

# “Ukrainian banking system efficiency after double reducing of the number of bank institutions”

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# UKRAINIAN BANKING SYSTEM EFFICIENCY AFTER DOUBLE REDUCING THE NUMBER OF BANK INSTITUTIONS

## Abstract

The article intends to evaluate the efficiency and performance of Ukrainian banking system based on two stages. The first stage, when the number of banks was on average the same during that period, and the second stage, that began in 2015 and when the number of banks began to fall quickly up to 82 institutions in 2018. The study is based on the model of dynamics norm of the banking system efficiency for two periods.

The concept of efficiency was used based on the methods of non-parametric statistic to obtain performance estimates. The implementation of a dynamic model, based on the peculiarities of the banking system functioning, allows to obtain a generalized assessment of the economic efficiency of banking activity before and after critical change in the number of bank institutions. The correlation matrix between financial indicators of the banking system activity was created and the dynamic norm for the two periods was calculated. Given the analytical comparison of indicators, more effective period was identified. The general results of the study indicate that the overall efficiency of the banking system started to grow up since 2015.

## Keywords

dynamic efficiency of the banking system, matrix of  
normative ratio, efficiency dynamic norm

## JEL Classification

G10, G21

## INTRODUCTION

Ukrainian banking sector has developed for more than twenty years. Ukrainian banking system had experienced dramatic changes over the last three years. The number of banks were on average the same during that period. Only since 2015, the number of banks began to fall quickly up to 82 institutions in 2018. Therefore, an appropriate performance measurement system is required to gauge the efficiency of banks. There are significant changes in Ukrainian banking system, it is under recession and in process of the "purge" of the banking system, therefore the issue of consequences of such changes is of particular relevance.

Banks primarily put great emphasis on the use of ratio analysis in gauging the efficiency. However, more innovative approach is required for measuring. On the other hand, the research of the commercial banks efficiency cannot be ignored, as through measuring efficiency of the banking system it can be understood whether the goals and objectives are achieved. This research is motivated by the necessity to use new approaches, such as non-parametric statistic methods, to measure efficiency.

## 1. LITERATURE REVIEW

Theory of economic growth argues that financial institutions, especially banks, are considered to be the most useful institutions to improve the productive capacity of the economy. At the same time, banks are an important internal source of crediting the national economy specially on the level of economic growth (Schumpeter, 1911). Therefore, the analysis of the relationship between banking credits supply and economic growth becomes very important (Abusharbeh, 2017). However, some banking variables have negative effect on economy growth (Bongini et al., 2017). Using efficiency to measure performance of revenue generated forms (Mouzas, 2006), some researchers had also distinguish efficiency in simple ways, such as “efficiency is doing things right while the counterpart effectiveness is doing the right things” (Drucker, 1997) and generally the same argument was put by Marciariello and Kirby (1994).

The 2007–2008 financial crisis had a great influence on the economy in general and particularly on banks institutions (Cerović, Suljić Nikolaj, & Maradin, 2017). In such economic circumstances, finding the methods for measuring the efficiency and interpreting efficiency scores becomes one of key points. Variety of methods used and financial parameters in private banking are compared (Sharma, G., & Sharma, D., 2017).

Aiello and Bonanno (2018) applied the intermediation approach to measure efficiency and to interpret the results. However, there are researches who have used “CAMELS” model to calculate efficiency. It could also be used to evaluate banking sector performance, as far as relative risk (Rostami, 2015). Chaudhary (2012) used the CAMEL model to analyze the performance of selected public and private banks in India. Another approach (Data Envelopment Analysis) can be implemented to obtain bank efficiency. The Brockett and Golany (1996) test can be used to identify group-based differences in efficiency (Asimakopoulous et al., 2018). The DEA and FDH (Free Disposal Hull) are applied to analyze the banking system (Stavárek & Řepková, 2012). Vighneswara (2015) used panel data techniques and robust data sets to determine bank assets quality and profitability.

Financial ratios are used to measure performance, including factors such as profitability, solvency, liquidity, and credit risk. The superiority of conventional banks in credit risk management, solvency and profitability was founded (Elmassah & Al Sayed, 2015). It was noted that the financial ratio approach suffers from the lack of consensus (Yang, 2012).

