

# Correlation of the Rate of Imperfect Competition and Profit in Banking Markets

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**Abstract**—This article aims to assess the evolution of imperfect competition in selected banking markets, in particular in the banking markets of Slovakia, Poland, Hungary, Slovenia and Croatia. Another objective is to assess the evolution of the relationship of imperfect competition and profit development in the banking markets. The article first provides an overview of literature on the topic. It then measures the degree of imperfect competition in individual markets using the Herfindahl-Hirschman Index. The commonly used indicator of total assets was chosen as an indicator. Based on this measurement, the individual banking sectors are categorized into theoretical definitions of the various types of imperfect competition - namely all surveyed banking sectors falling within the theoretical definition of monopolistic competition. Subsequently, using correlation analysis, i.e., the Pearson correlation coefficient, or the Spearman correlation coefficient, the connection between the evolution of imperfect competition and the development of the gross profit on selected banking markets was surveyed. It was found that with the exception of the banking market in Slovenia, where there is a positive correlation; there is no correlation between the evolution of imperfect competition and profit development in the selected markets. This means a recommendation for the regulators that it is not appropriate to rationalize a higher degree of regulation in granting banking licenses on the size of the profits attained in the banking market, as the relationship between the degree of concentration in the banking market and the amount of profit according to our measurements does not exist.

**Keywords**—Banking system, imperfect competition, profitability.

## I. INTRODUCTION

At present there is a current discussion on whether or not to restrict imperfectly competitive forms in the banking markets. The question is also frequently addressed as to whether the fluctuating market strength of individual banks on imperfectly competing markets relates to the size of their profits. We therefore decided to examine this issue in certain selected banking markets. We selected markets (countries) that have been passing through a relatively rapid development with regard to the changing number of banks on the markets and their market power. These countries share a common factor in that 25 years ago, they were Socialist countries and today they are functional market or mixed economies, an integral and important part of which is banking markets. Specifically, we are dealing with selected banking markets of former east European countries.

The aim of this paper is to evaluate imperfect competition in selected banking markets and to assess the relationship of

the evolution of imperfect competition and profit development of the banking markets.

## II. LITERATURE REVIEW

The topic of imperfect competition in the banking markets has been discussed by a number of authors. Matthews, Murinde and Zhao [10] examined the British banking market using calculations of the Lerner index and concluded that it can be described as monopolistically competitive, with the level of competition in the period under review largely unchanged. The evolution of competition in transition economies has been examined in a study [14]. The authors conclude that the market in the 1990s showed signs of monopolistic competition, with the degree of imperfect competition gradually decreasing. The lowest level of competition; i.e., the greatest market power of large banks, was mainly on local markets compared to international markets. Humphrey and Pulley [8] examined the relationship of deregulation in the banking markets to profit rates. The result of deregulation is that the banking markets are usually included in the theoretical concept of monopolistic competition. However, particularly larger banks have increasingly strong market power to influence their prices and output. The profitability of the banking sector also increased, but which was also affected by a change in banking strategies. Goldberg and Rai [7] researched works dealing with the relationship between concentration and profitability. Their findings show that there is no clear evidence of this relationship on real data in the banking sectors, as only about half of the studies show a positive relationship between these variables. Allen and Gale [1] investigated the relationship of the type of competition and effectiveness. They also tried to find an ideal degree of the competition environment in the banking markets, which would lead to a reasonable degree of effectiveness as well as stability of the banking environment. As well, the concept of imperfect competition and a level of profitability have been examined in another study [13]. Here the authors come to the conclusion that there is a positive relationship between concentration and profitability of the banking sector in North America and Japan, especially in the long term. Bikker and Haaf [2] express the view that there is a higher degree of competition in international markets than in local markets. They also note that a higher degree of competition exists more on the European markets (approaching monopolistic competition) than in other parts of the developed world. Řepková and Stavárek [12], based on the example of Turkey, characterise this market also as monopolistic competition. Unlike other studies, they conclude

that in Turkey the level of concentration has increased in recent years, posing a threat to the effectiveness of the banking sector. Other authors [6] demonstrated an effect of regulation on the degree of imperfect competition in banking markets. The relationship of concentration and profitability in selected markets has been examined in detail in another study [5]. By calculating the Herfindahl-Hirschman Index, they conclude that the European markets surveyed do not show any significantly definable relationship between concentration and profitability. Other authors have examined the Czech and British banking sectors in terms of the development of their profitability [3], [4].

