Market Concentration in banking sector of Serbia: decomposition of the Changes in 2016–2021

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Abstract: On the basis of five balance variables in bank balances (total assets, deposits, capital, operating income, and loans), the Hirschman–Herfindahl indices for period 2016–2021 are calculated. The indices values are decomposed by the Bajo and Salas approach, based on the fact that the Hirschman-Herfindahl index is a special case of the Hanna-Kay index. So the impacts of number of banks and dispersion of its market shares are established. Then we classified the concentration changes, depending on relations between the rates of changes of two factors. They were unequal and vary during the years. Among the identified types of changes there was the most frequent decrease of HHI, caused by decrease of inequality of market shares and decrease of number of banks, where the first was greater. Finally, in 2021, the number of banks decreased with an increase in the dispersion of their shares in the three variables, which from a theoretical point of view is a clear condition for the growth of the concentration index. In the case of the remaining two variables, the dispersion of the share was reduced, so that the realized change in the Hirschman–Herfindahl index belonged to the second type.

Keywords: market concentration, banking sector, decomposition of the index Hirschman–Herfindahl, number of banks, dispersion of market shares, types of the concentration degree changes

JEL codes: C38, G21, L10, L19

1. Introduction

Market concentration, as a process of increase of the market position of economic entities, is one of the main concept in economic theory, especially in industrial organization. It is generally assumed that market concentration results in growth of the power of individual market players. In theory, when the concentration level is high, the industry leaders have a market advantage or the largest entities hold the dominant market position collectively. Such a situation is considered as a typical of oligopolistic markets. A low concentration level, in turn, could imply a lack of market power or be characteristic of business entities with similar market shares. This suggests the existence of a greater degree of competition among firms, in accordance with one of the basic assumptions of economic theory about the inverse relationship between concentration and competition. Economic theory of course gives preference to low market concentration, i.e. competitive market structures, considering that they improve the performance of companies and the economy as a whole. The same attitude in economic theory basically prevails when it comes to competition, that is, concentration in the banking sector, although it should be pointed out that some empirical research points to its negative effects.

Generally, in this aspect concentration measurement is one of the most common methods of understanding and explaining the features of market structures by industry analysts, as well competition policy makers. Moreover, concentration analysis is the basic aspect of diagnosing the situation and structure of every market segment, and its results have significant cognitive values. This, of course, lead to demand for adequate concentration measures with highly diverse characteristics. This is evidenced by the large number of methods of measuring market concentration, developed not only in the initial period of development of this discipline, but especially during the last years. In the selection of methods for their analyses, the researchers decided on various criteria, including the characteristics that, in their opinion, the appropriate method (indicator) should possess, but not only that. Thanks to the influence of many factors, including the support of the appropriate state authorities, those methods have gained varying popularity, and among them the Hirschman-Herfindahl coefficient is in the leading position.

Over the past few years, a large number of works by Serbian authors have also been published, dedicated to the problems of market concentration (and competition), including in the banking sector. And in them, as a rule, the Hirschman-Herfindahl index (HHI) was used to determine the degree of market concentration, and it was calculated and cited in works that emphasize other measures of concentration, see the works of this author, for example [Bukvić 2019; Bukvić 2020a]. Since this index, starting from its first applications, more than three quarters of a century ago, gained and, according to many opinions (primarily thanks to Stigler), confirmed the reputation of an ideal measure of concentration, its wide application in research is not a surprise; just as its acceptance and use by many antimonopoly authorities, not only in developed countries (among otherc in Serbia, see the regulation governing concentration issues [Regulation on the content and manner of submission of the application for concentration 2016]), is not a surprise either. At the same time, its repeatedly highlighted imperfections are ignored, while on the other hand, all the possibilities that it provides as an analytical tool for deeper and more versatile analyzes are not used.

In the following text, we will deal with one of the possibilities of analysis based on the characteristics of the HHI, which allows identifying and quantifying the factors that affect changes in the index over time. The paper is based on a wider research of the mentioned issue [Bukvić 2022a] and the short announcement [Bukvić 2022b]. The banking sector of Serbia served us as a basis for the analysis. The period 2016–2021 was observed, during which this author continuously monitors concentration problems in the mentioned sector. Before that, it will first be necessary to give appropriate methodological remarks, which is devoted to section 2.