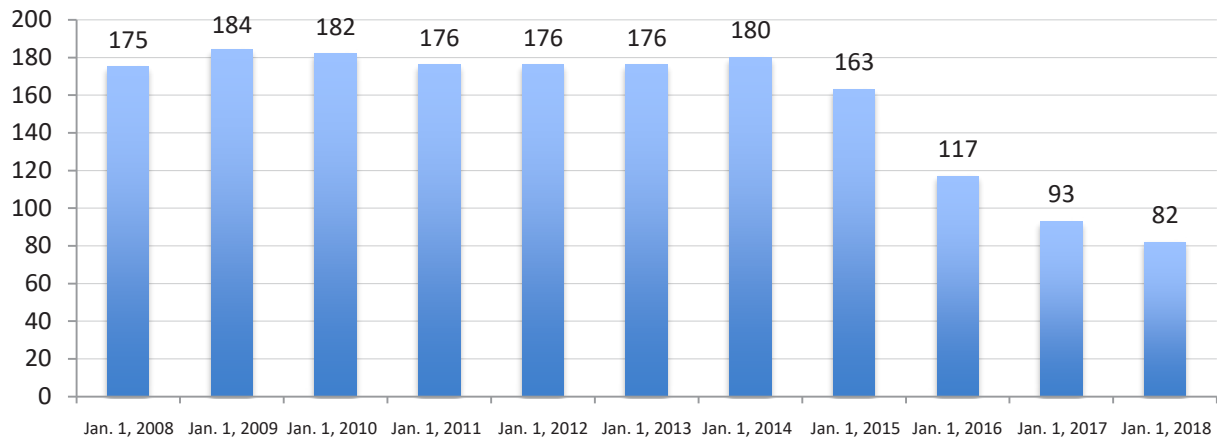
In studies on financial econometrics, the model of evolving dynamics behind the financial markets is used (Zhao, Z., 2008; Zhao, S., 2017). Methods of the non-parametric statistic are applied to the industry corporations but not to banks analyzed by Pogostinskaya (Pogostinskaya & Pogostinsky, 1999). Up to date, literature review in terms of the banking system efficiency is conducted through paying attention to both sides of productivity (i.e. effectiveness and efficiency) (Roghaniana, Raslia, & Gheysaria, 2012).

## 2. METHODS

The unstable macro economic situation in the world and especially in Ukraine requires the search for alternative methods to study the effectiveness of banking activities, taking into account the situation instability. In the global changing economic conditions, it is necessary to look for methods that allow using a variable set of financial indicators.

Dynamics norm can be applied to resist the influence of external factors. Based on the above-mentioned approach, it is suggested to measure the efficiency of the banking system activities as its ability to maintain state for a dynamic norm. Therefore, this research aims to model the dynamics norm of the efficiency of the banking system in two periods – before and after double reducing the number of banks. These statistical data are presented in Figure 1.

In order to model the dynamics efficiency of the banking system in the framework of double reducing the number of banks, two periods were defined. The first period (2013–2015) is characterized as relatively stable quantity of bank institutions, and during the second period (2016–2018), the quantity of bank institutions sharply decreased.



**Figure 1.** Dynamics of number of banks in Ukraine, 2008–2018

Banking efficiency has been estimated using a non-parametric model. The choice of methodology of dynamic norm as the most adequate research method is due to the fact that it enables to implement a systematic approach to the definition of efficiency and to describe in a formalized manner not only the state of the system (static analysis), but also the process of motion of the system object in time (dynamic analysis). The dynamic norm is expressed by a series of ranks of economic indicators, organized according to growth rates, taking into account their interrelations and mutual influence. In this way, a dynamic norm is created which allows us to evaluate the properties of the research object that cannot be described by any particular indicator.