### III. DATA AND METHODOLOGY

This paper basis its findings on Bankscope database data from 2005 - 2012. The primary indicator commonly used to evaluate the degree of concentration in the banking markets, i.e., the degree of imperfect competition, is the size of the balance sheet total. This was determined for each bank operating in Slovakia, Poland, Hungary, Slovenia and Croatia. We then calculated the Herfindahl-Hirschman Index (HHI); the calculation procedure is shown below. Then we compared the HHI calculated in each year using correlation analysis with the evolution of gross profit across the banking sector in the selected countries.

The HHI calculation and the principle of this method are explained according to [11]. The HHI's structure is founded on the hypothesis that the significance of a bank in the banking sector is a function of the square of its market share. This way of conceiving concentration highlights the influence of economically strong banks and, conversely, eliminates the influence of small banks. Analytically, the HHI takes the form of:

$$H = h(q_1, q_2, \dots, q_n) = \sum_{k=1}^n \left(\frac{q_k}{Q}\right)^2 = \sum_{k=1}^n r_k^2, \quad (1)$$

where  $h$  is the real function of the  $n$  variable,  $h: R^n \rightarrow R$ ,  $n$  is the number of banks in the banking sector,  $q_k$  is the production volume of the  $k$ th bank ( $k = 1, 2, \dots, n$ ),  $Q$  is the production volume of the banking sector and  $r_k$  is the  $k$ th bank's share of the production volume the banking sector.

The share of the  $k$ th bank on the market is expressed in the following way:

$$r = \frac{q_k}{Q} = \frac{q_k}{\sum_{k=1}^n q_k}, \quad (2)$$

where  $Q$  is the overall production of the sector and  $q_k$  is the production of the firm  $k = 1, 2, \dots, N$ .

The HHI achieves values within the interval of  $<0;1>$ . A zero value means that the market share of each bank is the same. Values equal 1 when there is a monopoly. A value approaching 1 means that a relatively low number of banks is producing a substantial part of the production (assets, deposits and loans in our case) on the given market. If the HHI value is greater than 0.18, the market environment is considered to be concentrated; if the HHI value is within the interval of

(0.1;0.18), the market is considered to be slightly concentrated. If the HHI value is less than 0.1, the market is considered to have little concentration. For easier orientation, the resulting value is sometimes multiplied by 10,000.

The method of correlation analysis is explained according to [9]. Correlation expresses the closeness, size and strength of the mutual relationship of the random samples' variables. Correlation coefficients equal values within the interval of  $<-1; 1>$ . The concept of a random sample means an  $n$ -tuple of independent random variables  $(X_1, X_2, \dots, X_n)$  having the same probability distribution as the random variable  $X$ . In order for us to conduct correlation analysis and determine whether the variables of concentration and profit are dependent on each other, we must conduct a normality test. A number of tests exist for verifying whether the random sample has a normal probability distribution. We selected the Shapiro-Wilk test for conducting this test. The test has the following formula:

$$SW = \frac{(\sum_{i=1}^n a_i(n)(X_{(n-i+1)} - X_i))^2}{\sum_{i=1}^n (X_i - \bar{X})^2}. \quad (3)$$

The principle of the test lies in the fact that it will estimate the parameter  $\sigma$  using the random variable  $S^* = \sum_{i=1}^n a_i X_i$  and its estimation is compared with the estimate based on the random variable  $\sum_{i=1}^n (X_i - \bar{X})^2$ . We thus test the null hypothesis  $H_0$  (the random sample has normal probability distribution) against the alternative  $H_1$  (the random sample does not have normal probability distribution). The important output of this analysis is the resulting  $p$ -value, which determines whether the null hypothesis is accepted or rejected and which expresses the lowest possible level of significance  $\alpha$  for rejecting  $H_0$  for the given realization of the random sample. If the  $p$ -value is less than or equal to  $\alpha$ ,  $H_0$  is rejected; if the  $p$ -value is greater than  $\alpha$ ,  $H_0$  is not rejected. We selected a standard value for the level of significance, i.e., 0.05. For the calculating correlation, we used Pearson's correlation coefficient. For pairs of values  $(X_1, Y_1), (X_2, Y_2), \dots, (X_n, Y_n)$ , the formula for Pearson's correlation coefficient is:

$$r = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^n (X_i - \bar{X})^2} \sqrt{\sum_{i=1}^n (Y_i - \bar{Y})^2}} \quad (4)$$

where  $\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i$  is the mathematical average of the first measurements and  $\bar{Y}$  is the mathematical average of the second measurements.

