FINANCE
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CONCENTRATION OF THE CREDIT INSTRITUTIONS AND THEIR BRANCHES IN THE EUROPEAN UNION

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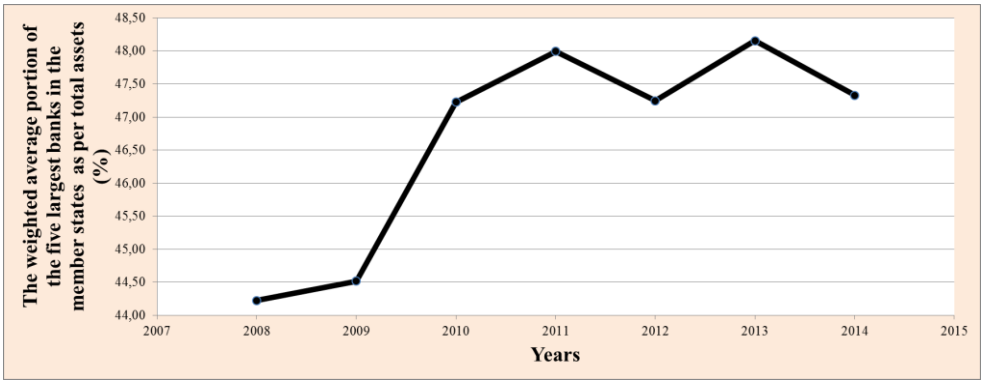
***Abstract**: The banking concentration can be analysed as per total assets, deposits, exposures, net interest income or profit but this paper studies the geographical concentration of the banks registered in the European Union and geographical concentration of their branches. This paper makes evidence for strong correlation revealed between number of banks and branches. By using linear regression model, it is also proven that the number of credit institutions, the GDP per capita, the territory, the ratio of the citizens having at least minimal digital interest in the sovereign have no direct and significant effect on the number of branches. The sole proven factor that determinates the number of branches is the population of the sovereigns. Furthermore, the paper illustrates the concentration by plotting Lorenz-curve, calculates the Gini and CR_3 indexes of number of credit institutions and their branches.*
***Keywords:** bank, branches, concentration, Gini-index, Lorenz-curve*

INTRODUCTION

Before the last financial crisis emerged in 2007-2008, strong concentration has been formed in the banking market. It was supported by technical innovations, banking liberalization and deregulation. In the European Union this process was more specific where efforts to establish a single European banking market was enlarged (Ferreira - 2012). Though, the reasons changed, the process of strengthening the concentration continued from the year 2008. The five largest banks' total assets weighted average portion to the aggregated total assets of European banks was 44.23 % in 2008 and its value was 47.33 % in 2014. The following chart illustrates this process.

In the United Kingdom where numerous significant European banks located, huge growing was in concentration of mortgage market. While the market share of the five largest banks was 53.1 % before the crisis, this ratio increased, its value was 71.4 % by the year 2010 (Smith - 2010). As it is visible on the chart above, similar but not so strong process was also observable in case of total assets of banks registered in the European Union.

Figure 1 – The weighted average portion of the five largest banks in the member states of the European Union as per total assets in period 2008-2014



Source: Own calculation based on data of European Central Bank

Some studies could not prove that the concentration has unfavourable effect on efficiency. For example, Casu and Girardone suggest that the degree of concentration is not necessarily related to the degree of competition (Casu and Girardone - 2006). On the contrary, in some studies it is proven that concentration of certain part of the banking assets could cause difficulties. For example, in Lucchetta opinion, the concentration of the risk of liquidity and the risk of crediting endanger the sound banking activity (Lucchetta – 2015).

The above listed studies dealt with the concentration by selecting one or more balance sheet or profit or loss statement data. However, the concentration can be approach from geographical point of view, as this paper does it.

Data and Method of the Calculation

The results of the analysis are based on data on number of banks and number of branches derived from the Statistical Data Warehouse of the European Central Bank (European Central Bank – 2015a). In the calculation domestic banking groups, standalone banks, foreign controlled subsidiaries and branches were taken into account on consolidated base.

