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Article

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CLUSTER ANALYSIS OF SEPARATE INDICATORS OF THE BANKING SYSTEMS OF NORTH MACEDONIA, THE EU MEMBER STATES AND THE BALKAN COUNTRIES

Emilija Stojanova Ivanovska, PhD¹

Abstract

In this paper, a multivariate analysis of the computer statistics, i.e. the Cluster analysis of the banking system concentration indicators and the financial intermediation and portfolio quality indicators by applying the complete linkage and the Ward's linkage method are presented.

The main idea is to find out whether the level of banking system concentration and degree of financial intermediation in banking system of North Macedonia is similar or closer to any of the EU Member States or the Balkan countries.

Furthermore, since the appropriately modified analyses were performed also with the structural indicators of the banking system and results obtained 10 years ago, the objective is to see whether there are any positive shifts in the similarity of the analysed characteristics of the banking system in North Macedonia to a particular country or group of countries.

In the conducted cluster analysis made by applying the method of complete linkage to the indicators of concentration of the banking sector, North Macedonia is grouped first with the Slovak Republic and then with Croatia which means that the similarity of the values of these indicators of these countries is the largest. Regarding the outcome of the second cluster analyses, of the indicators of financial intermediation and portfolio quality by using two comparative clustering methods, North Macedonia is grouped with Montenegro in the penultimate cluster and then this cluster is grouped with Serbia, which confirms that the level of financial intermediation in these Balkan countries is lower compared to the EU Member States, but on the other side the quality of the portfolio is good.

Keywords: *banking system, concentration indicators, indicators of the degree of financial intermediation, Cluster Analysis, North Macedonia*

JEL Classification: *F41, G21, G10, N10, O11*

1. Introduction

In this paper, an analysis of concentration and other characteristics of the banking system in the Republic of North Macedonia, 27 EU Member States (excluding Great Britain) and 3 Balkan countries (Serbia, Albania and Montenegro) using Cluster Methods is presented in order to see if the banking system in North Macedonia taking into account these indicators is similar or close to the banking system in any EU

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country or the Balkan countries.

Because similar analysis is made with the data from 2007, based on structural indicators of the banking system indicators, here the analysis will be made with data mainly from 2017 (or 2016 and 2015) (if not available) and will be appropriately modified with the intention of comparing the results after 10 years to see if there are any positive shifts in the similarity of the analyzed features of banking system in North Macedonia to a particular country or group of countries.

Data on North Macedonia are mostly from the National Bank of the Republic of North Macedonia's website, data on the 27 member states of the European Union are from the European Central Bank website while data on Serbia, Albania and Montenegro are from their central banks' websites while part of the data is obtained from the following sources: BCSEE Review 2017, CEICdata and HegliLibrary.

The statistical software SAS is used for the analysis.

2. The case of North Macedonia: Short overview of banking system concentration indicators and the indicators for the level of financial intermediation and portfolio quality

Before the a choice of cluster analyses of banking sector indicators are presented, the general overview of the banking sector indicators in North Macedonia will be given in order to provide a better understanding and perception of the following analyses.

Concentration in the banking sector is usually measured according to the Herfindahl index and CR indicators for the concentration of the most important positions in the balance sheets of the five largest banks (CR5 indicator). The *Herfindahl Index (HI)* of the total assets is calculated as the sum of the squares of all the credit institutions' market shares in terms of total assets, according to the following equation

$$H = \sum_{j=1}^n (S)_j^2 \quad (1)$$

, where S denotes each bank's share in the total amount of the analyzed category in this case total assets, rather than the total number of banks in the system. When the index ranges between 1.000 and 1.800 units, the level of concentration in the banking system is considered acceptable².

In the first graph of the Figure 1, the trends of indicators for concentration of the banking sector concerning the following categories: household loans, corporate loans, household deposits, corporate deposits and total assets, for the period 2004 till 2017 in North Macedonia are presented.

In 2017, for the first time, the concentration in the banking system of North Macedonia, according to the Herfindahl Index in all analyzed categories can be assessed as being within the acceptable level. Thus, the Herfindahl Index of household loans was 1.690, of corporate loans was 1.348, of household deposits was at its highest level of 1.783, of corporate deposits was at its lowest level of 1.327, while the Herfindahl Index of the

² Report on financial structures, European Central Bank, October 2017, p.30.

total assets amounted to 1.357.

If we look at the dynamics of the Herfindahl Index in the banking sector of North Macedonia, in the period 2004 to 2017, we can see that for the household loans category, the Herfindahl Index in 2004 stood at 1.800, for the next 5 years was growing cyclically, reaching a maximum of 2.064 in 2009. In the next 8 years, this indicator showed continuous decline, and for the last three years starting from 2015, the Herfindahl Index of household loans was within the acceptable concentration level with the lowest value being 1.690 in 2017. The Herfindahl Index of household deposits, in 2004 was at the highest level of all other categories and of all subsequent years and stood at 2.450 since then, continuing to decline beginning from 2005, and in 2017 was within the acceptable concentration range for the first time, but close to the upper limit from 1.800. The Herfindahl Index for the total assets of the banks in the North Macedonia, was within the acceptable concentration level throughout the period, and from the level of 1.700 in 2004, it was generally declining. Thus, from 2004 to 2017, the Herfindahl Index of total assets decreased by 343 points.