### IV. RESULTS

First, the results of the HHI calculation for each country are shown for the period surveyed (see Table I). All countries except Hungary showed a downward trend in the level of concentration. From this it is clear that the lowest concentration rate levels, i.e., the most competitive environment, have been achieved in the banking sector in Poland. Even at the beginning of the period surveyed, these values were lower than the final values of other countries.

Only in two years was the HHI higher than 0.1, i.e., than the lower limit for moderate concentrations as defined by the Herfindahl-Hirschman Index. The reason for this is, in addition to the traditionally higher number of banks in Poland, also the growth of the importance of medium-sized banks in the period surveyed. Specifically, it is a matter of the growth in the share of medium-sized banks in terms of loans to the non-financial sector. The main factor in the reduction of the concentration in Slovenia is a decline in assets of the largest Slovenian bank (Nova Ljubljanska Banka) due to its loss-making operations. In the case of Slovenia, greater involvement of the medium-size banks in lending operations contributed to the reduction of imperfect competition. Hungary's banking sector is one of the sectors analyzed for which the degree of concentration has not changed significantly, and even grew by 0.05. The Hungarian banking sector passed through its difficulties in connection with foreign currency loans (particularly Swiss francs), while at the same time, major European banks such as Raiffeisen Bank and UniCredit Bank entered or expanded their presence in this sector during the period surveyed. The most concentrated banking sector is the banking sector in Slovakia. Its default value of around 0.23 indicates a saturated market greatly influenced by larger banks. However, the index value decreased during the years surveyed mainly due to the impact of the financial crisis and the adoption of the euro. Adopting the euro meant a loss of significance in the deposits of foreign banks in banks operating in Slovakia, which led to a decline in assets (or weaker growth in assets) in the group of large banks.

TABLE I  
THE DEVELOPMENT OF HHI IN SELECTED COUNTRIES

year	SK	PL	HU	SLO	CR
2005	0.238	0.105	0.135	0.189	0.162
2006	0.232	0.099	0.148	0.189	0.149
2007	0.225	0.109	0.146	0.195	0.150
2008	0.208	0.090	0.132	0.176	0.150
2009	0.164	0.082	0.132	0.162	0.146
2010	0.164	0.079	0.132	0.144	0.134
2011	0.162	0.075	0.131	0.137	0.136
2012	0.147	0.072	0.140	0.127	0.135

SK = Slovakia, PL – Poland, HU – Hungary, SLO – Slovenia, CR - Croatia.

TABLE II  
THE DEVELOPMENT OF PROFIT BEFORE TAXES IN SELECTED COUNTRIES  
(EUR/THOUSANDS)

Year	SK	PL	HU	SLO	CR
2005	407 800	2 181 194	1 341 017	352 600	483 427
2006	607 000	2 348 104	1 497 834	441 700	587 338
2007	529 100	3 127 296	1 718 240	551 800	736 918
2008	534 700	3 497 107	1 411 211	282 200	785 409
2009	331 900	2 326 038	1 110 108	93 155	621 161
2010	628 200	3 513 146	286 644	-107 246	663 810
2011	443 200	4 467 300	-1 063 062	-512 081	688 909
2012	608 200	4 413 389	-223 785	-771 073	591 293

SK = Slovakia, PL – Poland, HU – Hungary, SLO – Slovenia, CR - Croatia.

TABLE III  
THE RESULTS OF NORMALITY TESTS IN SELECTED COUNTRIES

Country	Variable	P_Value	H <sub>0</sub>
SK	HHI	0.074	not rejected
	profit	0.395	not rejected
PL	HHI	0.475	not rejected
	profit	0.229	not rejected
HU	HHI	0.048	rejected
	profit	0.137	not rejected
SLO	HHI	0.315	not rejected
	profit	0.346	not rejected
CR	HHI	0.006	rejected
	profit	0.977	not rejected

SK = Slovakia, PL – Poland, HU – Hungary, SLO – Slovenia, CR - Croatia.

TABLE IV  
THE RESULTS OF CORRELATION ANALYSIS IN SELECTED COUNTRIES

country	variable	p_value	H <sub>0</sub>
SK	Pearson CC = 0.0001	1.000	not rejected
PL	Pearson CC = -0.6898	0.058	not rejected
HU	Spearman CC = 0.6667	0.071	not rejected
SLO	Pearson CC = 0.9665	0.000	rejected
CR	Spearman CC = -0.024	0.955	not rejected

SK = Slovakia, PL – Poland, HU – Hungary, SLO – Slovenia, CR - Croatia; CC = correlation coefficient

Table II shows the gross profits achieved in each banking market. The relationship of these values to the degree of concentration is examined by means of correlation analysis.