2. Methodological Notes: Hirschman-Herfindahl Index as a Special Case of the Hanna-Kay Index and the General Entropy Index

The Hirschman-Herfindahl index, as a measure of concentration independently proposed by Albert Hirschman in 1945 [Hirschman 1945] and Oris Herfindahl in 1950 [Herfindahl 1950], is determined as a special case of the concentration index, which is generally represented as

$$HHI = \sum_{i=1}^{N} w_i s_i \tag{1}$$

in which the market shares of participants (companies) s_i are weighted by those shares themselves ($s_i=w_i$), therefore

$$HHI = \sum_{i=1}^{N} s_i^2. \tag{2}$$

It is obvious that, unlike some later formulated indices of this type, the HHI gives greater importance to stronger market participants/firms, which leads to a certain asymmetry in the distribution of the index values themselves. Whether that fact is an advantage or a disadvantage of the index, is a question to which there is no real and unique answer, which, among other things, is evidenced by concentration indices of a similar type constructed with the opposite weighting system (for example, Hall-Tideman index). On the other hand, the minimum value of the range in which the HHI values move [1/N ; 1] depends on the size of the set, i.e. sample (number of market participants). This is already a evident imperfection of the index, but it is ignored in most works. Let's see what that means specifically. Thus, even in the ideal case (equal competencies of the participants), the minimum value of the index (2) will be 0.5 for two participants, 0.25 for four, 0.10 for ten, 0.05 for twenty participants, etc., so we will get completely different information about the market situation in which there is an ideal equality of participants. In the aforementioned, ideal case (all market shares are equal, so their dispersion is equal to zero), the equivalent number, which is determined as the reciprocal of the Hirschman-Herfindahl index and shows the number of mutually equal firms, is equal to the actual number of market actors.

In the general case, of course, this will not be the case, market share dispersions will never be zero and will vary significantly from one market to another. If, therefore, the existence of a different dispersion of market shares (therefore their inequality) is taken into account, it will become clear that the HHI is characterized by ambiguous informativeness, that is, that the same index values can be obtained for very different market situations. This imperfection of it is quite clearly seen from the derivative of the basic formula, which is reached by its elementary transformation (taking into account that the sum of market shares is equal to the one $\Sigma s_i=1$ and their arithmetic mean to quotient $\bar{s}=1/N$)

$$HHI = N\sigma^2 + \frac{1}{N}, \tag{3}$$

as it can be read just in Herfindahl's [Herfindahl 1950: 20]. And then, it should also be emphasized, this disaggregation was often highlighted as an advantage of the Hirschman-Herfindahl index, because it shows that the index recognizes the importance of both relevant factors (N and σ^2) in market analysis. Although, it is not known what follows the fact that HHI equals the arithmetic mean plus the sum of squared deviations from it, as it stated Adelman [Adelman 1969: 100]. It is obviously that there is no simple relation between the number of firms and the value of HHI, for the larger is N, the larger or smaller may be the index.

Expression (3), namely, clearly shows that, due to the action of two independent factors (the number of market actors N and the distribution of market shares, i.e. their variance σ^2), an infinite number of combinations of values N and σ^2 can occur, which can lead to the same values of the HHI index, as emphasized by Smaragdov and Sidoreiko [Smaragdov and Sidoreiko 2015], or much earlier Rhoades [Rhoades 1995], and many others, of course. That expression explicitly shows that market concentration depends on two abovementioned factors, exactly as defined by Waterson [Waterson 1984], so – the measure of concentration can be developed as a function of inequality and the number of firms. Thus, in fact, in a sense, the first market concentration surveys in USA from the end of the 1930s (Investigation of Concentration of Economic Power, TNEC– Temporary National Economic Committee), which had just met the problem of covering between these two variables: the number of participants and the distribution of its economic forces - production, revenues, assets, capital, employees, etc. At the same time, as can be inferred from (3), the effect of the second factor (dispersion of market shares) is directly proportional, while the effect of the first (number of market participants) cannot be clearly seen. The value of the index will therefore obviously decrease as the dispersion of market shares decreases, and when it has a value of 0 (zero), i.e. when all market participants have equal shares, the value of the index will be reduced to 1/N, as we have already stated.

In this paper, however, we will be interested in another consequence arising from expression (3), namely the possibility to mark off the influence of the mentioned factors N and σ^2 on the movement of HHI. This problem has been the subject of empirical tests with different methodological approaches, see [Kwoka 1985: 922], [Rhoades 1995] and others, or in more recent paper of De Gioia [De Gioia 2017], with other methodological assumptions. The discussion of these attempts does not belong to the aims of our considerations. Of course, expression (3) alone is not sufficient nor adequate for such a thing, so we will have to make some more methodological explanations.