The **CR5 Indicator (CR5)** shows the share of a certain analyzed category (in this case: household loans, corporate loans, household deposits, corporate deposits and total assets) of the five banks with the highest value of that category in the total amount of the same analyzed category in the banking sector, expressed as a percentage (%)³. The CR5 indicator is obtained by first ranking the banks according to the size of the category analyzed, then collecting the values of the top five values and putting them in terms of the total value of this category of all banks in the banking system⁴.

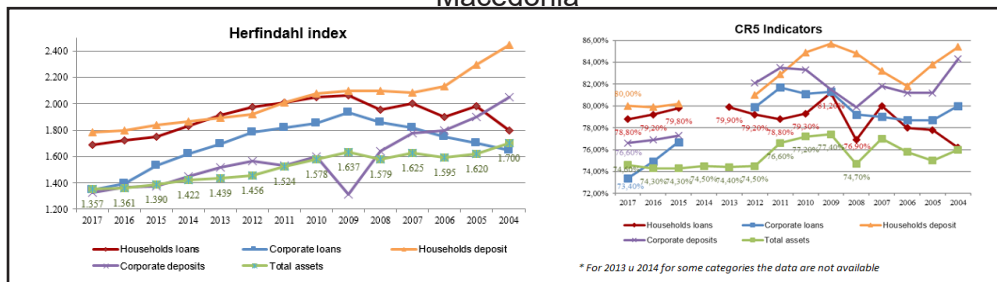
CR5 Indicator for the following categories: corporate loans, household deposits, corporate deposits and total assets in the banking system of the North Macedonia in 2017 was 73.4%, 80%, 76.6% and 74 respectively and they were all at the lower level compared with 2004 (when they were 80%, 85.4%, 84.3% and 76% respectively), with the exception of the category - household loans - which in 2017 was 78.8% and was higher than 2004, when it was 76.2%. In 2004, the CR5 Indicator was at the highest level of household deposits, corporate deposits and corporate loans, but in the 14-year period, these three categories experienced the largest decrease. If we look at the dynamics of the CR5 Indicator of household loans from 2004 to 2017, we can see that from the lowest level in 2004, it reached its maximum of 81.2% in 2009, then for the next two years, it declined to 78.8% in 2011, but in the following years the level was increasing, to the level of 78.8% again in 2017 (as it was in 2011). The CR5 Indicator of total assets from 76% in 2004 recorded a cyclical increase, reaching a maximum of 77.4% in 2009, followed by a trend of continuous decline and stabilization in the last 6 years at the level of about 74.5%.

The movement of the Herfindahl Index and the CR5 Indicator in the analyzed categories have a similar trend and we can conclude that from the relatively high level of concentration of the banking sector in 2004, the concentration of the banking sector in 2017 is on a moderate and acceptable level.

³ *Report on the risks in the banking system of the Republic of Macedonia in 2017, National Bank of the Republic of Macedonia, p.15.*

⁴ *Guideline of the European Central Bank on monetary and financial statistics (ECB/2014/15), European Central Bank, p.66.*

Figure 1. Indicators for concentration of the banking sector in North Macedonia

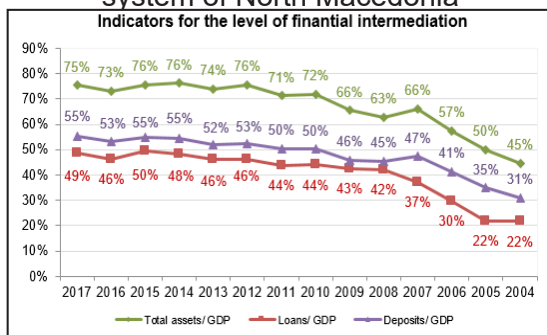


Source: Prepared by the Author, based on the data from the NBRNM

The level of financial intermediation in the banking system is measured using the following indicators of the degree of financial intermediation: the **ratio of total assets and gross domestic product (GDP)**, the **ratio of gross loans to GDP** and the **ratio of deposits and GDP**.

If we look at the trend, i.e. the dynamics of all three indicators listed above for the level of financial intermediation from 2017 to 2004 in North Macedonia, which are presented in Figure 2, we can see that the trend for all three indicators is similar, so from 2004 to 2007, there was growth in all indicators while in 2008 the effects of the global financial crisis contributed to a decline in household deposits, which in turn contributed to slowing growth in total assets and thus had direct impact to the reduction of the values of deposits / GDP and total assets / GDP. Over the next two years, 2009 and 2010, all indicators were up, while in 2011 there was some stagnation and slight decline, due to the slowdown of all economic growth and the uncertainty associated with the debt crisis in the Euro zone (primarily in Greece) impact of the slowdown in the growth of corporate deposits. After more significant growth in 2012, especially in the indicators of total assets / GDP and deposits / GDP in 2013 the indicator of total assets / GDP decreased while the other two indicators showed stagnation. Also in 2016, domestic political instability and slower economic growth had an impact on the larger reduction of all three indicators while in 2017 all the indicators again recorded growth. When comparing the level of all three indicators in 2017 with 2004, it can be seen that the total assets / GDP indicator increased by 30 percentage points (from 45% to 75%), the gross loans / GDP indicator increased by 27 percentage points (from 22% to 49%), while the deposits / GDP indicator increased by 24 percentage points (from 31% to 55%).