When looking for the factors that determine the number of the banks or branches, a multiple linear regression model has been used where the number of the banks (or branches) was the dependent variable. The main goal of the multiple linear regression is to find such predictors that have significant effect on the variation of the dependant variable. When creating a multiple regression model the following form was used:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon \quad (1)$$

where
Y is the dependent variable, X_i values are the predictor variables as well as

$$0 < i \leq n, i \in Z^+, n \in Z^+.$$

The value of ε is different in case of different β_i but during the model creation such combination of β_i coefficients are looked for where the value of ε is the lowest. This combination is expressed as follows:

$$\hat{Y} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n \quad (2)$$

The value of the R^2 is also calculated. This value expresses that how the model explains the dependent variable or in other words how strong the explanatory power of the model.

When determining the concentration, one of the most frequently used indexes is the Gini-index (Kovács - 2011). The index named from Corrado Gini (Gini - 1921). In order to determine the Gini index, the Lorenz-curve must be interpreted (Lorenz - 1905). At first this curve was used by Max Otto Lorenz American economist (Tóth - 2014). As a matter of curiosity, Lorenz published practically his doctorate dissertation and after that he had no other article but this sole work made his name famous (Kleiber - 2007).

The line segment between points (0;0) and (1;1) of the coordinate system is practically a diagonal of a unit square. The Lorenz-curve is constructed by plotting the cumulative relative frequency against the corresponding cumulative relative value of the variable in question (Fleming, Nellis - 2000).

The distance between the Lorenz-curve and the diagonal of the unit square expresses the strength of the concentration. Practically, the Gini-index is the numerically expressed value of this distance. If its value is zero, there is no concentration (each unit is equal) and if its value is one than there is total concentration (only one market player operates).

This paper also analyses the portion of cumulated number of the banks and branches of such three member states that have the largest number of banks or branches to the aggregated number of banks and branches on Union level. The interpretation of the result of the analysis is based on the practice applied by Federal Trade Commission and European Central Bank. From the year 1968 the American Federal Trade Commission of the Department of Justice applied the so called four-firm concentration ratio in order to determine the strength of the concentration during the evaluation of the effect of a merger (CR_4). However, from the year 2010 the Commission changed its methodology and commenced to use the so called Herfindahl-Hirschman index (Federal Trade Commission of Department of Justice 2015). The classification of the CR_4 was the following:

Table 1: Pools in classifications of the CR_4

Lowest value of the pool	Lowest value of the pool	Classification
higher than 0	less than or equal to 0.25	un-concentrated
higher than 0.25	less than or equal to 0.50	moderately concentrated
higher than 0.50	less than or equal to 1.00	highly concentrated

source: Brezina at al - 2012

The European Central Bank in its report on financial structures (European Central Bank 2015b) calculated the five largest banks' total assets to the aggregated total assets of all banks registered in the European Union (CR_5).

Though, this paper calculates the CR_3 ratio and the result is evaluated based on the Federal Trade Commission's classification introduced above.
If x_i expresses the market players' values, the formula of the CR_3 ratio is the following:

$$CR_3 = \frac{\sum_i^3 x_i}{\sum_i^n x_i} \quad (3)$$

where
n market players operates on the market as well as

$$0 < i \leq n, i \in Z^+, n \in Z^+.$$

RESULT OF THE CALCULATION

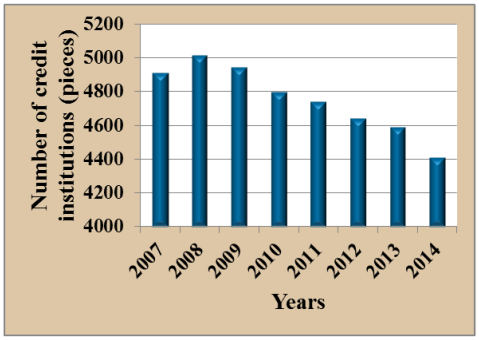
The number of credit institutions and their braches

According to the statistical data warehouse of the European Central Bank regarding consolidated banking data, 4408 standalone banks or banking groups operated in the European Union at the end of 2014. The number of their branches was 205455 (since there is no disclosed data on branches of United Kingdom as at the end of 2014 the average number of last five years was applied as for 2014 in case of UK).