Let's first recall that HHI is a special case of the Hanna-Kay index [Hannah and Kay 1977]

$$HKI = \left(\sum_{i=1}^{N} s_i^{\alpha} \right)^{\frac{1}{\alpha-1}}, \qquad \alpha > 0; \alpha \neq 1, \tag{4}$$

when $\alpha=2$, where we omitted the formula for the case $\alpha=1$, which is of no importance for our analysis. As shown by Bajo and Salas [Bajo y Salas 1998; Bajo and Salas 2002; Bajo-Rubio and Salas 2004], the Hanna-Kay index (4) can also be represented by the general entropy index in the form of expression (5), where the case $\alpha = 1$ is again omitted:

$$HKI = \frac{\left[1 + \alpha(\alpha-1)GEI\right]^{\frac{1}{\alpha-1}}}{N}, \alpha > 0; \alpha \neq 1 \tag{5}$$

where GEI is the general entropy index, further determined by expression (8), excluding the case $\alpha = 0$ and $\alpha = 1$, which have no significance for the Hirschman-Herfindahl index, i.e. in the general case:

$$HKI(\alpha) = \frac{\varphi\left[GEI(\alpha)\right]}{N}, \forall \alpha > 0, \tag{6}$$

where $\varphi[GEI(\alpha)]$ is the component of the inequality in (5), as an increasing function of the generalized entropy index.

It follows from (6) that the change in concentration can be decomposed into two parts

$$\frac{\Delta HKI(\alpha)}{HKI(\alpha)} \approx \frac{\Delta \varphi[GEI(\alpha)]}{\varphi[GEI(\alpha)]} - \frac{\Delta N}{N} \tag{7}$$

Let us finally state the formula of the general entropy index, according to [Cowell 1977]

$$GEI = \frac{1}{N} \frac{1}{\alpha(\alpha-1)} \sum_{i=1}^{N} \left[\left(S_i \middle/ \bar{S} \right)^{\alpha} - 1 \right], \qquad \forall \alpha \neq 0, 1 \tag{8}$$

where $\bar{s}$ denotes the arithmetic mean of market shares.
If α=2 is put in (8), we get:

$$\frac{\Delta HHI}{HHI} \approx \frac{\Delta \varphi[GEI(2)]}{\varphi[GEI(2)]} - \frac{\Delta N}{N} \tag{9}$$

which is the starting point of our next analysis.
The above-mentioned methodological procedure has, surprisingly, been applied very rarely until now. Bajo and Salas adopted it on a large sample of 68 industrial and non-industrial sectors in Spain [Bajo y Salas 1998]. The next two examples refer to the financial sector, specifically – insurance in India in period since 2002-03 to 2007-08 [Sastry 2012] and the banking sector in Poland in period 1996–2005 [Jackowicz i Kowalewski 2007]. Finally, in a recent paper [Bukvić 2022a], this author applied it to the banking sector in Serbia, according to the data available at the time, ending with the middle of 2021.