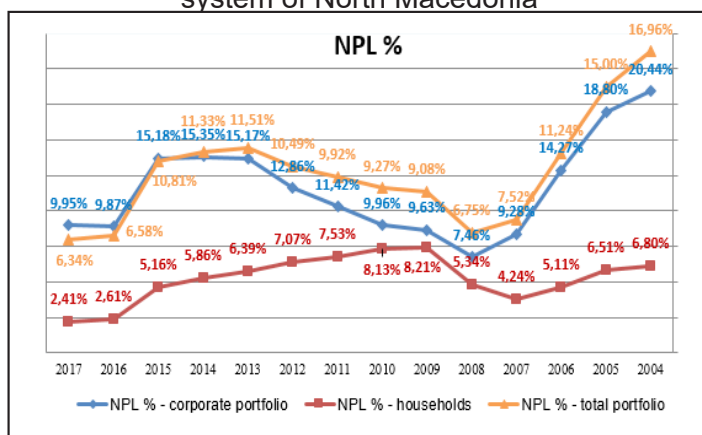
Figure 2. Indicators for the level of financial intermediation in the banking system of North Macedonia



Source: Prepared by the Author, based on the data from the NBRNM

In the Figure 3, the movement of total **non-performing loans rate (NPL rate (%))**, NPL rate of corporate portfolio and NPL rate of household portfolio are presented, as indicators of the quality of the loan portfolio. In 2004 the NPL rate of the total portfolio was at its highest level of 17% in the whole analyzed period (NPL rate of corporate portfolio was 20,4%) and due to high portfolio growth rates over the next four years (on average around 31% annually) they continued to decline to 6.8% (and 7.5 % of corporate portfolio). In 2009, as a result of the global financial crisis, the rate of the non-performing loans increased to 9.1% and it continued to grow to 15.3% in 2014. In 2016 the total non-performing portfolio decreased by 38%, mainly as a result of changes in regulation⁵ (the mandatory transfer of part of the non-performing portfolio, that is fully provisioned for more than two years, to off-balance sheet accounts), and thus the NPL rate decreased to 6.6% of total portfolio. In 2017 the rate of total non-performing portfolio was 6.3% (retail portfolio NPL rate was 2.4, while corporate portfolio NPL rate was 10%).

Figure 3. Quality of loan portfolio expressed through NPL rate in the banking system of North Macedonia



Source: Prepared by the Author, based on the data from the NBRNM's annual reports

⁵ Decision on amendment the Decision on credit risk management, Official Gazette of the Republic of Macedonia No.223/15 and Decision on the Methodology for credit risk management, Official Gazette of the Republic of Macedonia No.149/18

3. Methodology

In this paper, cluster analysis of the banking system concentration indicators and the financial intermediation and portfolio quality indicators of the analyzed countries, North Macedonia, the EU Member States and the Balkan countries by applying two different linkage method are performed and presented. **Cluster Analysis (CA)** is method of multivariate analysis which is used for grouping of objects into groups so that the objects inside the groups are more similar and the objects between groups are significantly different. CA is a multivariate procedure for detecting natural groupings in data. CA classification is based upon the placing of objects into more or less homogeneous groups in a manner such that the relationship between groups is revealed. Care should be taken that groups (classes) are meaningful in some fashion and are not arbitrary or artificial. The clustering technique is based on minimizing within-group deviations on the one hand and maximizing variations between groups. There are different methods used for cluster analysis and they differ mainly in the way that the difference between two clusters is calculated and can be classified into the following two general groups: hierarchical methods including agglomerative methods and divisive methods and non-hierarchical methods also known as k-means clustering methods. In this paper, two standard hierarchical agglomerative cluster methods, complete linkage and Wards' method are presented.

The two key steps within cluster analysis are the measurement of distances between objects and to group the objects based upon the resultant distances (linkages). The distances provide for a measure of similarity between objects and may be measured in a variety of ways, in this case with Euclidean distance. The criteria used to then link (group) the variables may also be undertaken in a variety of manners as a result significant variation in results may be seen. Linkages are based upon how the association between groups is measured. The following are the steps in the agglomerative hierarchical clustering for grouping in this case 30 items: Start with 30 clusters. Each containing a signal country, search the distance matrix for the nearest (most similar) pair of clusters, merge "most similar" clusters, repeat Steps 2 and 3 a total of 29 times (All objects will be in a single cluster at the end).

The two performed cluster analyses are based on the following banking sector / system indicators:

I. **Banking sector concentration indicators** based on the following two indicators: The Herfindahl Total Assets Index (HIA) and CR5 Total Assets Indicator (CR5), and II. **Financial intermediation and portfolio quality indicators**, including the following indicators: Ratio of total assets and GDP (ABDP), Ratio of total loans and deposits (KD), Household loan to GDP ratio (KDBDP) and Non-performing loans to total gross loans (NKVK). Additionally, cluster analysis with the following structural indicators: Herfindahl Index, CR5 Indicator, population density, citizens per credit institution, citizens per ATM, citizens per employee in the banking system, citizens per branches, assets per employee in the banking system is also presented.

