The Impact of COVID-19 on Bank Efficiency in the Western Balkans: A DEA Approach

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Abstract

This paper aims to assess and compare the relative efficiency of commercial banks in six Western Balkan developing countries (North Macedonia, Serbia, Montenegro, Bosnia and Herzegovina (B&H), Kosovo[1], and Albania), using the leading nonparametric methodology Data Envelopment Analysis (DEA) for the period 2016-2020, and investigating the impact of the COVID-19 pandemics on the performance of banking systems in these countries. The output-oriented DEA model has been implemented with interest expenses and non-interest expenses as inputs and interest revenue and non-interest revenue as outputs. Our findings show that the average efficiency of the six Western Balkan banking systems differs, and Kosovo's banking system has noted the highest average efficiency in the whole observed period (2016–2020). In contrast, the banking system in Bosnia and Herzegovina noted the lowest average efficiency. The COVID-19 pandemic decreased the relative efficiency of the banking sectors in all six of the Western Balkan countries observed, except Kosovo. However, additional research that includes all pandemic years is recommended to assess the impact of the COVID-19 pandemic on the banking systems in the Western Balkans. This study provides invaluable insights for academic members, banking management and regulatory bodies, governments, and the interested public. It is the first empirical study that includes a glimpse of the first impact of the COVID-19 pandemic on banking systems in the developing countries of the Western Balkans.

Introduction

With the disintegration of the Socialist Federal Republic of Yugoslavia (SFRY) and the Union of Soviet Socialist Republics (USSR) at the end of the 1980s and the beginning of the 1990s, the countries of Central and Eastern Europe abandoned the system of "planned economies". They began to rapidly build economic systems based on market principles and rules that were compatible

[1] *All references to Kosovo in this document should be understood to be in the context of United Nations' Security Council Resolution 1244 (1999).*

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and comparable with those of developed countries (Cvetkoska et al., 2020). Except Albania, the six Western Balkan countries studied were all part of SFR Yugoslavia until 1991. Therefore, these countries underwent a transition process that included "the transition of ownership, of the market, and of the political structure" (Vojnić, 1995). This, of course, implied a fundamental restructuring of their banking sectors as well. Namely, in the past economic system, banks were "financial organizations that in most cases were designed to support the central planning apparatus" (Cvetkoska et al., 2021). However, other authors (Radzic & Yuce, 2008) claim that "Yugoslavia's banking market differed from other planned economies in the sense that its banks participated in commercial as well as financial activities for enterprises."

In this transition process, the Western Balkan countries experienced quite some challenges in restructuring their banking sectors, such as numerous reorganizations (mergers, acquisitions, changes in management, etc.) (Toci, 2009). The main characteristic of these countries' financial sectors is that, unlike in developed countries, they are "largely dominated by banks rather than the capital market." The financial systems of the Western Balkan countries are dominated by banks (banks hold 83–98% of financial sector assets, except for Kosovo with 65%), which are mostly foreign-owned. Banks operate on a traditional business model characterized by the taking of deposits and the provision of loans. Their banking systems are "well capitalized and liquid," but challenges regarding asset quality and indirect credit risk remain. Furthermore, they "seem less prone to financial stress from maturity mismatches" (ECB, 2019).

This paper aims to assess the efficiency of the banking sectors in six Western Balkan countries and then analyze and comment on the impact of the COVID-19 pandemic on their efficiency. This study addresses the inevitable question: How has the COVID-19 pandemic affected the efficiency and performance of banks in the Western Balkan?

The efficiency of any business is crucial for its sustainability and growth. It refers to "the minimization of inputs used by a firm to produce a given level of outputs or the maximization of outputs produced by a given set of inputs under a given state of technology" (Toci, 2009). The leading non-parametric methodology, DEA, is "the most widely used efficiency evaluation method" (Radojicic et al., 2018). As a result, the DEA-window technique with two inputs and two outputs was used in this study from 2016 to 2020 (5 consecutive years). The findings reveal that the average efficiency of the six Western Balkan banking systems differs over the observed period, and Kosovo's banking system has noted the highest average efficiency in the whole observed period (2016-2020). In contrast, the banking system in Bosnia and Herzegovina noted the lowest average efficiency. The COVID-19 pandemic decreased the relative efficiency of the banking sectors in all six of the Western Balkan countries observed, except Kosovo. These findings will be important to bank management, regulatory bodies, investors, and the public.

The rest of the paper is structured as follows: After the introduction, Section 2 presents a literature review of studies concerning bank efficiency with DEA for each of the six Western Balkan countries. Section 3 presents the methodology used, variables, and data. Section 4 presents and analyses the findings. Section 5 discusses the results, while Section 6 concludes the paper.

Literature Review

The literature on the efficiency of banks in the Western Balkans is still "relatively scarce, though growing, with the parametric approach dominating the non-parametric approach" (Toci & Hashi, 2013). Data Envelopment Analysis is one of the leading non-parametric approaches to measuring efficiency. Since its introduction in 1978 by Charnes, Cooper, and Rhodes, the DEA methodology has gained popularity and spread its application in many industries. Moreover, DEA has been implemented in numerous studies regarding banking worldwide. According to Emrouznejad & Yang's (2018) study, banking is one of the top five areas in which DEA is most commonly applied, along with agriculture, supply chain, transportation, and public policy.