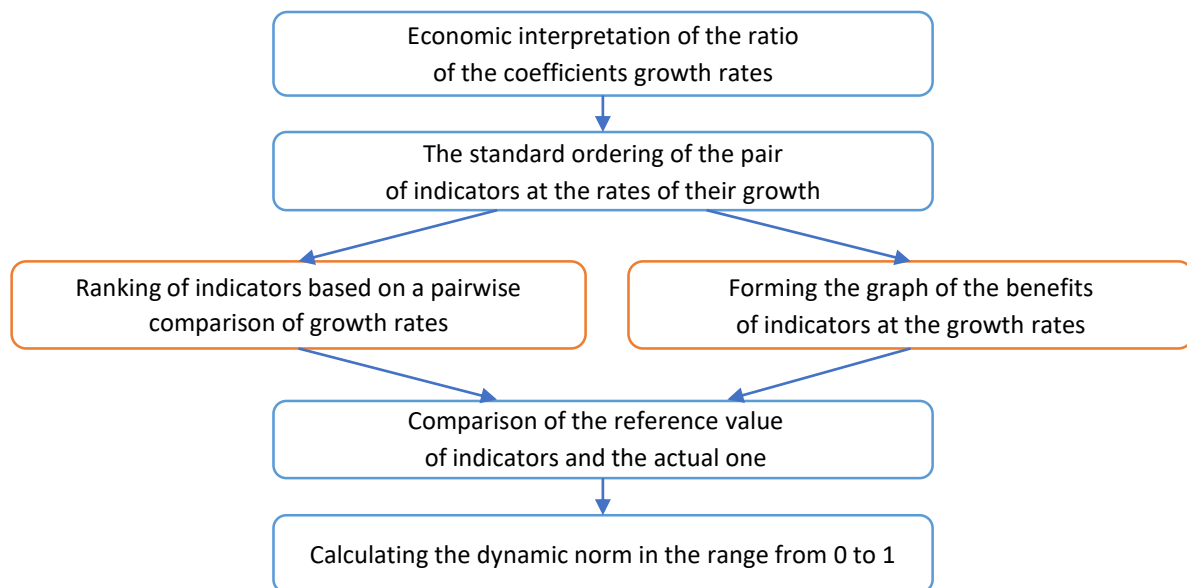
The implementation of a dynamic model, based on the peculiarities of the banking system's functioning, allows to obtain a generalized assessment of the economic efficiency of banking activity before and after critical change in the number of bank institutions. Thus, the dynamic model of the banking efficiency is an instrument of detecting the influence of changing the number of banks on the efficiency of Ukrainian banking system. In addition, by applying a normative model, a desirable state of the banking system can be described in a formalized form. For this purpose, an ordered series of indices of analytical indicators dynamics, which characterize the economic efficiency of banking activity, are formed. A comparative analysis of the normative ordering of indicators, reflected in the dynamic norm, with their actual ordering allows you to detect inversions (deviations). The number of in-

versions detected calculates an integral estimation of the economic efficiency of the bank. The higher value of the integral estimation testifies to the more effective activity of the bank.

Researching the possibilities provided by the use of non-parametric statistics methods and the methodology of forming a model of a dynamic standard has led to the conclusion that this approach meets the requirements of the complex analysis of economic efficiency of banking activity. It should be noted that the methodology for constructing a model of dynamic norm is widely used in modern economic research, in particular while analyzing the financial state of an enterprise according to the reporting, in banking activities – to study liquidity and solvency, bank risks. Also, non-parametric statistics are used in other sectors of the economy. In particular, the specialists of the Physics and Technology Center of the National Academy of Sciences of Ukraine used the “non-parametric index method to analyze productivity growth, technological progress and changes in efficiency on the example of agriculture in Ukraine”.

Detailed consideration of issues related to the definition of the point of structural change in the banking system development describes the essence of the methodology chosen for the study. The methodological features of forming a dynamic standard and constructing a normative dynamic model of the economic efficiency of banking activity are also considered.

Forming a model of a dynamic norm consists of seven stages (see Figure 2).



**Figure 2.** Forming a model of the banking system dynamic norm

To calculate the quantitative parameters of the banking system efficiency, a number of technical indicators is used that can be divided into two groups: operational efficiency indicators and profitability indicators (Table 1).