In the first cluster analysis of the indicators of the first group the method of complete linkage, which is suitable for clustering items (observations) in this cases countries. Complete linkage was originated by *Sorensen (1948)*. Using complete linkage at each stage, the distance (similarity) between clusters is determined by the distance

(similarity) between the two elements, one from each cluster, that are most distant. The distance between two clusters is defined by the following formula:

$$\begin{aligned} D_{KL} &= \max \max d(x_i, x_j) \quad i \in C_K, j \in C_L \\ D_{JM} &= \max(D_{JK}, D_{JL}) \end{aligned} \quad (2)$$

In complete linkage, the distance between two clusters is the maximum distance between an observation in one cluster and an observation in the other cluster. Complete linkage is strongly biased toward producing clusters with roughly equal diameters, and it can be severely distorted by moderate outliers (Milligan 1980).

Because the data are in different measurement scales (absolute amounts and %), in order to be measurable, they are first transformed by obtaining the square Euclidian distance.

Based on the indicators of the second group, cluster analysis of the analysed country is performed, using complete linkage as well as the Ward's method (Ward 1963), which is based on minimizing the "loss of information" from joining two groups, whereby

$$D_{JM} = \left[\frac{d(x,x) = (1/2) \sum (x - y)^2}{((N_J + N_K) D_{JK} + (N_J + N_L) D_{JL} - N_J D_{KL}) / (N_J + N_M)} \right] \quad (3)$$

This method is usually implemented with loss of information taken to be an increase in an error sum of squares criterion. At each step in the analysis, the union of every possible pair of clusters is considered. And the two clusters whose combination results in the smallest increase in minimum loss of information are joined. Ward's method is based on the notion that the clusters of the multivariate observations are expected to be roughly elliptically shaped. It is hierarchical precursor of nonhierarchical clustering methods that optimize some criterion for dividing data into a given number of elliptical groups. Ward's is a popular default linkage which produces compact groups of well distributed size.

4. Results and Findings

Since the data of the banking sector concentration indicators are in different scales (absolute amounts and %), before starting the cluster analysis, the data are transformed in order to minimize the bias in weighting and to obtain comparable variables using Squared Euclidian distance of the standardized variables to mean zero and variance one. After performing the cluster analysis using the complete linkage method, the entire history of cluster generation together with the maximum distance between clusters are shown in Table 1 and Table 2 (Appendix).

Table 1. Cluster analysis of the banking sector concentration indicators, using the complete linkage method

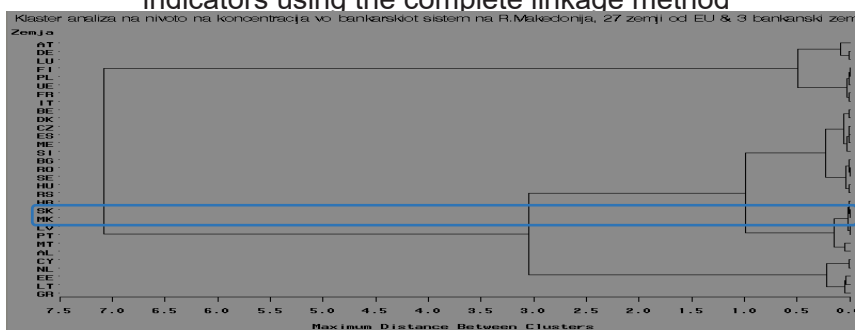
The CLUSTER Procedure Complete Linkage Cluster Analysis				
Mean Distance Between Observations = 4				
Cluster History				
NCL	Clusters Joined		FREQ	Norm Max Dist
30	LV	PT	2	0.0003
29	SK	MK	2	0.0005
28	FI	PL	2	0.0007
27	RO	SE	2	0.0012
26	CZ	ES	2	0.0031
25	HR	CL29	3	0.0047
24	FR	IT	2	0.0053
23	BG	CL27	3	0.0068
22	CL28	UE	3	0.0074
21	HU	RS	2	0.0077
20	BE	DK	2	0.0082
19	DE	LU	2	0.0099
18	CL26	ME	3	0.0104
17	CY	NL	2	0.0112
16	CL25	CL30	5	0.0206
15	CL18	SI	4	0.0245
14	CL22	CL24	5	0.0284
13	CL23	CL21	5	0.0342
12	EE	LT	2	0.039
11	MT	AL	2	0.0456
10	CL12	GR	3	0.0475
9	CL20	CL15	6	0.0617
8	AT	CL19	3	0.0933
7	CL16	CL11	7	0.1537
6	CL17	CL10	5	0.2174
5	CL9	CL13	11	0.2345
4	CL8	CL14	8	0.4936
3	CL5	CL7	18	0.9924
2	CL3	CL6	23	3.0515
1	CL4	CL2	31	7.0819

Source: Author's calculations using the SAS software

We can see that North Macedonia and the Slovak Republic are merged into the 29th cluster where the maximum normal distribution is 0.0005 and then with Croatia in the 25th cluster where the maximum normal distribution is 0.0047. The general rule is that the smaller the maximum normal distribution, the more compact the cluster is.

The graph of the cluster merge is shown in Figure 4. Because the complete linkage method is a hierarchical method, first of all a country is a separate cluster. The next step is to merge into one cluster of the “two most similar” countries according to the distance matrix, with this step repeated 30 times until all the countries are finally merged into one cluster.

Figure 4. Dendrogram of cluster analysis of the banking sector concentration indicators using the complete linkage method



Source: Author's calculations using the SAS software

Furthermore, the cluster analysis of financial intermediation and portfolio quality indicators, using two clustering methods, the already presented complete linkage method and the Ward's method will be presented, as the recommendation is that at least two methods should be used in cluster analysis in order to compare the obtained results.