There were 3967 standalone banks and 441 banking groups in the European Union but taking the members of banking groups as separated institutions into account, the number of credit institutions was 7268 as at 31/12/2014. However, this study uses consolidated banking data. In other words, banks belonging to one banking group were dealt as one institution.

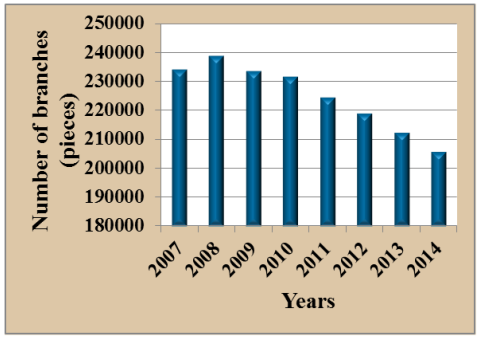
The number of credit institutions continuously fell in the period 2007-2014, as it is also occurred in case of branches. The following two charts show the number of credit institutions and their branches where continuous decreasing in the numbers is well observable in both cases.

Figure 2 – The number of credit institutions in the European Union in the period 2007-2014



Source: own calculation based on data of European Central Bank

Figure 3 – The number of branches in the European Union in the period 2007-2014

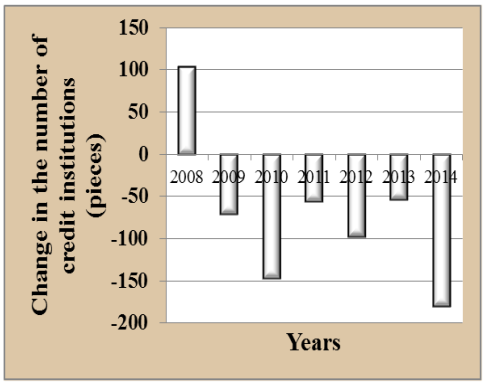


Source: own calculation based on data of European Central Bank

In order to analyse the strength of the connection between the number of credit institutions and their branches operating in the 28 member states of the European Union in the period 2007-2014, the numbers of banks and braches disclosed by the European Central Bank was compared. There is strong correlation between the two data sequences. The value of the correlation coefficient is 0.982. Since the maximum value of the correlation coefficient is 1 practically it is a functional relationship (the minimal value of the correlation coefficient is 0 which expresses lack of relationship).

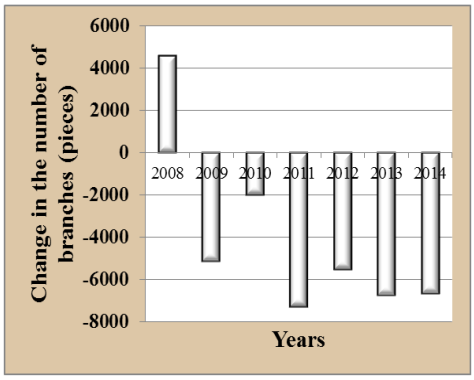
Nevertheless, comparing the annual changings occurred in the numbers of the banks and branches the situation is quite different. The correlation coefficient is sharply falls, its value is 0.690. The following charts show differences in annual changings of number of banks and number of branches.

Figure 4 – Change in the number of the credit institutions in the European Union in the period 2007-2014



Source: own calculation based on data of European Central Bank

Figure 5 – Change in the number of branches in the European Union in the period 2007-2014



Source: own calculation based on data of European Central Bank

Since decrease in number of credit institutions is slower than decrease in number of branches, it is presumable that the unbalance in the time of realization of reduction is the main reason for weakening of the correlation coefficient.

In order to exclude the effect of shift in time, the differences were aggregated in both cases. In other words, the data of a certain year were reduced by the related data of the year 2007. Having compiled such new database, the correlation coefficient between difference of numbers of credit institutions comparing with the base year 2007 and difference of numbers of branches compared with the base year 2007 was calculated. The following table shows the process of calculation.

