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 conventional 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:

$$\text{max } u, v \left( \sum_m u_m y_{mj} \right)$$

Subject to:

$$\sum_k v_k x_{kj} = 1$$

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.

| 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 d.d.                           | L    | 1.0000     |
| INTESA SANPAOLO BANKA d.d.                    | L    | 0.9510     |
| NLB BANKA dd                                  | S    | 0.5096     |
| SBERBANK BH d.d                               | L    | 0.4757     |
| RAIFFEISEN BANK d.d                           | L    | 0.4416     |
| SPARKASSE BANK d.d                            | L    | 0.4236     |
| UNION BANKA d.d                               | S    | 0.3594     |
| ZIRAATBANK BH d.d                             | S    | 0.3502     |
| VAKUFSKA BANKA d.d                            | S    | 0.3268     |
| KOMERCIJALNO-INVESTITICIONA BANKA d.d         | S    | 0.1518     |
| ASA BANKA d.d                                 | S    | 0.1285     |
| BOR BANKA d.d                                 | 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     |
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).

6. References

[1] Centralna banka Bosne i Hercegovine, ‘Online statistika CBBH’, 2018.
[2] Agencija za bankarstvo Federacije Bosne i Hercegovine, ‘Informacija o bankarskom sistemu Federacije’, 2017.
[3] M. Jayakumar, R. P. Pradhan, S. Dash, R. P. Maradana, and K. Gaurav, ‘Banking competition, banking stability, and economic growth: Are feedback effects at work?’, J. Econ. Bus., vol. 96, pp. 15–41, Mar. 2018.
[4] J. C. Paradi and H. Zhu, ‘A survey on bank branch efficiency and performance research with data envelopment analysis’, Omega, vol. 41, no. 1, pp. 61–79, Jan. 2013.
[5] D. Memić and S. Škaljić-Memić, ‘Performance Analysis and Benchmarking of Commercial Banks Operating in Bosnia and Herzegovina: a DEA Approach’, Bus. Syst. Res., 2013.
[6] V. Efendić, ‘Efficiency of the Banking Sector Of Bosnia-Herzegovina with Special Reference to Relative Efficiency of the Existing Islamic Bank’, in 8th International Conference on Islamic Economics and Finance, 2011.
[7] Dang-Thanh and Ngo, ‘Evaluating The Efficiency Of Vietnamese Banking System An Application Using Data Envelopment Analysis’, J. Appl. Financ. Bank., vol. 2, no. International Scientific Press, 2012.
[8] A. Jehovaness, ‘Commercial Banks Efficiency in Tanzania’, 2006.
[9] A. Said, ‘Risks and Efficiency in the Islamic Banking Systems: The Case of Selected Islamic Banks in MENA Region’, Int. J. Econ. Financ. Issues, vol. 3, no. 1, pp. 66–73, 2013.
[10] N. Hermes and V. Thi Hong Nhung, ‘The Impact of Financial Liberalization on Bank Efficiency: Evidence from Latin America and Asia’.
[11] D.-T. Ngo, ‘Measuring the Performance of the Banking System Case of Vietnam (1990-2010)’, J. Appl. Financ. Bank., vol. 2, no. 2, pp. 1792–6599, 2012.
[12] E. Loukoianova, ‘Analysis of the Efficiency and Profitability of the Japanese Banking System; Elena Loukoianova; IMF Working Paper 08/63; March 1, 2008’, 2008.
[13] H. A. H. Al-Tamimi, ‘The Use of Data Envelopment Analysis in Banking Institutions: Evidence from the UAE Commercial Banks’.

[14] J.-E. Sturm and B. Williams, ‘DEREGULATION, ENTRY OF FOREIGN BANKS AND BANK EFFICIENCY IN AUSTRALIA’, 816, 2002.

[15] A. Said, ‘Efficiency in Islamic Banking during a Financial Crisis—an Empirical Analysis of Forty-Seven Banks’, online) International Scientific Press, 2012.

[16] E. Beccalli, B. Casu, and C. Girardon, ‘Efficiency and Stock Performance in European Banking’.

[17] Agencija za bankarstvo Federacije Bosne i Hercegovine, ‘Informacija o subjektima bankarskog sistema Federacije BiH sa stanjem na dan 31.12.2017. godine’, 2018.

Appendices

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

| Bank                          | Employee | Loans  | Deposits | P/L  |
|-------------------------------|----------|--------|----------|------|
| ASA BANKA d.d. - SARAJEVO     | 211      | 274.441| 326.156  | 1.826|
| ADDIKO BANK d.d. - SARAJEVO   | 435      | 554.145| 602.771  | -37.629|
| BOR BANKA d.d. - SARAJEVO     | 139      | 260.907| 234.676  | 2.321|
| BOSNA BANK INTERNATIONAL d.d. - SARAJEVO | 371 | 538.147| 553.283  | 6.358|
| INTESA SANPAOLO BANKA d.d.    | 561      | 1.277.155| 1.304.552| 27.098|
| BOSNA I HERCEGOVINA BANKA d.d. V. KLADUŠA | 77 | 50.339  | 64.631   | 1.422|
| NLB BANKA d.d. - SARAJEVO     | 444      | 688.288| 806.237  | 10.513|
| PROCREDIT BANK d.d. - SARAJEVO| 206      | 310.518| 237.871  | -876|
| RAIDFEISEN BANK d.d. BiH - SARAJEVO | 1.312 | 2.309.696| 3.198.724| 52.529|
| SBERBANK BH d.d. - SARAJEVO   | 425      | 965.377| 907.777  | 8.193|
| SPARKASSE BANK d.d. BOSNA I HERCEGOVINA - SARAJEVO | 521 | 928.220 | 962.586 | 18.685|
| UNION BANKA d.d. - SARAJEVO   | 192      | 157.221| 451.115  | 397|
| UNICREDIT BANK d.d. - MOSTAR  | 1.225    | 3.078.263| 3.745.498| 81.527|
| VAKUFSKA BANKA d.d. - SARAJEVO| 197      | 216.344| 273.958  | 688|
| ZIRAATBANK BH d.d. - 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.    | 567      | 1.344.411| 1.364.551| 24.910|
| BOSNA I HERCEGOVINA 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|
| Bank Name                                  | City          | Total Assets (BiH) | Total Liabilities (BiH) | Non-Performing Loans (BiH) |
|--------------------------------------------|---------------|--------------------|-------------------------|---------------------------|
| Raiffeisen Bank d.d. BiH                   | Sarajevo      | 1,320              | 2,408,240               | 3,368,311                 | 72,620                     |
| Sberbank BH d.d. Sarajevo                  | 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                     |
| Union Banka d.d. Mostar                    | Sarajevo      | 1,260              | 3,368,178               | 4,241,733                 | 89,531                     |
| Ziraatbank BH d.d. Sarajevo                | Sarajevo      | 326                | 792,873                 | 686,175                   | 2,620                      |

Source: [17]