Table 3 and Figure 5 show the distances between the analyzed countries and their clustering using complete linkage method from which we can see that the Republic of North Macedonia is grouped with Montenegro in Cluster 29, where the maximum normal distribution is 0.0039. In the next step, this cluster is grouped with the Republic of Serbia, in cluster 22, and after that this cluster is grouped with cluster 28, which includes Bulgaria and Croatia.

Table 3. Cluster analysis of the financial intermediation and portfolio quality indicators of the banking system using the complete linkage method

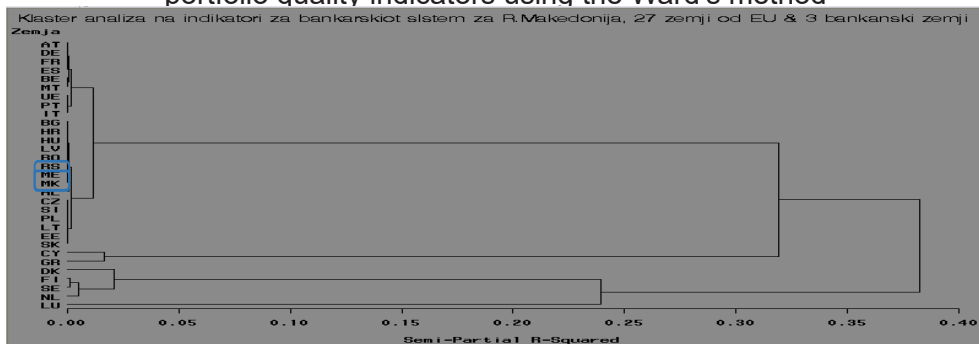
The CLUSTER Procedure Complete Linkage Cluster Analysis				
Mean Distance Between Observations = 8				
Cluster History				
NCL	Clusters Joined	FREQ	Norm Max Dist	T i e
30	CZ SI	2	0.0038	
29	ME MK	2	0.0039	
28	BG HR	2	0.0044	
27	FR ES	2	0.0049	
26	HU LV	2	0.01	
25	AT DE	2	0.0103	
24	EE SK	2	0.0119	
23	CL30 PL	3	0.0179	
22	RS CL29	3	0.0196	
21	BE MT	2	0.0228	
20	CL26 RO	3	0.0345	
19	UE PT	2	0.0347	
18	CL25 CL27	4	0.0553	
17	CL23 LT	4	0.0599	
16	CL28 CL22	5	0.0647	
15	CL17 CL24	6	0.082	
14	CL16 CL20	8	0.097	
13	CL19 IT	3	0.1179	
12	CL14 AL	9	0.1777	
11	CL18 CL21	6	0.1872	
10	FI SE	2	0.2765	
9	CL11 CL13	9	0.2885	
8	CL9 CL15	15	0.408	
7	CL10 NL	3	0.7106	
6	CL8 CL12	24	0.8485	
5	CY GR	2	1.1352	
4	DK CL7	4	1.4764	
3	CL6 CL5	26	3.877	
2	CL4 LU	5	4.2297	
1	CL3 CL2	31	5.6525	

Source: Author's calculations using the SAS software

Based on the indicators in the second group the cluster analysis using the Ward's method including all generations of the clustering history is presented in Table 4 (Appendices) and Figure 5. First listed are the number of clusters and the names of the clusters joined. Next, the number of observations in the new cluster and the semi partial R^2 are displayed. The latter value represents the decrease in the proportion of variance accounted for by joining the two clusters. Next listed is the squared multiple correlations, R^2 which is the proportion of variance accounted for by the clusters.

Similarly with this method, North Macedonia and Montenegro are merged into the 29th cluster, and then the Republic of Serbia into the 22nd cluster which means that we can conclude that this is a "natural" grouping of countries according to these indicators.

Figure 5. Dendrogram of cluster analysis of the financial intermediation and portfolio quality indicators using the Ward's method



Source: Author's calculations using the SAS software

Based on the results obtained from the presented cluster analyzes, it can be concluded that the level of concentration of the banking system in North Macedonia is higher than the three Balkan countries - Serbia, Albania and Montenegro and is similar to the Slovak Republic and then with Croatia. In terms of financial intermediation indicators and portfolio quality, the Republic of North Macedonia is "most similar" to Montenegro and Serbia, and then to Croatia and Bulgaria, from the EU Member States, which means that this level is still lower than most EU members countries.

At the end of this analyses for comparison reasons, also the cluster analysis of **structural indicators of the banking sector** 10 year ago (in 2007) is going to be presented, in order to see whether there is a positive shift in the similarity of the analysed characteristics of the banking system of the Republic of North Macedonia to a particular EU member country or group of countries. Thus in the structural indicators of the banking sector, the following indicators are included: Herfindahl Index, CR5 Indicator, population density, citizens per credit institution, citizens per ATM, citizens per employee in the banking system, citizens per branches, assets per employee in the banking system. This cluster analysis is also performed using complete linkage method.

