Technical Efficiency of banks in Slovakia from the point of view of mortgage transactions

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Introduction

During the period after the financial crisis, the Slovak banking sector maintained its credit growth. In the Slovak Republic, real estate and housing loans represent a large share of total loans and bank assets. The financing of real estates was a dominant element, because the loans were used not only to purchase real estate, but also to finance of development projects. Slovak households have long been among the fastest in debt in the eurozone. The loans to GDP ratio grew from 25% in 2015 to 32,9 % in 2019.[2]

The analysis of the technical efficiency of the Slovak banks mortgage business points out the areas, in which the individual banks are specific. A summary overview of the technical efficiency of the mortgage banks in Slovakia points out their relative advantages and disadvantages. BCC models with variable returns to scale were used for the analysis, because this model consider the size of the banks. Three output-oriented models have been used and they give recommendations to improve the output of banks. One input-oriented model gives recommendations to improve the use of inputs of the banks.

According to economic theory, efficiency is defined as a state where it is impossible to produce one more unit of a good with the given resources without having to limit the production of another good. It assumes a perfect state, when there is no waste and the company produces at the limit of its production possibilities. [3]

The main approaches to measuring efficiency include deterministic (deviation from the production possibilities frontier means inefficiency) and stochastic (includes an error component) methods. The methods are further divided into parametric (contains a random component) and non-parametric (does not contain a random component). DEA (Data Envelopment Analysis) is included among non-parametric methods.

2 Source: http://www.helgilibrary.com/indicators/mortgage-loans-as-of-gdp/
[3] Kočišová, Kristína: Efektívnosť bankového sektora: Stochastic frontier approach. Ekonomická fakulta Technickej univerzity v Košiciach. 2008. Available online: http://www3.ekf.tuke.sk/konfera2008/zbornik/files/prispevky/kocisova.pdf

Principles of DEA analysis

The DEA method presents results on the relative efficiency. The results of the efficiency of the banks were different if the set of banks or the selected inputs and outputs were changed. The interpretation of the results must take into consideration the presented restrictive conditions of the analysis.

Picture 1: Production possibilities frontiers of DEA models
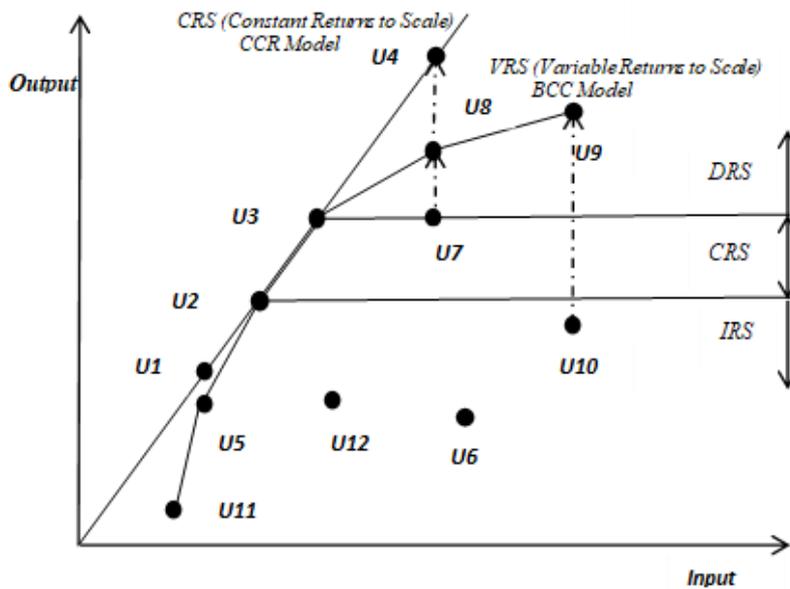
Source: processed according to: Dlouhý, Martin, Jablonský, Josef. Zíková, Petra : Analýza obalu dat. Professional Publishing, 2018. ISBN 978-80-88260-12-7, s. 23-25.
CRS = Constant returns to scale model
VRS = Variable returns to scale model
U = designation of DMU (Decision Making Unit; in this case, banks are designated as DMUs).

Jablonský and Dlouhý (2004[4] have described input-oriented CCR-I (Charnes-Cooper-Rhodes-Input) model as the form of linear programming:

$$\max z = \sum_{i=1}^{m} u_i * y_{iq}$$

Under the conditions:

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[4] Jablonský, Josef and Dlouhý, Martin. 2004. Modely hodnocení efektivnosti produkčních jednotek. Praha: Professional Publishing. ISBN 80-86419-49-5.

$$\sum_{i=1}^{m} u_i * y_{iq} \leq \sum_{j=1}^{r} v_j * x_{jk\,;} \quad k = 1,2,\ldots\ldots n$$

$$\sum_{i=1}^{m} u_i * y_{iq} - \sum_{j=1}^{r} v_j * x_{jk} \leq 0 \quad k = 1,2,\ldots\ldots n$$

$$\sum_{j=1}^{m} v_j * x_{jk} = 1$$

$$u_i \geq 0, i = 1,2,\ldots\ldots n$$

$$v_j \geq 0, i = 1,2,\ldots\ldots m$$

Jablonský and Dlouhý (2004) have written the input-oriented BCC-I in the form:

$$\max z = \sum_{i=1}^{m} u_i * y_{iq} + \mu$$

Under the conditions:

$$\sum_{i=1}^{m} u_i * y_{iq} + \mu \leq \sum_{j=1}^{r} v_j * x_{jk\,;} \quad k = 1,2,\ldots\ldots n$$

$$\sum_{j=1}^{m} v_j * x_{jk} = 1$$

$$u_i \geq 0, i = 1,2,\ldots\ldots r$$

Parameter μ reflects the conditions of convexity of the BCC-I model.