Based on the above-mentioned priorities regarding the growth rates of some indicators relative to others, a matrix of reference preferences will be constructed. Formally, the matrix of normative ratios at the rate of growth of the coefficients included in the model can be described as follows (Pogostinskaya, & Pogostinsky, 1999):

$a_{ij}$  – is an element of the matrix of preferences, located at the intersection of the  $i$ -th line and the  $j$ -th column;

$a_{ij} = 1$  if the  $i$ -th index should increase faster than  $j$ -th;

$a_{ij} = -1$  if the  $i$ -th index should increase slower than  $j$ -th;

$a_{ij} = 0$  if the normative correlation between  $i$ -th and  $j$ -th indices is not established.

Based on the formal description of the matrix and the economic content of the indicators and their growth rates, the matrix of reference preferences will be constructed (Table 2) to determine the efficiency of banking activity. The matrix of preferences is necessary for comparing reference values of normative relations with the actual values obtained based on the results of calculations based on real data of the banking system.

**Table 1.** Indicators for calculating the dynamic norm

No.	Indicator	Abbreviation	Calculation	Dynamics	Priority
1	Return on equity	ROE	NP/OE	Increase	$F(NP) > F(OE)$
2	Return on assets	ROA	NP/A	Increase	$F(NP) > F(A)$
3	Capital multiplier	MK	A/OE	Decrease	$F(A) < F(OE)$
4	Adequacy of regulatory capital	H2	RC/A	Increase	$F(RC) > F(A)$
5	Revenue/expense ratio	IE	I/E	Increase	$F(I) > F(E)$
6	Share of capital in liabilities	OEP	OE/P	Increase	$F(OE) > F(P)$
7	The ratio of bad loans	PCP	C/PC	Decrease	$F(C) < F(PC)$

**Table 2.** The matrix of reference preferences for the banking system efficiency

Indicator	NP	OE	A	RC	I	E	P	C	PC
NP	0	1	1						
OE	-1	0	1				1		
A	-1	-1	0	-1					
RC			1	0					
I					0	1			
E					-1	0			
P		-1					0		
C								0	1
PC								-1	0

Let's calculate the dynamic norm for two periods in the banking system of Ukraine: the first period – a period of insignificant number of banks operating on the financial market, which lasted until 2015 (the number of the operating banks has decreased by 28%); the second period – the number of operating banks to be put on at rather stable level in the banking system since 2016.

### 3. RESULTS AND DISCUSSION

According to the results of the implementation of the dynamic norm model, the economic efficiency of the banking system in certain periods is compared.

First, the model applied to a period of insignificant presence of foreign capital to analyze the 2013–2015 period is given in Table 3.

At the next stage, the matrix of actual ratios of growth rates of indicators that characterize the banking system was constructed (Table 4).

**Table 4.** The matrix of actual ratios of the banking system performance indicators in 2013–2015

Indicator	NP	OE	A	RC	I	E	P	C	PC
NP	0	-1	-1						
OE	1	0	-1				1		
A	1	1	0	-1					
RC			1	0					
I					0	-1			
E					1	0			
P		-1					0		
C								0	-1
PC								1	0

A matrix of matrices of reference and actual ratios of indicators has been constructed. The algorithm for constructing the matrix of coincidences is as follows:

$s_{ij}$  – is an element of the matrix of reference concurrent preferences, which is at the intersection of the  $i$ -th row and the  $j$ -th column;

$f_{ij}$  – is an element of the matrix of actual relations, which is at the intersection of the  $i$ -th line and the  $j$ -th column;

**Table 3.** Input statistic data of the Ukrainian banking system, 2013–2015, in UAH bln

Indicator	January 1, 2013	January 1, 2014	January 1, 2015	Growth rate 2013–2014, times	Growth rate 2014–2015, times
NP	4,899	1,436	-52,966	0.29	-36.88
OE	169,320	192,599	148,023	1.14	0.77
A	1,127,192	1,278,095	1,316,852	1.13	1.03
RC	178,909	204,976	188,949	1.15	0.92
I	150,449	168,888	210,201	1.12	1.24
E	145,550	167,452	263,167	1.15	1.57
P	1,127,192	1,278,095	1,316,852	1.13	1.03
C	815,327	911,402	1,006,358	1.12	1.10
PC	72,564	70,178	135,858	0.97	1.94

$d_{ij}$  – is an element of the match matrix, which is located at the intersection of the  $i$ -th row and the  $j$ -th column;

$d_{ij} = 1$  if  $s_{ij} = 1$  simultaneously with  $f_{ij} \geq 0$ ; or

if  $s_{ij} = -1$  simultaneously with  $f_{ij} < 0$ ;

$d_{ij} = 0$  in all other cases.