Table 2 - The process of calculation of differences

Year	Number of credit institutions	Number of branches	Annual change in number of credit institutions	Annual change in number of branches	Change in number of credit institutions comparing with number in base year 2007	Change in number of branches comparing with number in base year 2007
2007	4910	234105	-	-	-	-
2008	5014	238684	104	-4579	104	4579
2009	4943	233564	-71	5120	33	-541
2010	4796	231568	-147	1996	-114	-2537
2011	4740	224302	-56	7266	-170	-9803
2012	4642	218800	-98	5502	-268	-15305
2013	4588	212094	-54	6706	-322	-22011
2014	4408	205455	-180	6639	-502	-28650

Source: own calculation

In the base year 4910 credit institutions and 234105 branches operated in the European Union. When comparing the differences described above, it becomes clear that there is strong correlation between data sequences in the last two columns of the table above, as it was observable in case of pure data of credit institutions and their branches. The value of the correlation coefficient is 0.980.

There are four possibilities for varying the number of credit institutions. If a credit institution terminates its activity without successor, the number of credit institutions decreases by one bank. The situation is the same if a bank is bought by another bank via merger. In that case, the number of credit institutions also decreases by one bank. If a bank is divided to two or more banks, the number of banks increases. In the fourth scenario, the bank is not merged but bought, thus the number of credit institutions remains the same.

Since the number of credit institutions decreases in period 2007-2014, the first two scenarios were analysed where the number of banks decreased.

If the bank terminates its activity without successor, the process is trivial: at first certain part of the branches are closed and after closing the branches the bank terminates its activity.

If merger follows the acquisition, the number of banks decreases but in parallel fall in number of branches is also observable in dataset. Consequently, parent banks close branches after acquisition. It cannot be detected from the dataset, whether the branches of the parent bank or branches of the subsidiary are closed.

The predictors of the number of branches and banks

The number of branches might depend on different factors. The greater geographical area needs more branches or the increase in number of citizens also might generate growing in the number of branches. The higher number of credit institutions within a sovereign could also generate growing. However, selling banking products via internet has invers effect.

In order to get clear picture on factors that have influence on number of branches, a multiple regression model has been employed where the dependent variable was the number of branches of the member states of the European Union (Y) and the following predictor variables were included in the model:

- number of credit institutions registered in the authority of the sovereign (X_1),
- GDP per capita of the sovereign (X_2),
- number of citizens of the sovereign (X_3),
- territory of the sovereign (X_4),
- the ratio of the citizens having at least minimal digital interest in the sovereign (X_5).

The last predictor embodies the possibility of spread of the banking services provided via internet in the model. However, this data is available only for the year 2015 (Eurostat 2015) and others show data related to the end of the year 2014. Since significant change in the ratio of the population having base IT knowledge is not feasible, therefore using data of the year 2015 does not weaken the strength of the model.

The calculation was made by the Gretl statistical software and the result is the following:

$$\hat{Y} = 3659.61 + 1.294X_1 + 0.014X_2 + 0.342X_3 + 20.422X_4 - 243.997X_5 \quad (4)$$

According to the result, if the number of credit institutions grows by one, the number of branches grows by 1.294. Growth in the GDP per capita has effect on the branch number. If the predictor grows by one euro, the number of branches grows by 0.014. Also, if the population grows by thousand capita, the number of branches grows by 0.342. The model suggests that largest territory generates highest number of branches. More specifically, one thousand km^2 generates 20.422 branches. As it was presumed, the IT knowledge has negative effect. One percentage growth in the ratio generates termination of activity of 243.997 branches.

In that case the value of R^2 is quite high (0.88) but some of the coefficients of the predictors are seems to be such variables that could be excluded from the model while the explanatory power does not decrease significantly. In order to determinate which predictors could be excluded from the model, the so called t statistics was applied in the calculation where the coefficients of the predictors were divided by their standard error. The result of calculation of the t statistics was the following:

Table 3 - Calculation of the t statistics

Variable	Coefficient	Standard error	t value	p value
Number of credit institutions (pieces)	1.294	3.331	0.389	0.701
GDP per capita (euro)	0.014	0.056	0.244	0.81
Population (thousand capita)	0.342	0.065	5.25	0
Territory (thousand km^2)	20.423	8.026	2.545	0.019
Digital knowledge (percent)	-243.997	206.231	-1.183	0.249