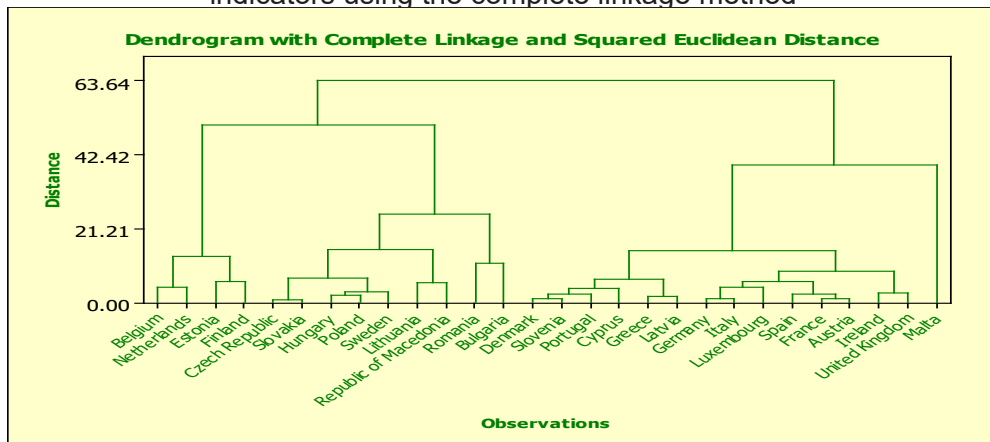
From the Table 5 it can be seen that the distance between Republic of North Macedonia and Lithuania is the smallest and these two countries are joined in the 14th cluster, thus based on the structural indicators, banking sector in Macedonia is the most similar to Lithuania (Figure 6).

Table 5. Cluster analysis of the banking sector structural indicators using the complete linkage method

The CLUSTER Procedure Complete Linkage Cluster Analysis			
Mean Distance Between Observations = 16			
Cluster History			Norm Max Dist e
NCL	Clusters Joined	FREQ	
27	CZ SK	2	0.046
26	FR AT	2	0.0651
25	DE IT	2	0.0667
24	GR SI	2	0.0889
23	LV HU	2	0.0993
22	ES CL26	3	0.1407
21	CL24 PT	3	0.1785
20	DK CY	2	0.2061
19	IE UK	2	0.2359
18	CL25 CL22	5	0.2406
17	BE NL	2	0.2738
16	CL23 PL	3	0.2784
15	EE FI	2	0.3146
14	LT HK	2	0.3463
13	CL16 SE	4	0.4039
12	CL20 CL21	5	0.4063
11	CL27 CL13	6	0.4355
10	CL18 CL19	7	0.6518
9	RO BG	2	0.6913
8	CL10 LU	8	0.8001
7	CL17 CL15	4	0.8019
6	CL11 CL14	8	0.8701
5	CL12 CL8	13	1.4517
4	CL6 CL9	10	1.7085
3	CL7 CL4	14	2.5075
2	CL5 MT	14	2.577
1	CL3 CL2	28	3.9072

Source: Author's calculations using the SAS software

Figure 6. Dendrogram of the cluster analysis of the banking sector structural indicators using the complete linkage method



Source: Author's calculations using the SAS software

If we compare these two countries we can find many similarities like geographical area, population, political background (Macedonia was republic of Yugoslavia till 1991, when Lithuania was in Soviet Union till 1990) and level of development of the countries that also lead to the similarity in the development of the banking systems. Evolution of the banking system in Lithuania, from state-owned mono-banks to a modern banking system is alike and in the same time period as in Republic of North Macedonia.

5. Conclusion

According to the indicators for measuring the degree of concentration in the banking sector, the Herfindahl Index and the CR5 Indicator for the concentration of the more important positions in the balance sheets (household loans, non-financial corporate loans, household deposits, household deposits, non-financial corporate deposits) conclusion is that from the relatively high level of concentration in the banking system in the North Macedonia in 2004, in 2017, the level of concentration in the banking system is considered moderate and acceptable.

Based on the results obtained from the presented cluster analyzes by applying the hierarchical agglomeration complete linkage method, it can be concluded that in terms of the indicators of the concentration, the level of the banking system in North Macedonia is higher than the two Balkan countries – Serbia and Montenegro and is similar to the Slovak Republic and then with Croatia.

Moreover, cluster analysis of the indicators of financial intermediation and portfolio quality was performed, using two comparative clustering methods, the complete linkage method and the Ward's method, according to which the North Macedonia is "most similar" to Montenegro and Serbia, and then to Croatia and Bulgaria, from the EU Member States, which means that this level is still lower than most EU member country. Thus, this cluster analysis confirms that the level of financial intermediation in these three Balkan countries is much lower compared to the EU Member States, but on the other side the quality of the credit portfolios stands on a good level and is better than some of the EU member countries.

At the end, comparing the results of the cluster analysis of the structural indicators of the banking sector from 2007 data North Macedonia was clustered with Lithuania, but over the past 10 years in North Macedonia there has been decrease in the concentration level in the banking sector while in Lithuania these indicators have further increased. Due to the issues with the data availability for 2017 for the structural indicators of the banking systems in all analyzed countries, the cluster analyses for the banking sector indicators had to be accordingly altered and modified.