The matrix of matching the reference and actual ratios of performance indicators describing the banking system activity at the stage of the insignificant presence of foreign capital in the system is presented in Table 5.

**Table 5.** Matrix of matches of actual and reference ratios of the banking system performance indicators, 2013–2015

Indicator	NP	OE	A	RC	I	E	P	C	PC
NP	0	0	0						
OE	0	0	0				1		
A	0	0	0	1					
RC			1	0					
I					0	0			
E					0	0			
P		1					0		
C								0	0
PC								0	0

Indicator	NP	OE	A	RC	I	E	P	C	PC
NP	0	0	0						
OE	0	0	1				0		
A	0	1	0	0					
RC			0	0					
I					0	0			
E					0	0			
P		0					0		
C								0	1
PC								1	0

Given the comparison matrices of reference and actual rates of indicators growth, the efficiency of the banking system's performance is estimated as follows:

$$EF = \frac{\sum_{i=1}^n \sum_{j=1}^n d_{ij}}{\sum_{i=1}^n \sum_{j=1}^n |s_{ij}|}, \quad (1)$$

where  $EF$  – assessment of the banking system efficiency;  $n$  – number of indicators in the dynamic norm;  $i, j$  – numbers of indicators in the dynamic norm;

$s_{ij}$  is an element of the matrix of reference concurrent preferences, which is at the intersection of the  $i$ -th row and the  $j$ -th column;

$d_{ij}$  is an element of the matrix of matches, which is at the intersection of the second row and the  $j$ -th column.

The integral indicator of the banking system efficiency at the stage of the insignificant presence of foreign capital in the system is for the period 2013–2014 ( $EF1$ ) and for the period 2014–2015 ( $EF2$ ), respectively:

$$EF = \frac{\sum_{i=1}^9 \sum_{j=1}^9 d_{ij}}{\sum_{i=1}^9 \sum_{j=1}^9 |s_{ij}|} = \frac{4}{14} = 0.285, \quad (2)$$

$$EF = \frac{\sum_{i=1}^9 \sum_{j=1}^9 d_{ij}}{\sum_{i=1}^9 \sum_{j=1}^9 |s_{ij}|} = \frac{4}{14} = 0.285. \quad (3)$$

The integrated value of the indicator of the banking system efficiency at the stage of the insignificant presence of foreign capital (IEF) in two periods will be calculated as the arithmetic mean:

$$IEF = \frac{EF1 + EF2}{2} = \frac{0.285 + 0.285}{2} = 0.285. \quad (4)$$

For comparison, the dynamic performance standard of the banking system in the period of significant reduction in the number of bank institutions in the banking system is calculated (Table 6).

Matrix of the actual and theoretical data comparison for the second period is given in Tables 7 and 8.



**Table 6.** Input statistic data of the Ukrainian banking system, 2016–2018, in UAH bln

Indicator	January 1, 2016	January 1, 2017	January 1, 2018	Growth rate 2016–2017, times	Growth rate 2017–2018, times
NP	–66,600	–159,388	–24,360	–2.39	0.15
OE	103,713	140,490	156,506	1.35	1.11
A	1,254,385	1,237,924	1,301,560	0.99	1.05
RC	104,753	109,653.6	115,817.6	1.05	1.06
I	199,193	190,691	178,235	0.96	0.93
E	265,793	350,078	202,595	1.32	0.58
P	1,254,385	1,237,924	1,301,560	0.99	1.05
C	1,009,768	823,614	1,090,914	0.82	1.32
PC	222,149	444,667	594,999	2.00	1.34