Source: own calculation

The result of the calculation of the t statistics showed that only two predictors had actual effect on the number of branches: the population and the territory. Excluding the effect of the number of credit institutions, the GDP per capita and the ratio of the citizens having at least minimal digital interest, the remaining model is the following:

$$\hat{Y} = -1984.49 + 0.361X_3 + 17.26X_4 \quad (5)$$

The explanatory power remained high, its value was 0.87. However, it is logical that there is connection between population and territory. Both of them partly embody the effect of the other in the model. Therefore, the effect of the population and the territory was separately analysed. In case of territory the explanatory power was very low. Consequently it was also excluded from the calculation. Therefore, only the population was not excluded from the calculation. The equality expressing the effect of the population predictor is the following:

$$\hat{Y} = -888.003 + 0.452X_3 \quad (6)$$

According to this result, if the population grows by thousand citizens, the number of branches will increase by 0.452. The value of the R^2 was 0.84. Similarly, a multiple regression model has been created in order to determine the factors that have influence on number of credit institutions. The predictor variables were the same:

- GDP per capita of the sovereign (X_1),
- number of citizens of the sovereign (X_2),
- territory of the sovereign (X_3),
- the ratio of the citizens having at least minimal digital interest in the sovereign (X_4) and the result was the following.

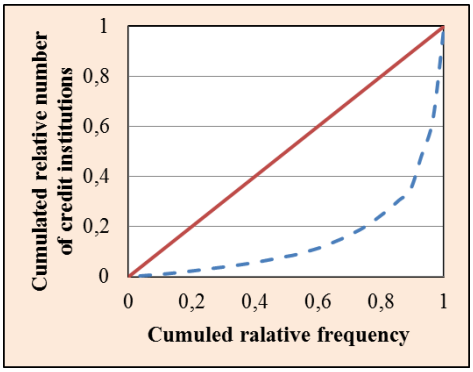
$$\hat{Y} = -316.373 - 0.00006X_1 + 0.011X_2 - 0.721X_3 + 14.8772X_4 \quad (7)$$

The value of R^2 was very low (0.40) as well as the t values also predicted that other predictors are likely able to forecast the number of the credit institution.

Lorenz-curve

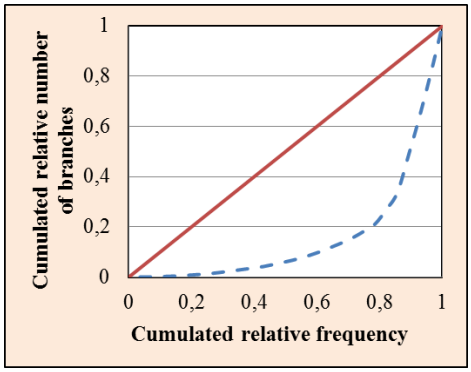
The Lorenz-curve and the Gini-index indicates strong concentration in distribution of credit institutions and branches among member states of the European Union. The following two charts illustrate the Lorenz-curve as at the end of 2014.

Figure 6 – Lorenz-curve of the credit institutions 2014



source: own calculation

Figure 7 – Lorenz-curve of the branches 2014



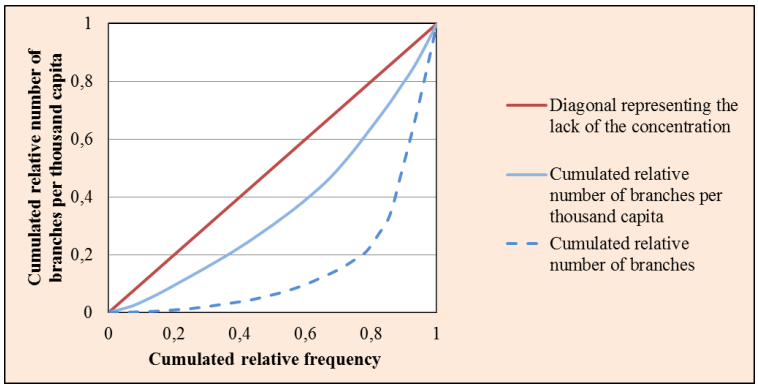
source: own calculation

The value of Gini-index of the credit institutions is 0.6972 which practically did not vary in the period 2007-2017. The minimal value in the period was 0.6939 in 2011 and the maximum value was 0.7004 in 2013. The average of the values is 0.6974, the dispersion was 0.0023.