3. Changes in Concentration in the Banking Sector of Serbia: The Hirshman-Herfindahl Index and Its Decomposition

The following analysis will cover the period 2016-2021, in which the author permanently monitors the state of market concentration (and competition) in the banking sector of Serbia. In those years, the number of banks was constantly decreasing, eventually falling from 30 in 2016 to 23 in 2021. In fact, this only continues the trend of decreasing the number of banks, started by the transformation of not only the banking sector after the changes in 2000. We wrote about the changes and the emergence of the modern banking sector in an earlier paper [Bukvić 2019]. As we have already pointed out, we will not deal here with the adequacy of the Hirschman-Herfindahl coefficient as a measure of market concentration, nor, in order to obtain a more objective picture of the degree of concentration, will we apply other measures of concentration (first of all, the Linda index), as we did in other works. We will first accept Hirschman-Herfindahl index as an indicative measure of the degree of market concentration, and then proceed to its decomposition according to mentioned methodological considerations.
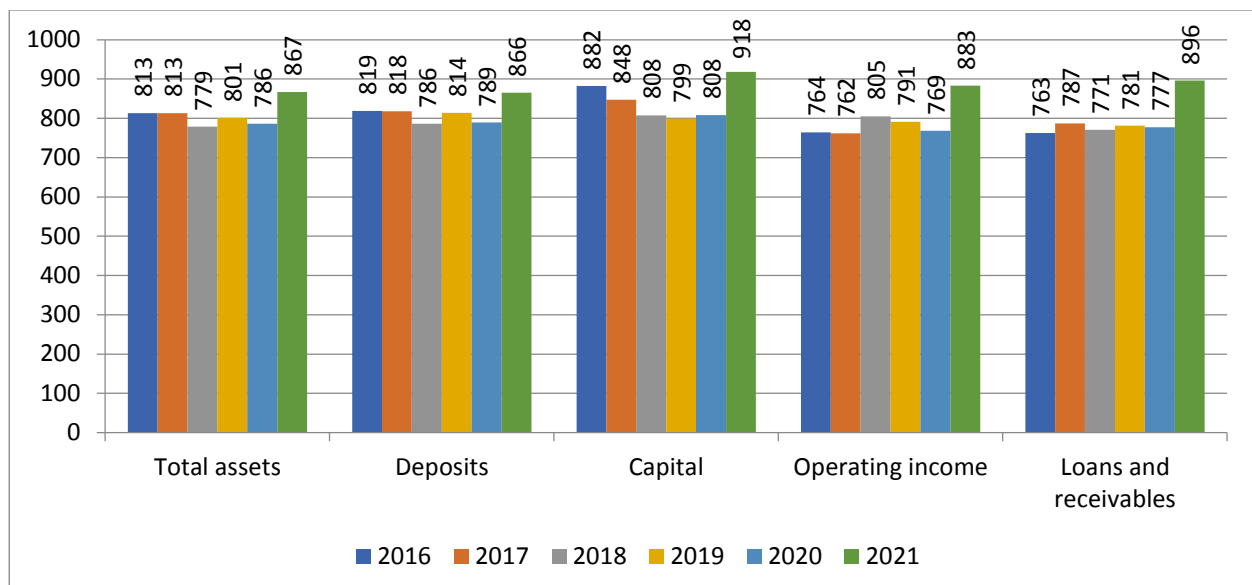
Figure 1 - Hirschman-Herfindahl concentration index in the banking sector of Serbia* 2016–2021
* Without Kosovo and Metohia.
Source: Recalculated on the basis of data from [Financial statements of banks 2016–2021].

General information about the degree of concentration in the banking sector of Serbia (without Kosovo and Metohia) is given in Figure 1. The values of the Hirschman-Herfindahl coefficient for five balance variables, which we applied in earlier works, are shown. As before, data from the financial statements of banks,

available on the website of the National Bank of Serbia, were used. Accepting the standard division into low, medium and high concentration (with cut-off values of 1000 and 1800), we can conclude that the concentration is low (in all cases less than 900), although close to moderate. As we can see, in the observed period, the increase and decrease of the value of the index alternated, so that in the last year there was a relatively large increase in all observed variables. What particularly attracts attention is just the significant growth of the coefficient (for all variables) in 2021 compared to previous years. This moment will be explained later.

The calculated and presented values of the Hirschman-Herfindahl index will be used for the analysis that is the subject of this paper. As already pointed out, in order to determine the influence of the mentioned factors (the number of participants and the dispersion of their shares) on the movement of the HH index, we will start from expression (8), and then we will apply the procedure given by expressions (10) and (11), as was done in the work of Polish authors [Jackowicz i Kowalewski 2007]:

$$I\varphi(GEI) = \frac{\left|\frac{\Delta\varphi[GEI(t)]}{\varphi[GEI(t-1)]}\right|}{\left|\frac{\Delta\varphi[GEI(t)]}{\varphi[GEI(t-1)]}\right| + \left|\frac{\Delta N(t)}{N(t-1)}\right|} \tag{10}$$

$$IN = \frac{\left|\frac{\Delta N(t)}{N(t-1)}\right|}{\left|\frac{\Delta\varphi[GEI(t)]}{\varphi[GEI(t-1)]}\right| + \left|\frac{\Delta N(t)}{N(t-1)}\right|} \tag{11}$$

Based on the initial data, taking into account the identity of the Hirschman-Herfindahl index (and the Han-Kay index) and the general entropy index, we calculated the components of the HHI index, i.e. its changes and the contribution of each of the components, according to expressions (10) and (11). The obtained results are presented in table 1. A high percentage of explained changes (over 88% in all cases) confirms the quality of the performed analysis and the relevance of the obtained results. The contributions of the factors (distribution of shares and number of firms) show significant variations during the period, and in the last year the influence of the number of firms is significantly greater.