Table III shows the results of a test of normality for each country. As can be seen in the table, the data files for Slovakia, Poland and Slovenia have a normal probability distribution (the P\_value is greater than the chosen significance level  $\alpha = 0.05$ ) In this case, as part of the correlation analysis, we also used Pearson's correlation coefficient. In contrast, the data for Hungary and Croatia HHI values do not have a normal probability distribution ( $\alpha < 0.05$ ), and therefore we must continue to use the Spearman correlation coefficient.

The resulting values of both correlation coefficients and the P\_values, based on which we decided to reject or not reject a null hypothesis that there is a correlation relationship between the two variables, are given in Table IV.

The hypothesis that there is no correlation relationship between the degree of concentration and gross profit was not rejected for the banking sectors of Slovakia, Poland, Hungary and Croatia. In other words, in these banking sectors we did not find any link between the development of an imperfect concentration and the development of gross profit. Only for Slovenia, based on an analysis of the data, a positive correlation dependence arose between concentration and profit (the correlation coefficient is positive). Thus we can conclude that only in Slovenia's banking sector is it true that gross profits (the sector is more imperfectly competitive) increase with a higher degree of concentration within the banking sector.

## V. DISCUSSION

If we generalise the results shown in the previous chapter, we can conclude that the rate of imperfect competition is

reduced in the banking sectors surveyed, because the value of the Herfindahl-Hirschman Index in the period in question are falling in the banking markets (except for Hungary). However, all the markets analysed can be classified as monopolistically competitive. Furthermore, there is no correlation between the degree of imperfect competition in the banking markets and the size of the gross profit (except for Slovenia).

A downward trend in imperfect competition occurs in all of our studies mentioned. This is a general trend in mature banking markets, where large banks are losing their important role, especially in the field of standard banking services - deposits and loans. Medium-large sized banks are becoming increasingly more important, as well as new small banks, which are pushing for an aggressive market pricing policy. In the case of deposits, they offer clients higher interest rates than standard, while generally supplementing them with free services. The main competitive factor in providing loans is again primarily the interest rate offered (in this case lower than standard) supplemented with flexible conditions for the disbursement and repayment of loans.

In terms of a link between the degree of imperfect competition and the amount of earnings, our results essentially confirm the ambivalent relationship evidenced in the real data in the banking sectors. In about half of the works, there is a proven positive relationship between the degree of imperfect competition (concentration) and profit. In our case, we were not able to establish a link in four of the five surveyed sectors. Only the banking sector of Slovenia showed a positive correlation relationship between the degree of imperfect competition and the amount of gross profit. This result can be explained by the existence of many economic and non-economic factors that affect the profitability of banks. The general trend of decline in the rate of imperfect competition observed in market economies is accompanied by various large gains or their different development. Among the most important economic factors in the period which we have examined, we may certainly include the impact of the financial crisis, whose impact is reflected in a number of sectors in losses of the banks (in our case, two sectors), or at least a significant reduction in profits. The aspect of time is also significant - every banking sector in the long term increases - or the value of its assets increases. Taking into account the nature of the banking business being the difference between interest on loans and interest paid on deposits, then from this point of view profit of banking sector should in time grow (despite the declining rate of imperfect competition). Large banks are presently under much greater competitive pressure in connection with the start-up of medium and small size banks and their comparatively aggressive pricing policies. Large banks must respond to this reality by changing not only their pricing policies, but also their overall strategies, all of which increases the costs to the banks.

## VI. CONCLUSION

In this article, we have come to the conclusion that the rate of imperfect competition in banking markets is decreasing. At

the same time, we have arrived at the conclusion that there is no link between the development of imperfect competition and the value of gross profits in the banking sector. These results are beneficial for the banks themselves, which is evidenced in that their economic performance is not affected by the rate of imperfect competition. As well, the benefits for the regulator of the banking market lie in the impossibility of the argument of increasing the market environment (the degree of competition) due to the possibility of higher or lower profitability. The ambivalence of any possible argument depends on whether the regulator wants to satisfy public opinion and reduce bank profits, or to satisfy the banks, which logically want to achieve higher profits. For other researchers, the results of this article are beneficial as further evidence of unclear relations between the degree of imperfect competition and profits in the banking markets.

It will be necessary to examine the issue further with a larger number of banking markets. It will also be appropriate to take into account more factors that may influence the development of profits.

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