The concentration slightly increased in case of branches in the analysed period. The minimal value was 0.671 in 2009 and the maximum was 0.6845 in 2014. The average of the values was 0.6764 and the dispersion was 0.0048.

However, the result of the analysis presented above could be misleading. If the number of citizens is taken into account, the strong correlation sharply falls in case of number of branches (since the number of credit institutions per thousand capita is quite high in Luxemburg the concentration does not change significantly). The following chart illustrates that how significant is the changing if the concentration of number of branches per thousand capita is included in the analysis as at the end of 2014.

Figure 8 – Lorenz-curve illustrating the number of branches and number of branches per thousand capita



Source: own calculation

While the Gini-index of the number of branches was 0.6845, the Gini-index of the number of branches per thousand capita was 0.2750.

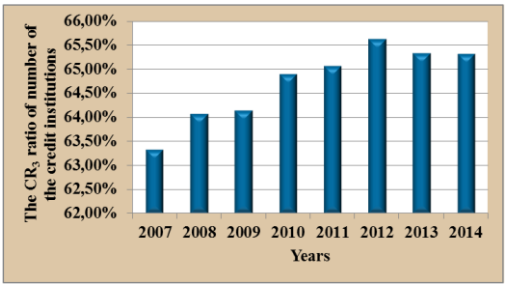
The CR3 ratio of the credit institutions and branches in the European Union

The CR_3 ratio of number of the credit institutions is interpreted in the analysis in such a way where three member states that have the highest number of banks were selected and their aggregated number of banks was divided by the number of banks in the European Union. Also, the CR_3 ratio of number of the branches is interpreted in the analysis in such a way where three member states that have the highest number of branches were selected and their aggregated number of branches was divided by the number of branches in the European Union.

Close to two third of the banks (in the period 2007-2014 63.32%-65.62%) were recorded in Austria (604 banks), Poland (627 banks) and Germany (1648 banks). The value of the CR_3 ratio slightly increases in the analysed period. It indicates slight strengthening of the concentration.

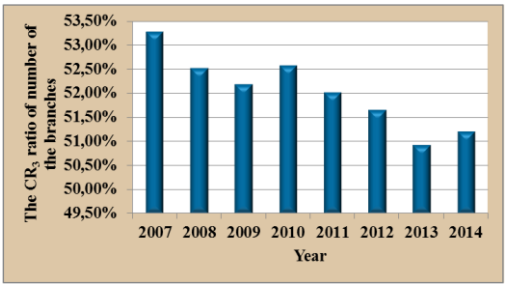
The three countries having the highest number of branches were continuously Spain, Germany and France in the period 2007-2014. The ratios of these sovereigns were between 50.93 and 53.27. The number of branches was 32083 in Spain, 32083 in Germany and 35389 in France in 2014. On the contrary of the process identified above, the CR_3 ratio slightly decreases in period 2007-2014. The following two charts illustrate the CR_3 ratios in the period 2007-2014.

Figure 9 – CR_3 ratio of number of the credit institutions 2007-2014



Source: own calculation

Figure 10 – CR_3 ratio of number of the branches 2007-2014



Source: own calculation

It is visible that the ratio of the number of banks and number of branches is higher than 50 percent. Applying the classification of the American Federal Trade Commission of the Department of Justice, these values indicate strong concentration in both cases.

CONCLUSION

The number of banks and branches continuously falls in the European Union and there is strong correlation between the number of the banks and branches. The value of correlation coefficient is 0.982.

It is proven that the number of credit institutions, the GDP per capita, the territory, the ratio of the citizens having at least minimal digital interest in the sovereign have no direct and significant effect on the number of branches. The sole proven factor that determinates the number of branches is the population of the sovereigns. According to the applied model, about two thousand citizens generate one banking branch in the European Union.

The number of banks and branches fell in period 2007-2014 and the concentration ratios determined by the Gini and CR_3 indexes show strong concentration among member states of the European Union.

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