This study conducts an in-depth review of the literature on bank efficiency studies with DEA approach in each of the Western Balkan countries examined (eight in Serbia, six in North Macedonia, none in Montenegro, three in Albania, three in Kosovo, five in Bosnia and Herzegovina, and six cross-country studies that include any of these Western Balkan countries). Table 1 provides an overview of the scholarly literature on bank efficiency in each of the countries studied.

Methodology

In this paper, we assess and compare the relative efficiency of commercial banks in each of the six Western Balkan developing countries (North Macedonia, Serbia, Kosovo, Montenegro, Albania, and Bosnia and Herzegovina) using the DEA window analysis technique for the period 2016-2020, in order to assess the impact of the COVID-19 pandemic on the efficiency and performance of the six countries' banking sectors.

Table 1

Scholarly literature regarding Western Balkan bank efficiency

Cross-country studies	North Macedonia	Bosnia and Herzegovina	Serbia	Albania	Kosovo	Montenegro
Toci (2009)	Giustianiani & Ross (2008)	Efendić & Avdić (2011)	Mihailović et al. (2009)	Spaho (2015)	Zogjani & Kelmendi (2015)	none
Anayiotos et al. (2010)	Cvetkoska (2010)	Abu-Alkheil et al. (2012)	Marković et al. (2015)	Spaho, Mitre & Shehu (2015)	Zogjani, Mazelliu & Humolli (2018)	
Toci & Hashi (2013)	Micajkova & Poposka (2013)	Memić & Škaljić-Memić (2013)	Radojicic et al. (2015)	Braimllari & Benga (2019)	Sahiti & Sahiti (2021)	
Varesi (2015)	Naumovska & Cvetkoska (2014)	Efendić (2017)	Popović, Stanković & Marjanović (2017)			
Cvetkoska, Fotova Čiković & Tasheva (2021)	Naumovska & Cvetkoska (2016)	Husejinović (2019)	Lukić, Sokić & Kljenak (2017)			
Milenković et al. (2022)	Fotova Čiković & Cvetkoska (2017)		Savić et al. (2017)			
	Cvetkoska and Fotova Čiković (2020)		Radojicic et al. (2018)			
			Bošković & Krstić (2020)			

Source: Authors' research

Data Envelopment Analysis is one of the most prominent nonparametric methodologies extensively used in different industries and "applied in more than 6500 publications" (Radojicic et al., 2018) since its introduction in 1978. DEA is a technique of operations research that is used in the efficiency evaluation of homogeneous units called decision-making units (DMUs) (Braimllari & Benga, 2019). The DMUs can be banks, hospitals, police stations, tax offices, defense bases, schools, insurance companies, libraries, university departments, etc. DEA is a "productive efficiency measurement method" (Rabar, 2013) with the use of the "same multiple inputs and multiple outputs" (Jemrić & Vujčić, 2002). The basic DEA model introduced by Charnes, Cooper, and Rhodes (1978) assumed a constant return to scale (CRS). This model was extended in the study of Banker, Charnes, and Cooper (1984), who introduced the BCC DEA model with a variable return to scale (VRS) (Anayiotos et al., 2010). Furthermore, a DEA model can be input- or output-oriented. The input orientation focuses on the minimization of inputs while satisfying at least the given output levels. In contrast, the output orientation attempts to maximize outputs without requiring more of any of the observed input values (Cooper et al., 2007).

DEA has several advantages over parametric methodologies, including "a single unambiguous measure of performance, the handling of multiple input and output variables in different measurement units, and without any assumptions on data distribution; a focus on DMU best practices and recommendations by calculating a virtual DMU efficiency for each DMU under evaluation" (Mihailović et al., 2009); "the ability to include more than one output and not set assuages" (Cvetkoska & Fotova Čiković, 2021). The DEA methodology provides a separate evaluation of the efficiency of each DMU in the sample relative to its reference set, thus "providing a relative measurement of efficiency for every single DMU" (Anayiotos et al., 2010).

In this study, the leading nonparametric DEA technique Window analysis under the VRS assumption, based on the Banker-Charnes-Cooper (BCC) model, has been used, and more specifically, the operating (income-based) approach has been applied following Cvetkoska & Fotova Čiković (2020). The input and output variables were chosen using the model in Banker et al. (2010) and Cvetkoska & Fotova Čiković (2020). Therefore, in this study, two input and two output variables have been selected: interest expenses and non-interest expenses as inputs and interest revenue and non-interest revenue as outputs. The data for those variables have been drawn from the official financial reports of each commercial bank. The detailed specification of the variables is presented in Table 2.

