks operating in the Federation of Bosnia and Herzegovina in the period 2016-2017. An analysis is conducted of over 12 banks that had positive overall profit lost at the end of 2016 and 2017 years published by the Banking Agency of Federation of Bosnia and Herzegovina. Data Envelopment Analysis (DEA) method with two input and three output parameters is used for efficiency measurement. Each bank's efficiency is presented for the 2016 and 2017 years. For an observed period, large banks showed more efficiency than small banks. Based on the results shown in this research and features used in this model there is a significant difference in the relative efficiency of the top two banks and the rest of the 10 banks.

Keywords: Data envelopment analysis (DEA), Efficiency, Banks in Federation of Bosnia and Herzegovina

1.   Preparation

In last twenty years banking sector of Federation of Bosnia and Herzegovina was rapidly growing from total assets of 2.474 million in 1997 to 21.039 million in 2017 [1]. On the 31.12.2017 total number of banks operating in FBiH was 15 banks. 14 of them are private property while one of them is a government property [2]. One bank is operating under principles of Islamic banking while rests of them are operating under conventional rules. In this paper, we investigate efficiency of banks in 2017 year. For analysis, Data Envelopment Analysis (DEA) is used.

Banking sector competition and stability are long term drivers of economic growth in European countries [3].

2.   Literature Review

Many authors were studying bank efficiency using DEA method [4]. In 2013 Memic and Skaljic-Memic [5] compared efficiencies of banks in two entities of BH using several financial indicators consecutively in a distinctive efficiency measure. Efendic [6] compared bank efficiencies in BH as Islamic and convectional banking groups using DEA method. Ngo [7] investigated banking sector performance for period 1990-2010 using DEA method. [8] Analyzing Tanzanian banks grouped by size and residency for period of 1998-2004 period Jehovaness concluded that banks still have a reason to improve their performances. Ali Said [9] examines correlation between bank efficiency and credit, operational and liquidity risk employing Pearson's Correlation Coefficient. He found that there is negative relationship between credit risk and bank efficiency in Islamic banks in MENA region for period 2004 to 2007 [10]. They explore the impact of financial liberalization on bank efficiency using data from ten developing economies for the period 1991-2000. They

find positive impact of financial liberalization programs on bank efficiency. Ngo [11] investigated efficiency of 22 Vietnam's banks using DEA approach for 2008 and 2009 year. They concluded that analysis shows averagely high efficiency. In 2008 Loukoianova [12] analyzed the efficiency and profitability of Japanese banks from 2000-2006 showing that the performance of Japanese banks has increasingly improved since 2001 [13]. Comparing relative ranking on efficiency for banks in the United Arab Emirates Al-Tamimi concludes that the domestic banks are relatively more efficient than the foreign banks. Sturm and Williams' [14] study considers the efficiency of banking in Australia for period 1988-2001 using DEA approach. They concluded that after deregulation period and diversification in bank type bank efficiency seem like to increase significantly. Said [15] using DEA approach showed that the efficiency of Islamic banks operates in Middle Eastern and non-Middle Eastern Counties have increased during an economic crisis in period 2006-2009 [16]. They studied bank cost efficiency for a section of European banks listed in the year 2000 engaging DEA and Stochastic Frontier Approach (SFA) suggesting that stocks of cost-efficient banks have a tendency to outperform their inefficient counterparts.

3. Methodology

Data Envelopment Analysis (DEA) is nonparametric method in economic and operations research for valuation of production-possibility frontiers (PPF). Largely used for empiric measurement of technical efficiency of decision-making units (DMUs). CCR DEA model is officially developed by Charnes, Cooper and Rhodes in 1978 (Charnes) where the weights structure is calculated by means of mathematical programming and constant returns to scale (CRS) are assumed. Banker, Charnes and Cooper established a model in 1984 with variable returns to scale (VRS).