References

European Central Bank (2017) "Report on financial structures" Working paper, available at: <https://www.ecb.europa.eu/pub/pdf/other/reportonfinancialstructures201710.en.pdf>

Everitt, B.S., Landau, S., Leese, M., and Stahl, D. (2009) "Cluster Analysis", 5th edition, King's College London, UK

International Monetary Fund (2017) "Financial Soundness Indicators (FSIs)", available at: <https://www.imf.org/external/np/sta/fsi/eng/fsi.htm>

International Monetary Fund (2017) "Global Financial Stability Report: Getting the Policy Mix Right". Washington, DC, April.

International Monetary Fund (2017) "World Economic Outlook", available at: <https://www.imf.org/en/Publications/WEO/Issues/2017/07/07/world-economic-outlook-update-july-2017>

National Bank of the Republic of North Macedonia (2017) "Data and indicators for the banking system of the Republic of Macedonia", available at: <http://www.nbrm.mk/ns-newsarticle-banking-system-indicators.nspk>

National Bank of the Republic of North Macedonia (2015) "Decision on Decision on amendment the Decision on credit risk management, Official Gazette of the Republic of Macedonia No.223/15"

National Bank of the Republic of North Macedonia (2015) "Decision on the Methodology for credit risk management, Official Gazette of the Republic of Macedonia No.149/18"

National Bank of the Republic of North Macedonia (2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016 and 2017) "Financial Stability Reports for the Republic of Macedonia", available at: <http://www.nbrm.mk/ns-newsarticle-previous-reports-on-the-banking-system-of-the-republic-of-macedonia.nspk>

National Bank of the Republic of North Macedonia (2011 and 2012) "Report on Banking System of the Republic of Macedonia", available at: <http://www.nbrm.mk/ns-newsarticle-previous-reports-on-the-banking-system-of-the-republic-of-macedonia.nspk>

National Bank of the Republic of North Macedonia (2004, 2005, 2006, 2007, 2008, 2009 and 2010) "Report on Banking System and Banking Supervision of the Republic of Macedonia", available at: <http://www.nbrm.mk/ns-newsarticle-previous-reports-on-the-banking-system-of-the-republic-of-macedonia.nspk>

National Bank of the Republic of North Macedonia (2013, 2014, 2015, 2016 and 2017) "Report on the risks in the banking system of the Republic of Macedonia", available at: <http://www.nbrm.mk/ns-newsarticle-previous-reports-on-the-banking-system-of-the-republic-of-macedonia.nspk>

Stojanova, E. (2009) "*Analysis of different aspects of banking system of the Republic of Macedonia using advanced quantitative financial econometric methods – comparative approach*", Master thesis, University Ss. Cyril and Merhodus, Faculty of Economics – Skopje

Vaskov, M. (2015) "*Level of concentration and structural characteristics of the non-performing loans in the banking system of the Republic of Macedonia*". Working Paper, National Bank of the Republic of Macedonia

World Bank (2017) "Bank nonperforming loans to total gross loans (%), World Bank Open Data

Appendices

Table 2. Distances of the banking sector concentration indicators, using the complete linkage method