Table 2

Inputs and outputs of the DEA model

Character of variable	Variables	Elements of the variables
INPUT	interest expenses (I1)	
	non-interest expenses (I2)	Expenses on fees and commissions General administrative expenses and depreciation Expenses on value adjustments and provisions Other operating expenses
OUTPUT	interest revenues (O1)	
	non-interest revenues (O2)	Income from fees and commissions Other operating income

Source: Authors' research

The envelopment form of the output-oriented BCC DEA model is given in (1) – (5):

$$(BCC-Oo) \qquad \max_{\eta_B,\lambda} \eta_B \tag{1}$$

$$subject\ to \qquad X\lambda \le x_0 \tag{2}$$

$$\eta_B y_0 - Y\lambda \le 0 \tag{3}$$

$$e\lambda = 1 \tag{4}$$

$$\lambda \geq= 0 \tag{5}$$

where η_B is a scalar. The input data for DMUj (j = 1, …, n) are (x1j, x2j, …, xnj), and the output data are (y1j, y2j, …, ynj); the data set is given by two matrices X and Y, where X is the input data matrix, and Y is the output data matrix, λ is a column vector and all its elements are non-negative, while e is a row vector and all its elements are equal to 1 (Cooper et al., 2007, pp. 22, pp. 91–92), (Cvetkoska & Barišić, 2017, pp. 33–34). The BCC efficiency requires the fulfilment of two conditions: (1) the result of the BCC efficiency to be equal to 1 (100%), and (2) all slacks to have a zero value (Cvetkoska et al., 2021).

The "window analysis" technique is defined as "subdividing the entire period of data into smaller windows to be analyzed separately" and is often used to "analyze the evolution of efficiency trends over time." With the window analysis, every window is separately analyzed with DEA (Paradi et al., 2018). Moreover, the window analysis is also treated as "a method for studying the stability of DEA results" because it involves the removal of entire sets of observations and their replacement by other (previously not considered) observations (Cooper et al., 2007). This technique is one of the methods used "to verify productivity change over time," which makes it very applicable in "detecting performance trends of a decision-making unit over time" (Repkova, 2014).

The DEA analysis's most significant advantage is that it is advantageous with small samples and works well when multiple inputs and outputs are selected. This method increases the number of observed DMUs and introduces dynamicity and a time dimension into the DEA model (Cvetkoska & Fotova Čiković, 2020). According to Repkova (2014), the DEA window analysis technique can be perceived as "a special case of a sequential analysis." Its advantage is reflected in the possible comparison and contrast of the performance and efficiency of each DMU against itself and other banks, as well as its performance in other periods in addition to the performances of other units.

This method's most frequently mentioned limitation is that entities in the first and last periods are not tested as frequently as others (Cvetkoska & Fotova Čiković, 2020). Due to the notion that efficiency changes over time, we found that the DEA window analysis technique is the most suitable and appropriate technique for this study.

Research Analysis and Results

The six samples consist of a total of 92 banks that include 13 Macedonian banks (excluding one commercial bank that ceased to operate in August 2020), 24 Serbian banks, 8 Kosovo banks (out of a total of 11, since Komercijalna Banka AD Beograd is a branch of the Serbian Komercijalna Banka AD Beograd; Turkiye Cumhuriyeti Ziraat Bankasi does not publish its statements on its website; and Credins Bank is a newly founded bank that started operating on March 17, 2020), 12 Montenegrin banks, 12 Albanian banks, and 23 Bosnia and Herzegovina banks. The banks' efficiency and performance over the past five years (2016–2020) are analyzed, and then a three-year window is selected. The length of the window was determined using Sun's (1988) formula, which is n = 92,

five years from 2016 to 2020 (k = 5), the length of the window is three years (p = 3), and the number of windows is three (w = k + p + 1 = 5 + 3 + 1 = 3). In each window, there are 276 banks, and the number of "different" banks is 828. The national development banks have been excluded from the analysis due to their specific development and support roles in the financial market. The panel data used for all six samples is strongly balanced and is drawn from the audited financial reports for 2016–2020.

Every window includes three years (for example, window 1 includes three years: 2016, 2017, and 2018; whereas, in the next window (window 2), the data for 2016 is removed and the data for 2019 is added; and the final window (window 3) begins in 2018 and ends in 2020, as shown in Table 3.

Table 3

Inputs and outputs of the DEA model

Window 1	2016	2017	2018		
Window 2		2017	2018	2019	
Window 3			2018	2019	2020

Source: Authors' research

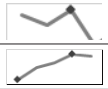
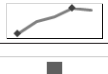
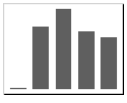
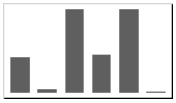
Table 4 shows the average relative efficiency of the banking system in each analyzed country by year, with yellow highlighting the average efficiency greater than 0.9000 (90.00%). These results show that Kosovo had the highest average relative efficiency in 2018 (0.9385, i.e., 93.85%). Additionally, the average efficiency of the banking system of each country for the whole period is presented, based on which we can state that Kosovo is the leader with 90.01%. Also, the column sparkline (in green) for the average efficiency for the whole period for each country's banking system is presented. The previous column has a line sparkline with red markers at the lowest and the highest points. Furthermore, we show the average efficiency of all systems for banking efficiency by year (the highest is achieved in 2018 (83.61%)) as well as a column sparkline (orange colour) for those efficiencies.