The best performing DMU is set to be a benchmark and others are compared to it. DMU can improve its technical efficiency by decreasing number of inputs per same amount of outputs or to increase number of outputs per same number of outputs.

Efficiency problem is solved by adapting maximization or minimization problem of inputs and outputs into linear programming under assumption that all inputs are greater than 0 and efficiency rate is between 0 and 1. Maximization formula for CRS model of DEA method can be represented by following formula:

$$\max u, v (\sum_m u_m Y_{m j_0})$$

Subject to:

$$\sum_k v_k x_{k j_0} = 1$$

Efficiency factor of j-th DMU is determined by following formula:

$$EF_j = \frac{\sum_m u_m y_{mj}}{\sum_k v_k x_{kj}}$$

where,

u is weight of *m-th* output factor, v is weight of $k–th$ input factor, x_{kj} is $k–th$ input of $j–th$ DMU, y_{mj} is $m–th$ output of $j–th$ DMU, *n* is number of DMU.

Data is used for banks operating in FBH for period 2017. Input and output data are presented in table below. As an input data we use Equity capital and number of employees. As an output data we use loans, deposit and profit loss amounts. Bank size is binary classification parameter of banks according to assets less than 1 billion (S – small) and greater than 1 billion (L – large) Data is used from the Federal banking Agency website

published data at the end of years 2016 and 2017. For data model evaluator we use Excel 2013's Solver add in.

Table 1. Data type

Variable Name	Type
Capital	Input
No. of Employees	Input
Loan Amount	Output
Deposit Amount	Output
P/L Amount	Output

4. Results

After model evaluation, we have bank efficiency results presented in tables below. As result of different regulations in operating rules, in 2016 three banks were excluded as result of negative records on output data for Addiko bank dd and Procredit Bank dd and Bosna Bank International dd.

Table 2. Bank efficiency in 2016

Bank Name	Size	Efficiency
UNICREDIT BANK dd	L	1.0000
INTESA SANPAOLO BANKA dd	L	0.9510
NLB BANKA dd	S	0.5096
SBERBANK BH dd	L	0.4757
RAIFFEISEN BANK dd	L	0.4416
SPARKASSE BANK dd	L	0.4236
UNION BANKA dd	S	0.3594
ZIRAATBANK BH dd	S	0.3502
VAKUFSKA BANKA dd	S	0.3268
KOMERCIJALNO-INVESTICIONA BANKA dd	S	0.1518
ASA BANKA dd	S	0.1285
BOR BANKA dd	S	0.1071

Average efficiency all banks is all 12 banks is 0.44. Average efficiency by DEA of large banks in 2016 is 0.66 while average efficiency of small banks is 0.28.

In 2017, three banks were excluded as result of negative records on output data for Asa bank dd and Procredit Bank dd and Bosna Bank International dd as result of different regulations in operating rules.

Table 3. Bank efficiency in 2017

Bank Name	Size	Efficiency
UNICREDIT BANK d.d.	L	1.0000
INTESA SANPAOLO BANKA d.d.	L	0.9427
NLB BANKA d.d.	L	0.4573
SBERBANK BH d.d.	L	0.4261
SPARKASSE BANK d.d.	L	0.3742
RAIFFEISEN BANK d.d.	L	0.3682
UNION BANKA d.d.	S	0.3587
VAKUFSKA BANKA d.d.	S	0.2643

Bank Name	Size	Efficiency
PRIVREDNA BANKA SARAJEVO d.d.	S	0.2525
ADDIKO BANK d.d.	S	0.1961
ZIRAATBANK BH d.d.	L	0.1659
KOMERCIJALNO-INVESTICIONA BANKA d.d.	S	0.1283

Average efficiency all banks is all 12 banks is 0.41. Average efficiency of large banks in 2017 is 0.53 while average efficiency of small banks is 0.24.