Table 1 - Decomposition of changes in the HH index for the Serbian banking sector* 2017–2021

Variable	Year	Rate of change			Explained		Factor contribution (%)	
		HHI	φ(GEI)	N	Rate of change	% of explanation	φ(GEI)	N
Total assets	2017	–0.001	–0.034	–0.033	–0.001	96.7	50.7	49.3
	2018	–0.042	–0.108	–0.069	–0.039	93.1	61.0	39.0
	2019	0.028	–0.010	–0.037	0.027	96.3	21.3	78.7
	2020	–0.018	–0.018	0	–0.018	100	100.0	0.0
	2021	0.103	-0.024	-0.115	0.091	88.5	17.5	82.5
Deposits	2017	0.029	-0.006	-0.033	0.028	96.7	15.4	84.6
	2018	-0.039	-0.105	-0.069	-0.036	93.1	60.3	39.7
	2019	0.035	-0.004	-0.037	0.033	96.3	9.8	90.2
	2020	-0.030	-0.030	0	-0.030	100	100.0	0.0
	2021	0.097	-0.030	-0.115	0.086	88.5	20.6	79.4
Capital	2017	–0.039	–0.071	–0.033	–0.038	96.7	68.3	31.7
	2018	–0.047	–0.113	–0.069	–0.044	93.1	62.1	37.9
	2019	–0.010	–0.047	–0.037	–0.010	96.3	56.0	44.0
	2020	0.011	0.011	0	0.011	100	100.0	0.0
	2021	0.136	0.005	-0.115	0.121	88.5	4.4	95.6
Operating income	2017	–0.004	–0.037	–0.033	–0.004	96.7	52.9	47.1
	2018	0.057	–0.016	–0.069	0.053	93.1	18.8	81.2
	2019	–0.017	–0.054	–0.037	–0.017	96.3	59.3	40.7
	2020	–0.029	–0.029	0	–0.029	100	100.0	0.0
	2021	0.149	0.017	-0.115	0.132	88.5	12.7	87.3
Loans and receivables	2017	0.032	-0.003	-0.033	0.031	96.7	8.3	91.7
	2018	-0.021	-0.088	-0.069	-0.019	93.1	56.1	43.9
	2019	0.014	-0.024	-0.037	0.013	96.3	39.3	60.7
	2020	-0.005	-0.005	0	-0.005	100	100.0	0.0
	2021	0.153	0.020	-0.115	0.135	88.5	14.8	85.2

* Without Kosovo and Metohia.

Source: Own calculations based on data from [Financial statements of banks 2016–2021].

Applying the classification intended for determining the types of changes in the Hirschman-Herfindahl index given in the work of Jackowicz and Kowalewski, we obtained a schedule of the types of changes in the Hirschman-Herfindahl index (table 2). As can be seen, not all theoretical possibilities are represented, that is, combinations of changes in inequality in the distribution of shares and the number of banks. The types of changes are distributed not completely unambiguously, which can be interpreted as a kind of confirmation of the conclusion about the importance of the choice of balance variables for similar analyzes of concentration (and consequently competition) [Bukvić 2020b]. The most common change presented in the last row of the table (decrease in share dispersion and decrease in the number of banks, with a higher absolute value of the growth rate of inequality), so we can say that it best characterizes the changes in concentration in the banking sector of Serbia in the observed period. The year 2020 is the only exception in the almost uniform distribution of types of changes with a decrease in the value of the HH index (with the exception of the variable "Capital", which we have already stated in previous works as having the least quality for suitable analyses). The year 2021 is characterized by a "pure" type of change – an increase in inequality in the distribution of shares with a decrease in the number of banks for variables X3, X4 and X5. In the case of the first two variables, a simultaneous decrease in the change in inequality and the number of participants was realized, but the relative decrease in the number of participants was greater in absolute value. The same type of change was realized in 2019 (except for variables X3 and X4), so this type of change in terms of representation completely approached the type presented in the last row of Table 2. A slightly different type of change in the case of a decline in the value of the HH index was in 2020 (with the mentioned exception of the capital index), with a decrease in inequality in the share distribution and an unchanged number of banks.