The results show that the Kosovo banking system is the most efficient (90,01%), while the B&H banking system is the least efficient (71.84%) over the entire 5-year period studied. However, the crucial analysis explores whether and how the COVID-19 pandemic has impacted these Western Balkan economies and, thus, their banking systems.

The obtained results for the Serbian banking sector show that the lowest efficiency (62.15%) was observed in the first examined year (i.e., in 2016), while the highest efficiency (78.04%) was observed in 2018. An evident decrease in efficiency after 2018 resulted in an efficiency score of 71.47% in 2020. The results regarding each bank indicate that large banks in Serbia note the highest efficiency (from 89.71% for Komercijalna Banka AD Beograd to 99.55% for Banca Intesa AD Beograd), whereas the small-sized banks (e.g., Mobi Banka AD Beograd and Api Bank AD Beograd) note the lowest efficiency (0.3206 and 0.3650, respectively). The study's findings are also consistent with those of Savic et al. (2012), who claimed that the majority of Serbian commercial banks have efficiency scores ranging from 60% to 70%.

Table 4

The average efficiency of the Western Balkan banking systems (2016-2020)

Western Balkan Country	Average efficiency of the whole banking system					Line sparkline	Average efficiency for the whole period for each country's banking system
	Year						
	2016	2017	2018	2019	2020		
North Macedonia	0,8041	0,8112	0,8160	0,7643	0,7771		0,7945
Serbia	0,6215	0,7566	0,7804	0,7491	0,7147		0,7245
Montenegro	0,8475	0,9170	0,9250	0,9125	0,8969		0,8998
Albania	0,7495	0,8361	0,8306	0,8143	0,7753		0,8012
Kosovo	0,9242	0,8977	0,9385	0,8396	0,9008		0,9001
Bosnia & Herzegovina	0,5932	0,6939	0,7260	0,7998	0,7792		0,7184
Average efficiency for the whole period of all analyzed banking systems	0,7567	0,8188	0,8361	0,8133	0,8073		

Source: Authors' research

The results for North Macedonia's commercial banks show that efficiency has been slowly increasing in the period 2016–2018, reaching its highest score of 81.60% in 2018, and after that decreasing in the period 2019–2020 (the slight increase from 76.43% in 2019 to 77.70% in 2020 is insignificant). When analyzing the average efficiency per term per bank (Appendix 1), it is evident that the group of large banks seems to outperform regarding efficiency (except for HalkBank AD Skopje, which notes an efficiency score of 69.98%). Moreover, small-sized banks note the lowest efficiency in the sample. Ohridska Banka AD Skopje is the least efficient bank in the sample, with an efficiency score of 63.15%, which is in line with the previous findings of Cvetkoska et al. (2021). Namely, this bank has noted "high impairment costs of financial assets in 2016," including the portfolio's growth provisions, as well as additional reservations at the discretion of the relevant bodies of the bank. It was acquired by Steiermaerkische Sparkasse Group in 2019 (Cvetkoska et al., 2021). In contrast, Stopanska Banka AD Skopje is the most efficient bank, with an efficiency score of 1 in 4 out of 5 years and an average efficiency of 99.89%.

The Montenegrin banking system showed its lowest efficiency in 2016 (84.75%) and its highest in 2018 (92.50%). It has noted a decrease in efficiency in 2019 and 2020. However, Montenegro's banking system is the second most efficient in the observed period, with 89.98%. The results for each commercial bank show that the largest banks are the most efficient. Crnogorska Komercijalna Banka AD Podgorica is the most efficient Montenegrin bank, with four years, a relative efficiency score of one, and an average efficiency of 98.80%.

The DEA window analysis technique results for the Albanian banking system show that 2016 was the least efficient year (with an efficiency score of 74.95%), whereas 2018 was the most efficient year (83.06%). What is captivating is that this is the only sample in which a bank has been relatively efficient in all of the observed years (Raiffeisen Bank S.A.), and this is a bank that belongs to the large banks' group. The large banks note the highest efficiency in the Albanian banking system (ranging from 89.38% to 100.0%).

The banking system in Kosovo shows inconsistent results, and it is the only Western Balkan country that noted a significant increase in efficiency from 83.95% in 2019 to 90.08% in 2020. Furthermore, it is the most efficient banking system in the sample, with an average efficiency of 90.01% for the whole observed period. The most efficient banks are large banks (in particular, ProCredit Bank, which notes a relative efficiency score of 1 in 3 out of 5 years). The least efficient bank is Banka Per Biznis, with an average efficiency score of 0.78462. These findings do not correspond with Varesi (2015) findings, where the Kosovar banking system was the least efficient (together with the Albanian).