**Table 7.** The matrix of actual ratios of the banking system performance indicators in 2016–2018

Indicator	NP	OE	A	RC	I	E	P	C	PC
NP	0	–1	–1						
OE	1	0	–1				1		
A	1	1	0	–1					
RC			1	0					
I					0	–1			
E					1	0			
P		–1					0		
C								0	1
PC								–1	0

Indicator	NP	OE	A	RC	I	E	P	C	PC
NP	0	–1	–1						
OE	1	0	–1				1		
A	1	1	0	–1					
RC			1	0					
I					0	1			
E					–1	0			
P		–1					0		
C								0	1
PC								–1	0

**Table 8.** Matrix of matches of actual and reference ratios of performance indicators of the banking system in 2016–2018

Indicator	NP	OE	A	RC	I	E	P	C	PC
NP	0	0	0						
OE	0	0	0				1		
A	0	0	0	1					
RC			1	0					
I					0	0			
E					0	0			
P		1					0		
C								0	1
PC								1	0

Indicator	NP	OE	A	RC	I	E	P	C	PC
NP	0	0	0						
OE	0	0	0				1		
A	0	0	0	1					
RC			1	0					
I					0	1			
E					1	0			
P		1					0		
C								0	1
PC								1	0



Integral indicator of the banking system efficiency at the stage of significant presence of foreign capital in the system was calculated:  $EF^1$  for the period 2006–2007, and  $EF^2$  for the period 2007–2008, respectively,

$$EF^1 = \frac{\sum_{i=1}^9 \sum_{j=1}^9 d_{ij}}{\sum_{i=1}^9 \sum_{j=1}^9 |s_{ij}|} = \frac{6}{14} = 0.428, \quad (5)$$

$$EF^2 = \frac{\sum_{i=1}^9 \sum_{j=1}^9 d_{ij}}{\sum_{i=1}^9 \sum_{j=1}^9 |s_{ij}|} = \frac{8}{14} = 0.571. \quad (6)$$

The integrated value of the indicator of the banking system efficiency at the stage of a significant presence of foreign capital in two periods  $IEF$  will be calculated as the arithmetic mean:

$$IEF = \frac{EF^1 + EF^2}{2} = \frac{0.428 + 0.571}{2} = 0.5. \quad (7)$$

Comparing the performance indicators of the banking system in two periods – before and after the structural fracture point – it can be noted that the system's efficiency in the first period was 0.285

pp, while the average efficiency in the second period was higher at the level of 0.5 pp. According to the results obtained, the most important factor for the effective banking sector is the quality of banks' financial indicators but not the quantity of banks institutions. The National Bank of Ukraine provides the pragmatic and most suitable policy as for the macro situation and implements the scenario of "toxic banks" elimination.

#### 4. PRACTICAL IMPLEMENTATION

The practical value of the conclusions and recommendations is significant. Approbation of the proposed approach of non-parametric model allows getting indicator of efficiency of the banking system activity in progress. The practical application of the model of the dynamic norm allows to survive changes in the financial situation and sustainability of the banking system in the dynamics. The methods of non-parametric statistic allowed to apply any number and combination of financial indicators in order to get the final integrated indicator. Providing only one final indicator made this approach acceptable and understandable to the society. Also it provides the ability to describe quantitatively the regularities and prospects for achieving efficiency of the system and allows to make strategic decisions on the macro level about the banking system development vector.

## CONCLUSION

The research proves that a definite point of structural change of the efficient activity of the Ukrainian banking system really became a turning point for the better. Having analyzed the Ukrainian banking system for its comparative effectiveness, it has been confirmed that the efficiency of the system with the introduction of tough methods of influence such as control and monitoring of financial indicators and obligatory normative has increased.

One of the reasons for the increase in the efficiency of the banking system after the reduction of number of banks is obviously that, in general, "bad" banks solve, first of all, their own problems posed by their shareholders, which differ significantly from the systemic general economic problems facing the economy and are formed in view of national economic policy. Owners of the "bad" banks focus on obtaining high profits and do not consider the country's economic security. They are not interested in lowering prices and fixing risks at an acceptable level in order to maintain the stability of the Ukrainian banking system.