5. Conclusion

According to the DEA results, larger banks have higher efficiency compared to the smaller banks in 2016 and 2017. UniCredit banks is the most efficient bank in both 2016 and 2017. Drop in average efficiency between large and small banks is the reason of relative huge asymmetry between each other. This means that relative difference in between large and small banks increased from 2016 to 2017. Inefficiency of smaller banks might lead to new acquisitions or mergers in grouping of smaller banks in Federation of Bosnia and Herzegovina in order to become more efficient in their businesses. In order to have more efficient results they might decrease amount of inputs (employees and capital) while keeping same amount of output (loans, deposits and P/L results). Second option is to increase no of outputs (loans, deposits, P/L results) while keeping same amount of inputs (employees and capital).

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Appendices

Appendix 1. Banks' inputs and outputs in 000 BAM for 2016

Bank	Employee	Loans	Deposits	P/L
ASA BANKA dd - SARAJEVO	211	274.441	326.156	1.826
ADDIKO BANK dd - SARAJEVO	435	554.145	602.771	-37.629
BOR BANKA dd - SARAJEVO	139	260.907	234.676	2.321
BOSNA BANK INTERNATIONAL dd - SARAJEVO	371	538.147	553.283	6.358
INTESA SANPAOLO BANKA dd BOSNA I HERCEGOVINA	561	1.277.155	1.304.552	27.098
KOMERCIJALNO-INVESTICIONA BANKA dd - V. KLADUŠA	77	50.339	64.631	1.422
NLB BANKA dd - SARAJEVO	444	688.288	806.237	10.513
PROCREDIT BANK dd - SARAJEVO	206	310.518	237.871	-876
RAIFFEISEN BANK dd BiH - SARAJEVO	1.312	2.309.696	3.198.724	52.529
SBERBANK BH dd - SARAJEVO	425	965.377	907.777	8.193
SPARKASSE BANK dd BOSNA I HERCEGOVINA- SARAJEVO	521	928.220	962.586	18.685
UNION BANKA dd - SARAJEVO	192	157.221	451.115	397
UNICREDIT BANK dd - MOSTAR	1.225	3.078.263	3.745.498	81.527
VAKUFSKA BANKA dd - SARAJEVO	197	216.344	273.958	688
ZIRAATBANK BH dd - SARAJEVO	299	661.167	506.439	196

Source: [2]

Appendix 2. Banks' inputs and outputs in 000 BAM for 2017

Bank	Employee	Loans	Deposits	P/L
ADDIKO BANK d.d. - SARAJEVO	390	607.143	646.497	5.249
ASA BANKA d.d. - SARAJEVO	211	321.373	399.207	-3.178
BOSNA BANK INTERNATIONAL d.d. - SARAJEVO	399	611.201	654.807	8.615
INTESA SANPAOLO BANKA d.d. BOSNA I HERCEGOVINA	567	1.344.411	1.364.551	24.910
KOMERCIJALNO-INVESTICIONA BANKA d.d. V. KLADUŠA	77	52.314	70.239	1.419
NLB BANKA d.d. - SARAJEVO	459	723.664	840.778	15.186
PRIVREDNA BANKA SARAJEVO d.d. - SARAJEVO	158	276.668	263.895	352
PROCREDIT BANK d.d. - SARAJEVO	167	346.058	242.290	-4.110

RAIFFEISEN BANK d.d. BiH - SARAJEVO	1.320	2.408.240	3.368.311	72.620
SBERBANK BH d.d. - SARAJEVO	440	975.554	1.096.585	5.770
SPARKASSE BANK d.d. BOSNA I HERCEGOVINA- SARAJEVO	528	963.660	1.081.661	19.842
UNICREDIT BANK d.d. - MOSTAR	1.260	3.368.178	4.241.733	89.531
UNION BANKA d.d. - SARAJEVO	192	182.308	585.659	1.003
VAKUFSKA BANKA d.d. - SARAJEVO	161	205.215	272.335	144
ZIRAATBANK BH d.d.- SARAJEVO	326	792.873	686.175	2.620

Source: [17]