Interestingly, the DEA window analysis results for Bosnia and Herzegovina show that no bank in this sample is relatively efficient in all of the examined windows and/or years. The average efficiency result for the entire period under consideration is 71.84%. The lowest efficiency has been recorded in 2016 (59.32%), whereas the highest was in 2019 (79.97%), followed by a slight fall to 77.92% in 2020. The most efficient banks are the large ones, except Intesa Sanpaolo Bank, which noted an average efficiency of 76.60%. This result is due to the overall low efficiency in the first studied year, 2016. The findings are consistent with Efendic and Avdic (2011)'s finding that B&H banks are "on average significantly inefficient," but not with Memić & Škaljić-Memić (2013)'s claim that small banks are more efficient than large banks.

Except for North Macedonia and Kosovo, which saw a slight increase in efficiency (from 76.42% in 2019 to 77.70% in 2020) and a significant increase in efficiency (from 83.95% in 2019 to 90.08% in 2020), all of the Western Balkan countries studied saw a decrease in efficiency in 2019 and 2020.The obtained results also show that the highest efficiency scores mainly were in 2018 (for North Macedonia, Serbia, Montenegro, and Kosovo; 2019 for Bosnia and Herzegovina, and 2017 for Albania), i.e., before the COVID-19 pandemic, whereas the lowest efficiency was noted in the first studied year: 2016 (and 2019 for North Macedonia and Kosovo).

Furthermore, the findings indicate that, in general, small-sized banks are least efficient. In contrast, large banks are most efficient in the Western Balkan countries, which is in line with the findings of Guistininani & Ross (2008), Micajkova & Poposka (2013), Fotova Čiković & Cvetkoska (2017), and Cvetkoska et al. (2021).

Discussion

In this paper, the relative efficiency of the banking sectors of six developing Western Balkan countries - North Macedonia, Serbia, Montenegro, Kosovo, Albania, and Bosnia and Herzegovina - has been evaluated by using the window DEA analysis technique for the period from 2016 to 2020. A balanced panel of data has been used for the six samples. The output-oriented BCC DEA window model results show a decrease in efficiency in most (four out of six) of the examined countries in 2020, which could potentially prove that the COVID-19 pandemic influenced these countries' banking systems. Even though it took a time lag for the spillover effects of the GFC (Global Financial Crisis) in 2008/09 in small and developing countries with underdeveloped financial systems (such as the sample countries of the Western Balkans), the COVID-19 pandemics and thus the crisis year (2020) affected all countries regardless

of their economic development and geopolitical position. The COVID-19 pandemic greatly impacted economies and societies globally because countries needed to face the new situation with numerous challenges for private, public, and business entities "while minimizing the negative social and economic implications" (Fotova Čiković, 2021). More importantly, it impacted every industry and every business sector globally. This empirical study supports this fact. However, if we want to confirm the impact of the COVID-19 pandemic on the Western Balkans' banking systems' efficiency, additional analyses, including those for 2021 and 2022, need to be conducted.

According to the findings, small banks are the least efficient, and large banks are the most efficient in the Western Balkan countries, as previously reported by Guistininani and Ross (2008), Micajkova and Poposka (2013), Fotova Čiković and Cvetkoska (2017), and Cvetkoska et al. (2021).

Except for North Macedonia and Kosovo, which saw a slight increase in efficiency (from 76.42% in 2019 to 77.70% in 2020) and a significant increase in efficiency (from 83.95% in 2019 to 90.08% in 2020), the other Western Balkan countries recorded a decrease in efficiency in 2019 and 2020. The obtained results also show that the highest efficiency scores mainly were in 2018 (for North Macedonia, Serbia, Montenegro, and Kosovo; 2019 for Bosnia and Herzegovina, and 2017 for Albania), i.e. before the COVID-19 pandemic, whereas the lowest efficiency was noted in the first studied year: 2016 (and 2019 for North Macedonia and Kosovo).

This is the first study that addresses and empirically measures the efficiency of the banking systems of Western Balkan countries, including the first pandemic year (2020), and thus the first study that addresses the COVID-19 pandemic impact on banks' efficiency and performance. For these reasons, this research represents a gain for the scientific community but also provides invaluable insights for banking management, regulatory bodies, governments, potential investors, the interested public, and other bank stakeholders.

Conclusion

This paper aimed to assess and compare the relative efficiency of commercial banks in each of the six developing countries in the Western Balkans - North Macedonia, Serbia, Kosovo, Montenegro, Albania, and Bosnia and Herzegovina - in the observed period from 2016 to 2020 and to explore the impact of the COVID-19 pandemic on the efficiency and performance of the banking sectors of the six Western Balkan developing countries in the year 2020. The DEA Window analysis technique has been employed with two inputs and two outputs: interest and non-interest expenses as inputs and interest and non-interest revenues as outputs.

According to the DEA Window O-V model results, the average efficiency of the six Western Balkan banking systems significantly differs. The highest average efficiency of the whole banking system in the whole observed period (2016–2020) has been noted in Kosovo, whereas B&H noted the lowest average efficiency, followed by the Serbian banking system.