Table 2 - Types of changes in the Hirschmann-Herfindahl index in the banking sector of Serbia* in the period 2017–2021

Change of HHI	$\Delta\varphi$	ΔN	Additional condition	Balance variables**				
				X1	X2	X3	X4	X5
Growth rHHI>0	>0	<0				2021	2021	2021
	>0	=0				2020		
	<0	<0	$|r\varphi| < |rN|$	2019 ; 2021	2019 ; 2021		2018	2017 ; 2019
Decline rHHI<0	<0	=0		2020	2020		2020	2020
	<0	<0	$|r\varphi| > |rN|$	2017 ; 2018	2017 ; 2018	2017 ; 2018 ; 2019	2017 ; 2019	2018

* Without Kosovo and Metohia; ** Balance variables: X1 – total assets; X2 – deposits; X3 – capital; X4 – operating income; X5 – loans and receivables.

Source: According to own calculations based on data from [Financial statements of banks 2016–2021].

Finally, let's mention that the existence of differences in the types of changes for various variables in the same years represents a kind of confirmation of the differences in importance between those variables, which is why our choice to include all five variables in the analysis is justified.

4. Conclusion

In this article, we made the decomposition of the Hirschman-Herfindal index, in order to obtain information about the influence of two factors (dispersion of market shares and the number of participants in the market) on the size of this index. Unlike the work of Jackowicz and Kowalewski [Jackowicz i Kowalewski 2007], in which this technique in the banking sector was also applied and the authors performed the analysis only on the variables of "assets" and "income", although the use of a larger number of concentration indicators, in this article the concentration and its decomposition are based on the use of Hirschman-Herfindahl index and five balance variables. We made this choice, given the previous studies of the concentration (and competition), in which this index was mainly used and with slight exceptions all the above variables. Based on previous analyzes of the insufficiently considered and insufficiently explained question about the connections between these balance variables [Bukvić 2020b], we did not want to give the advantage of any of them.

In the observed period, the number of banks in Serbia (without Kosovo and Metohia) continuously decreased, from 30 in 2016 to 23 at the end of 2021 (with the exception of 2020, in which it remained unchanged compared to 2019). But, regardless of that, the concentration index growth tendency is not observed, which is contrary to the intuitive (and theoretical) expectation. A small exception is the year 2019,

when a smaller increase in the index was recorded, but not for all variables, and in 2021, when there was a fairly large increase in the index (more than 10%), and for all observed variables.

The results of the decomposition of the Hirschman-Herfindahl index showed that the contributions of the two factors (the component of inequality in the distribution of market shares and the number of market participants) are unequal and vary by year. Among the selected types of change, the drop in the HH index caused by the decrease in the inequality of market shares and the decrease in the number of banks predominates, with the former being greater in absolute value. On the other hand, in 2021, most variables experienced an increase in value caused by an increase in the inequality component and a decrease in the number of banks, which from a theoretical point of view is a clear assumption of an increase in the degree of concentration. This year, therefore, for the first time in the observed period, there was for these variables a parallel increase in the value of the concentration index and a decrease in the number of banks. In interpreting this result, we must remember the warning that the change in the number of market participants is not a sufficient cause for the (opposite) change in the value of the concentration coefficient, which is clear from expression (3) and which we have already apostrophized. Specifically, this would mean that the entry of a new entrant will not automatically lead to a decrease in the concentration index, that is, it will not happen if that new entrant has a sufficiently large market share. Vice versa. Exactly this was the case in 2021, with the acquisition (practically, we can say - integration) of large enough banks, which by market share belong to the larger ones, the component of inequality in the value of the HH index was significantly increased. In fact, in the analyzed period of 2021, three similar acquisitions took place, and this had a significant impact on the increase in concentration.

As can be seen in table 2, in the observed period, the change in the last row of the table stands out in terms of frequency: a drop in the value of both variables, while the change in the dispersion of shares in absolute value is greater. This is followed by a change from the third order: also a decrease in the value of both variables, but with a greater absolute value of the change in the value of the number of banks. The final effect of these changes on the values of the Hirschman-Herfindahl coefficient is, of course, the opposite: in the first case it decreased, and in the second it increased.

Also very interesting is the result that the overall concentration index did not increase in the observed period, regardless of the fact that the number of banks constantly decreased (except in 2020), and that the component of the number of banks had in a significant number of cases an even greater contribution to the change in the concentration index. Of course, the last observed year appears as an exception.

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