As per the rule of authors Cooper, Seiford and Tone (2007)[5] the number of the inputs and outputs included into analysis should not be greater than third part of number of analyzed production units: The *m* and *s* denote the number of selected inputs and outputs, *n* denotes the number of DMU-s.

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[5] Cooper, William W., Lawrence M. Seiford, and Kaoru Tone. 2007. Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References and DEA-Solver Software, 2nd ed. Cham: Springer International Publishing, ISBN 10-0-387-45281-8.

$$n \geq max \ \{m \times s, \ 3(m + s)\};$$

Technical efficiency of banks in Slovakia

The banking sector in Slovakia has undergone a complex process of restructuring and subsequent privatization. This intensive reform process used similar instruments and similar speed of reform adoptions, but the impact of these changes among Central and Eastern European (CEE) countries is different. Understanding the drivers of bank efficiency is an important part of bank management and regulation.[6]

The following models consisting of these inputs and outputs were selected for analysis.

Table 1: Overview of the technical efficiency models of banks in Slovakia composition

Model Nr.	Input 1	Input 2	Output 1	Orientation	Typ of Model
Model 1	Mortgage Credits	-	Margin	Output oriented	BCC
Model 2	Mortgage Credits	-	Profit	Output oriented	BCC
Model 3	Mortgage Bonds	Deposits	Mortgage credits	Output oriented	BCC
Model 4	Deposits	-	Mortgage credits	Input oriented	BCC

Source: own processing

The following table presents the results of Model 1 for all analysed banks. Model 1 is output oriented VRS model with input Mortgage Credits and output Net Interest Margin.

Table 2: Results of Model 1

DMU Name	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Averaage Efficiency of Bank
VÚB	1	1	0,851	0,815	0,844	0,884	1	1	0,953	0,901	0,925
Tatra banka	1	1	1	1	1	1	1	1	1	1	1
SLSP	0,519	0,474	1	1	1	1	1	1	1	1	0,899
CSOB	0,519	0,474	1	1	1	1	1	1	1	1	0,899
OTP	0,666	0,772	0,993	0,878	0,784	0,634	0,675	0,656	0,704	0,664	0,743
Dexia (Prima)	0,442	0,371	0,592	1	0,637	0,632	0,712	1	1	1	0,738
Volksbank (Sberbank)	1	1	1	0,767	1	1	1	0,752	0,638	0,490	0,864
Uni Credit	1	0,685	0,750	0,722	0,775	0,700	0,782	0,783	0,156	0,157	0,651
Average of the Year	0,828	0,788	0,898	0,882	0,880	0,826	0,779	0,784	0,691	0,660	0,801

Source: own processing

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[6] Horvatova E. Technical Efficiency of Banks in Central and Eastern Europe. *International Journal of Financial Studies*. 2018; 6(3):66. https://doi.org/10.3390/ijfs6030066.

Model 1 shows that the most efficient bank within the analysed group of banks with the mortgage credits input and the net interest margin output was the Tatra Bank. From a time perspective, under said combination of inputs and outputs, the banks achieved the highest efficiency in 2009. We put this result in the context of the high interest rates that peaked in 2009.

The following table presents the results of Model 2 for all analysed banks. Model 2 is output oriented VRS model with input Mortgage Credits and output Profit.

Table 3: Results of Model 2

DMU Name	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Averaage Efficiency of Bank
VÚB	1	1	1	1	0,914	0,567	0,978	1	0,895	1	0,935
Tatra banka	1	1	1	1	1	1	1	1	1	0,854	0,985
SLSP	0,909	0,882	0,199	0,983	1	1	1	1	1	0,917	0,889
CSOB	0,540	0,363	0	0,786	0,827	0,596	0,816	0,680	0,748	0,560	0,592
OTP	0,162	0,142	0	0	0,072	0	0,125	0	1	0	0,150
Dexia (Prima)	1	0	0	0,173	0	0	0	0,102	0,349	0,254	0,187
Volksbank (Sberbank)	0,386	1	0	0,674	0	0	0,824	1	0	0	0,388
Uni Credit	1	1	1	0,638	1	0,506	0,110	0,134	0,136	0,106	0,563
Average of the Year	0,749	0,673	0,399	0,657	0,601	0,458	0,607	0,614	0,641	0,461	0,586

Source: own processing

Model 2 shows that the most efficient bank within the analyzed group of banks with the mortgage credits input and the profit output was the Tatra Bank. From a time perspective, under said combination of inputs and outputs, the banks achieved the highest efficiency in 2007. We link this result to the enormous growth of the credit market the real estate price boom.