There are no studies on the efficiency of the banking sectors of the six studied Western Balkan countries and no studies on the impact of COVID-19 pandemics on the efficiency and performance of banking systems in these countries.

This study, however, is not without limitations. Even though it is among the first studies to evaluate and assess the impact of the COVID-19 pandemic on the efficiency and performance of six Western Balkan economies, it only analyzes the first year of the pandemic (i.e., 2020). Furthermore, while 2020 was the most difficult pandemic year to date (due to the surprise effect and the countries' lack of preparedness for a crisis of this magnitude), more research should be conducted to gain new insights into the total impact and consequences COVID-19 left on these economies. Moreover, the DEA methodology itself has a few limitations. As Stolp (1990) claimed, "the enthusiasm for DEA has not been universal, and many detractors have criticized it on several methodological and substantive grounds." According to Jemrić and Vujčić (2002), "the main disadvantage of DEA is that the frontier is sensitive to extreme observations and measurement errors, since the basic assumption is that random errors do not exist and that all deviations from the frontier indicate inefficiency." Another caveat of DEA is that the classification of the relative efficient DMUs means those DMUs are "only efficient compared to the others in the sample" (Repkova, 2014). DEA, on the other hand, provides a "complete unbiased numerical score, ranking, and efficiency potential improvement targets for each of the inefficient units" (Popović et al., 2017) and should be viewed as "more conventional statistical methods, as an informative and useful tool for systematic sensitivity analysis" (Stolp, 1990) and "a significant diagnostic tool" that provides new insights to policymakers, investors, and other stakeholders" (Fotova Čiković & Lozić, 2022).

In future research, the ability of the banking management to cope with the crisis in the analyzed Western Balkan countries could be investigated.

Appendix 1

Table 5

Average efficiency by term for the Serbian commercial banks (2016-2020)

BANK	YEAR					Average score
	2016	2017	2018	2019	2020	
Addiko Bank AD Beograd	0.5550	0.5995	0.6255	0.6584	0.6500	0.6177
Agroindustrijsko Komercijalna Banka AD Skopje	1.0000	1.0000	1.0000	0.9729	1.0000	0.9946
Alta Banka AD Beograd	0.6297	0.6749	0.9120	0.9735	0.7337	0.7848
API Bank AD Beograd	0.2842	0.4228	0.4800	0.3374	0.3005	0.3650
Banca Intesa AD Beograd	0.9775	1.0000	1.0000	1.0000	1.0000	0.9955
Banka Postanska Stedionica AD Beograd	0.4854	0.7446	0.6943	0.6625	0.6878	0.6549
Bank of China Srbija AD Beograd	n.a.	1.0000	1.0000	0.6869	0.3534	0.6081
Credit Agricole Banka Srbija AD Novi Sad	0.6271	0.6213	0.6823	0.7105	0.7193	0.6721
Direktna Banka AD Kragujevac	0.3902	0.9663	1.0000	0.6827	0.6938	0.7466
Expobank AD Beograd	0.3666	1.0000	0.7938	0.5744	0.5371	0.6544
Erste Bank AD Novi Sad	0.7493	0.7918	0.7776	0.7324	0.7039	0.7510
Eurobank AD Beograd	0.8072	0.7694	0.8419	0.7962	0.7557	0.7941
Halkbank AD Beograd	0.6459	0.6616	0.7113	0.7246	0.7016	0.6890
Komercijalna Banka AD Beograd	0.7674	0.9324	0.9930	0.9704	0.8223	0.8971
Mirabank AD Beograd - Novi Beograd	0.2245	0.2545	0.4019	0.4564	0.9996	0.4674
Mobi Banka AD Beograd	0.2121	0.2777	0.3497	0.3677	0.3957	0.3206
NLB Banka AD Beograd	0.7068	0.6903	0.7845	0.6394	0.6618	0.6966
Opportunity Banka AD Novi Sad	0.9142	0.9347	0.9553	0.9709	0.8920	0.9334
OTP Banka Srbija AD Novi Sad	0.5957	0.5348	0.6202	0.9901	0.6204	0.6722
ProCredit Bank AD Beograd	0.8143	0.7533	0.6846	0.6290	0.6192	0.7001
Raiffeisen Banka AD Beograd	0.9311	1.0000	1.0000	1.0000	0.9114	0.9685
Sperbank Srbija AD Beograd	0.6259	0.6472	0.6662	0.6212	0.5575	0.6236
Srpska Banka AD Beograd	0.6398	1.0000	0.7560	0.8204	1.0000	0.8432
Unicredit Bank Srbija AD Beograd	0.9669	0.8810	1.0000	1.0000	0.8359	0.9368

Source: Results from the window DEA model

Table 6

Average efficiency by term for the North Macedonian commercial banks (2016-2020)