The obtained results prove once again that further development of the banking system will be largely determined by parallel efforts of the banking system itself with regard to the efficiency improvement,

legislative and regulatory bodies towards regulating the presence of foreign capital and determining the conditions for its entry into the domestic banking sector, as well as the state in solving the above-mentioned problems at the national level.

To prepare for full-scale competition with foreign banks, the banks themselves need active work to optimize their expenses, improve balances, and improve the quality of management. In addition, more importantly, a consistent policy of state bodies aimed at strengthening financial stable banks, reducing the excessive administrative burden, increasing their capitalization, creating favorable conditions for the formation of long-term resources, and reducing credit risks should be developed. Also, efforts should be directed to further development of the refinancing system, expansion of the guarantee mechanism, and fuller implementation of the National Bank of Ukraine's function as the lender of last resort. Such comprehensive and versatile measures will make domestic banks competitive participants in the global financial infrastructure and increase their efficiency.

Generally, one can conclude that the decrease in the number of banks positively influenced the general financial stability and efficiency of the Ukrainian banking system.

## REFERENCES

1. Abusharbeh, M. T. (2017). The Impact of Banking Sector Development on Economic Growth: Empirical Analysis from Palestinian Economy. *Journal of Emerging Issues in Economics, Finance and Banking (JEIEFB)*, 6(2), 2306-2316. Retrieved from [http://globalbiz-research.org/economics/images/files/26543\\_D756\\_JEIEFB\\_Mohammed%20T.%20Abusharbeh.pdf](http://globalbiz-research.org/economics/images/files/26543_D756_JEIEFB_Mohammed%20T.%20Abusharbeh.pdf)
2. Aiello, F., & Bonanno, G. (2018). On the sources of heterogeneity in banking efficiency literature. *Journal of Economic Surveys*, 32(1), 194-225. <https://doi.org/10.1111/joes.12193>
3. Anderson, T. W., & Hsiao, C. (1981). Estimation of dynamic models with error components. *Journal of the American Statistical Association*, 76(375), 598-606. <https://doi.org/10.2307/2287517>
4. Andrews, D. (1993). Tests for parameter stability and structural change with unknown change point. *Econometrica*, 61(4), 821-856. <https://doi.org/10.2307/2951764>
5. Asimakopoulou, G., Chortareas, G., & Xanthopoulos, M. (2018). The Eurozone financial crisis and bank efficiency asymmetries: Peripheral versus core economies. *Journal of Economic Asymmetries*, 18. <https://doi.org/10.1016/j.jeca.2018.e00099>
6. Bongini, P., Iwanicz-Drozowska, M., Smaga, P., & Witkowski, B. (2017). Financial Development and Economic Growth: The Role of Foreign-Owned Banks in CESEE Countries. *Sustainability*, 9(3), 335-360. <https://doi.org/10.3390/su9030335>
7. Brockett, P. L., & Golany, B. (1996). Using Rank Statistics for Determining Programmatic Efficiency Differences in Data Envelopment Analysis. *Management Science*, 42(3), 466-472.
8. Cerović, L., Suljić Nikolaj, S., & Maradin, D. (2017). Comparative analysis of conventional and Islamic banking: importance of market regulation. *Ekonomika misao*, XXVI(1), 241-263. Retrieved from <https://hrcak.srce.hr/file/270638>
9. Chaudhary, S. (2012). Performance appraisal of Indian banking sector: A comparative study of selected public and private sector banks. *International Journal of Research in Commerce and Management*, 3(6), 155-164.
10. Drake, L., Hall, M. J. B., & Simper, R. (2009). Bank modelling methodologies: A comparative non-parametric analysis of efficiency in the Japanese banking sector. *Journal of International Financial Markets, Institutions and Money*, 19(1), 1-15. <https://doi.org/10.1016/j.intfin.2007.05.002>
11. Drucker, P. (1977). *An introductory view of Management*. NY: Harper College Press.
12. Elmassah, S., & Al Sayed, O. (2015). Banking sector performance: Islamic and conventional banks in the UAE. *International Journal of Information Technology and Business Management*, 36(1), 69-81. Retrieved from <https://www.jitbm.com/JITBM%2036th%20Volume/6suzana%20final.pdf>
13. Maciariello, J., & Kirby, C. (1994). *Management Control Systems: Using Adaptive Systems to Attain Control* (2nd ed.). Englewood Cliffs, Prentice Hall, Inc.
14. Mouzas, S. (2006). Efficiency versus effectiveness in business networks. *Journal of Business Research*, 59(10-11), 1124-1132. <https://doi.org/10.1016/j.jbusres.2006.09.018>
15. Peck, J., & Shell, K. (2003). Equilibrium Bank Runs. *Journal of Political Economy*, 111, 103-123. <https://doi.org/10.1086/344803>
16. Pogostinskaya, N. N., & Pogostinsky, Yu. A. (1999). *System analysis of financial reporting* (96 p.). SPb.: Izdv Mikhailova VA.
17. Roghaniana, P., Raslia, A., & Gheysaria, H. (2012). Productivity Through Effectiveness and