Zemlja	AT	BE	BG	HR	CY	CZ	DK	EE	FI	FR	DE	GR	HU	UE	IT	LV	LT	LU	MT	NL	PL	PT	RO	SK	SI	ES	SE	RS	AL	ME	MK	
AT	0.000																															
BE	4.993	0.000																														
BG	2.112	0.595	0.000																													
HR	7.226	0.290	1.927	0.000																												
CY	14.658	2.940	5.793	1.992	0.000																											
CZ	3.697	0.084	0.229	0.619	3.959	0.000																										
DK	4.368	0.033	0.406	0.967	3.172	0.034	0.000																									
EE	11.549	6.584	10.385	4.115	0.781	7.885	6.883	0.000																								
FI	0.646	1.994	0.454	3.956	9.317	1.255	1.667	15.027	0.000																							
FR	0.373	2.563	0.716	4.834	10.471	1.722	1.194	16.447	0.037	0.000																						
DE	0.188	6.990	3.343	9.703	18.073	5.541	6.348	26.930	1.529	1.089	0.000																					
GR	12.964	6.505	10.999	4.855	0.870	8.238	7.251	0.179	18.802	17.312	28.945	0.000																				
HU	1.644	0.938	0.042	1.988	6.509	0.457	0.879	11.344	0.264	0.472	2.910	11.200	0.000																			
UE	0.514	2.279	0.550	3.891	9.701	1.482	1.501	15.422	0.030	0.026	1.935	16.343	0.318	0.000																		
IT	0.218	3.046	0.892	4.959	11.424	2.122	2.645	17.624	0.113	0.021	0.810	18.595	0.669	0.078	0.000																	
LV	6.559	0.123	1.242	0.070	1.924	0.408	0.284	5.029	3.091	3.804	8.955	5.137	1.706	8.443	4.388	0.000																
LT	18.875	4.931	8.452	2.653	0.265	6.116	5.535	0.156	12.711	14.055	22.879	0.190	9.988	18.154	18.153	3.941	0.000															
LU	0.373	7.979	4.162	10.672	19.273	6.527	1.166	26.858	1.974	1.459	0.040	28.327	3.448	1.656	1.149	9.944	24.012	0.000														
MT	10.696	1.190	3.304	0.339	0.427	1.852	1.402	2.247	6.124	7.095	18.471	1.304	3.970	6.528	7.889	0.542	1.300	14.815	0.000													
NL	15.787	3.579	6.488	1.832	0.045	4.542	3.789	0.488	10.256	11.444	19.248	0.692	7.268	10.607	12.483	2.478	0.157	20.442	0.731	0.000												
PL	0.607	2.055	0.456	3.652	9.994	1.307	1.719	15.096	0.002	0.029	1.466	15.917	0.248	0.014	0.100	3.175	12.800	1.892	6.215	10.320	0.000											
PT	6.583	0.100	1.168	0.083	0.221	0.365	0.204	5.180	2.971	3.870	8.751	2.295	1.621	3.313	4.245	0.001	3.991	9.732	0.615	2.583	3.044	0.000										
RO	2.525	0.389	0.027	1.240	5.222	0.112	0.258	9.748	0.619	0.957	4.082	10.241	0.137	0.786	1.241	0.945	7.324	4.747	2.842	5.980	0.656	0.879	0.000									
SK	7.322	0.261	1.572	0.019	1.471	0.618	0.380	4.279	3.651	4.395	8.833	4.402	2.048	3.990	5.024	0.031	2.939	10.844	0.337	1.954	3.712	0.044	1.284	0.000								
SI	3.702	0.170	0.233	0.592	3.661	0.054	0.054	7.505	1.298	1.750	5.514	8.054	0.413	1.465	2.193	0.487	5.886	6.259	1.826	4.262	1.927	0.447	0.161	0.654	0.000							
ES	3.394	0.138	0.176	0.788	4.272	0.012	0.036	8.483	1.079	1.516	6.174	8.829	0.339	1.312	1.891	0.522	6.658	8.953	2.120	4.999	1.134	0.472	0.068	0.771	0.098	0.000						
SE	2.342	0.463	0.009	1.338	5.395	0.150	0.307	9.959	0.844	0.860	3.871	10.504	0.091	0.688	1.150	1.053	8.039	4.597	3.018	6.148	0.574	0.894	0.055	1.367	0.177	0.105	0.000					
RS	1.655	0.840	0.035	1.988	6.624	0.406	0.651	11.597	0.285	0.456	2.949	12.206	0.031	0.343	0.673	1.627	6.526	3.835	3.941	7.443	0.287	1.540	0.092	2.020	0.442	0.314	0.044	0.000				
AL	8.199	0.550	2.005	0.042	0.959	0.961	0.635	3.345	4.305	5.112	10.807	3.612	2.502	4.605	5.787	0.208	2.237	11.797	0.183	1.329	4.847	0.233	1.694	0.084	0.883	1.175	1.799	2.538	0.000			
ME	2.971	0.247	0.575	0.345	4.587	0.042	0.185	8.871	0.853	1.241	4.839	9.530	0.224	1.031	1.585	0.044	7.044	3.533	2.407	5.298	0.892	0.850	0.021	0.648	0.071	0.027	0.025	0.192	1.84	0.000		
MK	7.475	0.299	1.943	0.019	1.974	0.669	0.416	4.110	3.744	4.519	10.010	4.253	3.143	4.690	5.164	0.043	3.939	11.001	0.297	1.842	3.924	0.653	1.928	0.002	0.490	0.350	1.454	1.105	0.04	1.02	0.000	

Source: Author's calculations using the SAS software

Table 4. Cluster analysis of the financial intermediation and portfolio quality indicators, using the Ward's method

The CLUSTER Procedure														
Ward's Minimum Variance Cluster Analysis														
Root-Mean-Square Distance Between Observations = 12.97144														
Cluster History														
NCL	Clusters Joined	FREQ	SPRSQ	RSQ	PSF	PST2	Time							
30	CZ SI	2	0.0000	1.00	19E4		18	CL23	LT	4	0.0000	1.00	7763	19.3
29	ME MK	2	0.0000	1.00	19E4		17	CL25	CL27	4	0.0000	1.00	5919	60.4
28	BG HR	2	0.0000	1.00	18E4		16	CL20	CL22	6	0.0001	1.00	5011	11.0
27	FR ES	2	0.0000	1.00	17E4		15	CL18	CL24	6	0.0001	1.00	3473	9.3
26	HU LV	2	0.0000	1.00	91E3		14	CL28	CL16	8	0.0001	1.00	2789	11.9
25	AT DE	2	0.0000	1.00	71E3		13	CL19	IT	3	0.0001	.999	2457	9.2
24	EE SK	2	0.0000	1.00	57E3		12	CL14	AL	9	0.0004	.999	1696	13.5
23	CL30 PL	3	0.0000	1.00	36E3	26.5	11	CL17	CL21	6	0.0006	.998	1253	40.0
22	RS CL29	3	0.0000	1.00	27E3	28.1	9	CL11	CL13	9	0.0017	.996	638	15.3
21	BE MT	2	0.0000	1.00	22E3		8	CL12	CL15	15	0.0019	.994	531	30.1
20	CL26 RO	3	0.0000	1.00	17E3	9.4	7	CL10	NL	3	0.0049	.989	357	5.1
19	UE PT	2	0.0000	1.00	13E3		6	CL9	CL8	24	0.0114	.977	217	48.5
							5	CY GR		2	0.1063	.961	161	
							4	DK CL7		4	0.0208	.940	142	7.1
							3	CL4 LU		5	0.2391	.701	32.8	26.8
							2	CL6 CL5		26	0.3189	.382	17.9	232
							1	CL2 CL3		31	0.3823	.000		17.9

Source: Author's calculations using the SAS software