BANK	YEAR					Average score
	2016	2017	2018	2019	2020	
NLB (Tutunska) Banka AD Skopje	0.8610	0.9849	0.9287	1.0000	0.8890	0.9327
Stopanska Banka AD Skopje	1.0000	1.0000	1.0000	0.9949	1.0000	0.9990
Komercijalna Banka AD Skopje	0.9350	1.0000	0.9907	0.9708	1.0000	0.9793
Halk Banka AD Skopje	0.6975	0.7024	0.7348	0.7154	0.6489	0.6998
Uni Banka AD Skopje	0.6832	0.8371	0.7327	0.6510	0.7431	0.7294
ProKredit Banka AD Skopje	0.6841	0.7169	0.6577	0.6555	0.6765	0.6781
TTK Banka AD Skopje	1.0000	0.9899	0.9571	0.9321	0.8528	0.9464
Kapital Banka AD Skopje	0.8367	0.4585	1.0000	0.9187	1.0000	0.8428
Stopanska Banka AD Bitola	0.6640	0.6443	0.6390	0.5839	0.7287	0.6520
Sparkasse Banka AD Skopje	0.8878	0.9042	0.7857	0.7427	0.6531	0.7947
Ohridska Banka AD Ohrid	0.6824	0.6791	0.7030	0.5506	0.5427	0.6316
Centralna Kooperativna Banka AD Skopje	0.6774	0.6284	0.6520	0.6530	0.6762	0.6574
Silk Road Banka AD Skopje	0.8439	1.0000	0.8260	0.5669	0.6906	0.7855

Source: Results from the window DEA model

Table 7

Average efficiency by term for the Montenegrin commercial banks (2016-2020)

BANK	YEAR					Average score
	2016	2017	2018	2019	2020	
Crnogorska komercijalna banka AD Podgorica member of OTP Group	1.0000	0.9404	1.0000	1.0000	1.0000	0.9881
Hipotekarna banka AD Podgorica	1.0000	0.9746	0.9940	1.0000	0.9299	0.9797
Prva banka Crne Gore AD Podgorica	0.9477	0.8890	0.7457	0.7796	0.7753	0.8275
ERSTE Bank AD Podgorica	1.0000	0.9445	0.9460	1.0000	1.0000	0.9781
NLB Banka AD Podgorica	0.9459	0.9133	0.9260	1.0000	0.8568	0.9284
Komercijalna banka AD Podgorica	0.2926	0.9198	0.9118	0.8556	0.7422	0.7444
Addiko Bank AD Podgorica	0.4359	0.9169	0.8867	0.8040	0.9374	0.7962
Universal Capital Bank AD Podgorica	0.8843	0.8459	1.0000	1.0000	0.9086	0.9278
Lovćen banka AD Podgorica	0.9135	1.0000	1.0000	0.9700	0.9642	0.9695
Zapad banka AD Podgorica	1.0000	0.8874	0.9776	0.6382	0.6483	0.8303
ZIRAAT Bank Montenegro AD Podgorica	0.7505	1.0000	0.9915	1.0000	1.0000	0.9484
Adriatic Bank AD Podgorica	1.0000	0.7726	0.7212	0.9030	1.0000	0.8794

Source: Results from the window DEA model

Table 8

Average efficiency by term for the Albanian commercial banks (2016-2020)

BANK	YEAR					Average score
	2016	2017	2018	2019	2020	
Alpha Bank - Albania S.A.	0.5178	0.6690	0.5989	0.6008	0.6504	0.6074
American Bank of Investment S.A.	0.5610	0.7182	0.6720	0.6534	0.8899	0.6989
Credins Bank S.A.	0.6641	0.7058	1.0000	0.8210	1.0000	0.8382
First Investment Bank, Albania S.A.	0.6777	1.0000	0.9804	0.6621	0.6902	0.8021
Intesa Sanpaolo Bank Albania S.A.	0.9099	0.9139	0.7643	0.9980	0.8831	0.8938
National Commercial Bank S.A.- BKT	0.8191	1.0000	1.0000	0.9417	1.0000	0.9522
OTP Bank Albania S.A	0.7440	0.8128	0.9444	1.0000	0.9494	0.8901
Procredit Bank S.A.	0.6706	0.5352	0.4886	0.3937	0.3729	0.4922
Raiffeisen Bank S.A.	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Tirana Bank S.A.	0.5967	0.7826	0.7140	0.9397	0.8356	0.7737
Union Bank S.A.	0.8334	0.8962	0.9067	0.7615	0.6487	0.8093
United Bank of Albania S.A.	1.0000	1.0000	0.8984	1.0000	0.3838	0.8564

Source: Results from the window DEA model

Table 9

Average efficiency by term for the Kosovar commercial banks (2016-2020)

BANK	YEAR					Average score
	2016	2017	2018	2019	2020	
NLB Bank	0.9310	0.9288	0.9286	1.0000	1.0000	0.9577
Banka për Biznes	0.6683	0.8561	0.9245	0.7759	0.6983	0.7846
Banka Ekonomike	0.8349	0.8339	0.8139	0.7831	0.6830	0.7898
Raiffeisen Bank Kosovo	0.9591	1.0000	0.9932	1.0000	1.0000	0.9905
ProCredit Bank	1.0000	1.0000	1.0000	0.9770	0.9996	0.9953
TEB J.S.C	1.0000	0.9695	0.9950	0.9216	0.9892	0.9750
Banka Kombëtare Tregtare	1.0000	0.8358	0.8526	0.5873	0.8365	0.8224
Turkiye Is Bankasi	1.0000	0.7572	1.0000	0.6716	1.0000	0.8858