The following table presents the results of Model 3 for all analysed banks. Model 3 is output oriented VRS model with input Mortgage Bonds and Deposits and output Mortgage Credits.

Table 4: Results of Model 3

DMU Name	2008	2009	2010	2011	2012	2013	2014	2015	2016	Averaage Efficiency of Bank
VÚB	1	0,896	0,875	0,788	0,785	0,752	0,748	0,816	0,853	0,835
Tatra banka	0,693	0,562	0,690	0,639	0,669	0,651	0,729	0,699	0,691	0,669
SLSP	1	1	1	1	1	1	1	1	1	1
CSOB	0,663	0,593	0,569	0,546	0,643	0,595	0,648	1	1	0,695
OTP	1	0,783	0,479	0,725	0,761	0,386	0,368	1	1	0,722

Dexia (Prima)	1	0,526	0,912	1	1	0,305	0,478	0,620	0,780	0,736
Volksbank (Sberbank)	1	1	1	1	1	0,488	0,554	0,383	0,359	0,754
Uni Credit	1	1	1	1	1	1	1	1	0,961	0,998
Average of the Year	0,919	0,795	0,815	0,837	0,857	0,647	0,690	0,815	0,835	0,801

Source: own processing

Model 3 shows that the most efficient bank within the analyzed group of banks with the mortgage credits input and the mortgage bonds and deposits output was the Slovenská sporiteľňa. From a time perspective, under said combination of inputs and outputs, the banks achieved the highest efficiency in 2008. We put this result in the context of the enormous growth of the credit market and the ability to effectively allocate resources into the mortgage loans.

The following table presents the results of Model 4 for all analysed banks. Model 4 is input oriented VRS model with input Deposits and output Mortgage Credits.

Table 5: Results of Model 4

DMU Name	2008	2009	2010	2011	2012	2013	2014	2015	2016	Averaage Efficiency of Bank
VÚB	1	0,889	0,768	0,671	0,645	0,519	0,674	0,748	0,790	0,744
Tatra banka	0,597	0,502	0,697	0,640	0,666	0,512	0,581	0,548	0,446	0,576
SLSP	0,987	1	1	1	1	1	1	1	1	0,998
CSOB	0,605	0,611	0,583	0,547	0,558	0,353	0,450	1	1	0,634
OTP	1	0,818	0,662	0,728	0,639	0,000	0,000	0,295	0,314	0,495
Dexia (Prima)	0,723	0,612	0,730	0,576	0,540	0,000	0,000	0,216	0,199	0,399
Volksbank (Sberbank)	1	1	1	1	1	0,000	0,000	0,253	0,287	0,615
Uni Credit	0,358	0,403	0,353	0,387	0,359	1	1	1	1	0,651
Average of the Year	0,784	0,729	0,724	0,693	0,676	0,423	0,463	0,632	0,629	0,6392

Source: own processing

Model 4 shows that the most efficient bank within the analyzed group of banks with the deposits input and the mortgage credits output was the Slovenská sporiteľňa.

From a time perspective, under said combination of inputs and outputs, the banks achieved the highest efficiency in 2008. We put this result in the context of the enormous growth of the credit market and the ability to effectively allocate resources into the mortgage loans.

The following table summarizes the results of the models according to which bank and in which year achieved the best results in the given model.

Table 6: Overview of the technical efficiency models of banks in Slovakia composition

Model Nr.	Input 1	Input 2	Output 1	Orientation	Typ of Model	The Best Average Efficiency of the Bank	The Best Average Efficiency of the Year
Model 1	Mortgage Credits	-	Margin	Output oriented	BCC	Tatra banka	2009
Model 2	Mortgage Credits	-	Profit	Output oriented	BCC	Tatra banka	2007
Model 3	Mortgage Bonds	Deposits	Mortgage credits	Output oriented	BCC	SLSP Uni Credit	2008
Model 4	Deposits	-	Mortgage credits	Input oriented	BCC	SLSP	2008

Source: own processing

The following figure shows how many banks achieved a technical efficiency value equal to 1 in any model in that year.

Picture 2: The number of models with the highest efficiency of banks (efficiency =1)

Source: own processing

Picture 2 shows that in 2008, 3 banks achieved their best results for the entire examined period. 2009 was not the best for any of the banks. Subsequently, in 2010, 3 banks achieved their best results, 2011 and 2015 appeared to be good years, when 2 banks recorded their best results

and years 2012, 2013 and 2014appeared be not very good years, when only 1 bank recorded t he best results.

Conclusion

The analysis of the technical efficiency of banks in Slovakia from the point of view of mortgage transactions in the period 2007-2017 points to the leading positions of the four largest banks - Slovenská sporiteľna, VÚB banka, Tatra banka and ČSOB banka. It also points to the strengths of individual banks from the point of view of their ability to effectively use selected resources in connection with selected outputs. The temporal aspect of the analysis points out that overall efficiency has been declining after the 2008 financial crisis.

Housing loans and mortgage banking continue to remain the dominant component of the business of banks in Slovakia, and therefore it is necessary to continue to pay attention to them.

References

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