- Efficiency in the Banking Industry. *Procedia – Social and Behavioral Sciences*, 40, 550-556. <https://doi.org/10.1016/j.sbspro.2012.03.229>
18. Rose, P. S. (2001). *Commercial Bank Management* (743 p.). McGraw-Hill.
19. Rostami, M. (2015). CAMELS' analysis in banking industry. *Global Journal of Engineering Science and Research Management*, 2(11), 10-26. Retrieved from <http://www.gjesrm.com/November-2015.html>
20. Schumpeter, J. A. (1911). *The Theory of Economic Development* (255 p.). Oxford: Oxford University.
21. Sharma, G., & Sharma, D. (2017). Comparison and Analysis of Profitability of Top Three Indian Private Sector Banks. *International Journal of Engineering Technology Science and Research*, 4(6), 173-180. Retrieved from [https://www.researchgate.net/publication/321225633\\_Comparison\\_and\\_Analysis\\_of\\_Profitability\\_of\\_Top\\_Three\\_Indian\\_Private\\_Sector\\_Banks](https://www.researchgate.net/publication/321225633_Comparison_and_Analysis_of_Profitability_of_Top_Three_Indian_Private_Sector_Banks)
22. Sinkey, J. F. (1992). *Commercial Bank Financial Management in the Financial-services Industry* (4th ed) (899 p.). Macmillan Publishing Company, Pennsylvania State University.
23. Šporčić, M., & Landekić, M. (2014). Nonparametric Model for Business Performance Evaluation in Forestry. *Computational and Numerical Simulations*, 452-485. <https://doi.org/10.5772/57042>
24. Stavárek, D., & Řepková, I. (2012). Efficiency in the Czech banking industry: A non-parametric approach. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 60(2), 357-366. <https://doi.org/10.1118/actaun201260020357>
25. Sultanum, B. (2014). Optimal Diamond-Dybvig Mechanism in Large Economies with Aggregate Uncertainty. *Journal of Economic Dynamics and Control*, 40, 95-102. <https://doi.org/10.1016/j.jedc.2013.12.011>
26. Vighneswara, S. (2015). *Modelling bank asset quality and profitability: An empirical assessment* (Economics Discussion Papers, No. 2015-27). Retrieved from <http://www.economics-ejournal.org/economics/discussionpapers/2015-27/file>
27. Yang, C. C. (2012). Service, investment, and risk management performance in commercial banks. *The Service Industries Journal*, 32(12), 2005-2025. <https://doi.org/10.1080/02642069.2010.551762>
28. Zhao, S. (2017). Does Financial Development Necessarily Lead to Economic Growth? Evidence from China's Cities, 2007-2014. *MATEC Web of Conferences*, 100(05032). <https://doi.org/10.1051/matec-conf/201710005032>
29. Zhao, Z. (2008). Parametric and nonparametric models and methods in financial econometrics. *Statistics Surveys*, 2, 1-42. <https://doi.org/10.1214/08-ss034>