Source: Results from the window DEA model

Table 10

Average efficiency by term for the B&H commercial banks (2016-2020)

BANK	YEAR					Average score
	2016	2017	2018	2019	2020	
Addiko Bank Banja Luka	0.5856	0.6127	0.6145	0.6759	0.6267	0.6231
Addiko Bank FBIH	0.4099	0.6406	0.7124	1.0000	1.0000	0.7526
ASA Banka	0.4379	0.4479	0.5936	0.7205	0.6759	0.5752
Bosna Bank International	0.5365	0.6994	0.7437	0.7968	0.6757	0.6904
Intesa Sanpaolo Banka	0.4957	0.7086	0.8778	0.9239	0.8240	0.7660
Komercijalna Banka Banja Luka	0.4423	0.5882	0.6807	0.7489	0.7508	0.6422
Komercijalno investiciona banka	0.9921	1.0000	1.0000	1.0000	0.8325	0.9649
MF banka	0.3459	0.6269	0.7120	0.8798	0.7484	0.6626
Naša banka	0.3936	0.5964	0.5193	0.6306	0.8004	0.5881
NLB Banka AD Banja Luka	0.8367	0.9836	0.8922	1.0000	1.0000	0.9425
NLB BANKA d.d. Sarajevo	0.5778	0.7151	0.7666	0.7872	0.7483	0.7190
Nova banka	0.7302	0.7068	0.6838	0.7161	0.6842	0.7042
PrivrednaBanka Sarajevo	0.8132	0.5910	0.6902	0.6988	0.7374	0.7061
ProCredit Bank	0.4199	0.4245	0.5497	0.5753	0.6175	0.5174
Reiffeisen Bank	0.9035	0.9740	1.0000	1.0000	0.9578	0.9671
Sberbank AD Banka Luka	0.4778	0.5567	0.7110	0.8679	0.9705	0.7168
Sberbank Sarajevo	1.0000	0.5842	0.6273	0.6929	0.6157	0.7040
Sparkasse Bank Sarajevo	0.6287	0.7448	0.7749	0.8139	0.8107	0.7546
UniCredit Bank Mostar	0.8006	0.9165	1.0000	1.0000	0.9703	0.9375
UniCredit Bank Banja Luka	0.4919	0.7663	0.8442	1.0000	0.8227	0.7850
Union Banka	0.4023	1.0000	0.5788	0.6590	0.7187	0.6718
Vakufska banka	0.5504	0.5610	0.6253	0.6041	0.7568	0.6195
ZiraatBank BH	0.3707	0.5144	0.4993	0.6027	0.5766	0.5127

Source: Results from the window DEA model

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Vpliv COVID-19 na učinkovitost bank na Zahodnem Balkanu: pristop z metodo analize ovojnice podatkov

Izvleček

Namen tega prispevka je oceniti in primerjati relativno učinkovitost poslovnih bank v šestih državah v razvoju na Zahodnem Balkanu - Severni Makedoniji, Srbiji, Črni gori, Bosni in Hercegovini (B&H), Kosovu in Albaniji - z uporabo vodilne neparametrične metodologije Data Envelopment Analysis (DEA) za obdobje 2016-2020 ter preučiti vpliv pandemije COVID-19 na uspešnost njihovih bančnih sistemov. Implementiran je bil izhodno usmerjen model DEA z obrestnimi in neobrestnimi odhodki kot vhodnimi podatki ter obrestnimi in neobrestnimi prihodki kot izhodnimi podatki. Naše ugotovitve kažejo, da se povprečna učinkovitost šestih bančnih sistemov Zahodnega Balkana razlikuje, pri čemer je bila v celotnem opazovanem obdobju (2016-2020) ugotovljena najvišja povprečna učinkovitost bančnega sistema Kosova, medtem ko je bila najnižja povprečna učinkovitost ugotovljena pri bančnem sistemu Bosne in Hercegovine. Pandemija COVID-19 je zmanjšala relativno učinkovitost bančnih sektorjev v vseh šestih opazovanih državah Zahodnega Balkana, razen na Kosovu. Vendar je za oceno vpliva pandemije COVID-19 na bančne sisteme na Zahodnem Balkanu priporočljiva dodatna raziskava, ki bi vključevala vsa leta pandemije. Ta študija zagotavlja neprecenljiva spoznanja za akademike, bančne upravne in regulativne organe, vlade ter zainteresirano javnost. Gre za prvo empirično študijo, ki vključuje vpogled v prvi vpliv pandemije COVID-19 na bančne sisteme v državah v razvoju na Zahodnem Balkanu.

Ključne besede: bančni sektor, analiza ovojnice podatkov, COVID-19, Zahodni Balkan