Concentration in Serbian Insurance Sector: 2011–2020 Changes and Their Decomposition

Bukvić, Rajko

Nizhny-Novgorod Engineering-Economic University, Knyaginino

2022

Rajko M. Bukvić[1]

CONCENTRATION IN SERBIAN INSURANCE SECTOR: 2011–2020 CHANGES AND THEIR DECOMPOSITION

Abstract

This paper analyses the concentration in the insurance sector and the impact of the market structure (distribution of market shares) and the number of insurance companies on the level of concentration (and competition) in the insurance sector in Serbia (excluding Kosovo and Metohija) in the ten-year period, from 2011 to 2020. The analysis relies upon a stated number of relevant concentration coefficients, based on the total insurance premium, showing a relatively high degree of concentration but without clear fluctuation tendencies. The differentiation of the impact of the mentioned factors was done on the basis of the decomposition of the Hannah-Kay index into two components, figuring the mentioned factors. Decomposition explained most of the degree variations concentration in all observed years (above 87.5%, at a minimum), primarily affected by market structure (changed market share) with a positive, though moderate, correlation; the result was quite different when it came to the number of insurance companies, where divergent and almost completely uncorrelated fluctuations were recorded.

Key words: concentration, competition, insurance, Serbia, indicators, decomposition, market shares, number of companies.

JEL C38, D43, G22, L11, L84

I. INTRODUCTION

During a past few decades, the interest in the analysis of the development of competition has grown tremendously, not only in the so-called real sector of the economy. In modern economic considerations, the attitude towards competition is almost unique: it is deemed a factor that ensures the efficiency of the market economy. Moreover, the concept of competition has acquired a status of a universal model, applicable not only in economics but also in sociology, anthropology, game theory and many other disciplines.

During almost two centuries of tradition[2] many aspects and characteristics of competition have been explored. Nevertheless, the theoretical thought has still not managed to build a unique and generally accepted definition of competition. Consequently, many other aspects, phenomena and facts related to competition have not been resolved satisfactorily. One of such issues is the measurement of competition, as one of the central points of the entire theory, which is of a special importance in the practical application of results (for example, in the implementation of antitrust policy and/or the competition protection policy).

The lack of satisfactory and/or generally accepted answer to the above question usually results in the application of relative assessments on a non-quantitative scale - such as strong, moderate, weak competition and the like - the basis for assessments of this type being expert assessments, sociological surveys or in a somewhat stricter approach, the results and/or consequences of competition. Such results include a number of market participants (companies), their revenues (incomes) and profits i.e. acquired assets and capital. Based on such data, the

---

[1] Scientific associate; Honorary Professor, Nizhny Novgorod State University of Engineering and Economics, Knyaginino (Russia), r.bukvic@mail.ru; r.bukvic@yandex.com.
[2] A. Smith is considered to be the founder of competition theory, although other economists and philosophers before him dealt with similar problems. We have in mind, first of all, mercantilists (T. Mann, A. Moncretien, V. Stafford, etc.), who paid significant attention to restricting the competition of foreign goods producers through state protectionism.

shares achieved precisely in the process of competition of market participants are stated in adequate sizes.

Directly related to the above is the identification and (possible) quantification of factors that lead to changes in the degree of concentration, both in general and in individual markets. This degree of concentration is considered to be directly related to monopoly power within the structure-conduct-performance (SCP) paradigm.[3] The theoretical and empirical work has pointed to a number of such factors, like barriers to market entry (legal, economic and/or technological, etc.) that must be taken into account in more complex market analyses.[4] All this applies not only to the real sector, but to the financial as well, to which greater attention has been dedicated recently, among other things in the field of competition, i.e. the competition protection policy.

The next research is dedicated to the problems of concentration in the insurance sector in Serbia (excluding Kosovo and Metohija). It is divided into two parts. The first part quantifies the level of concentration in the insurance sector in Serbia (excluding Kosovo and Metohija) in the last decade (2011-2020), using a few relevant indicators that shed light on several aspects of this market characteristic. In the second part, a demarcation is made between the influence of two factors whose changes affect the changes and dynamics of concentration: market structure (i.e. the changes in the composition of market shares) and the number of insurance companies. We have set the foundation for the research in the previous papers, where we have calculated a few different concentration measures in this sector,[5] and provided for the decomposition of the factors of their changes based on the Hirschman-Herfindahl index, one of the most commonly used indicators of concentration.[6] In this paper, the previous findings have been generalized and completed, and the decompensation has been provided of the indicators of concentration based on the Hannah-Kay concentration index and/or the general class index, of which the Hirschman-Herfindahl index is just one special case.

II. METHODOLOGICAL NOTES

The starting point of one of the most frequently used approaches in assessing the degree of competition in the market are the achieved shares of market participants, based on which the competition distribution among market players is defined. The basis of this approach is simple reasoning: the lower the concentration of shares, the less power (authority) of individual market participants and the greater opportunity for competition development. Such a connection can be presented in a simple linear model

$$L = 1 - C \tag{1}$$

Showing the inverse relation amongst the competition (L) and concentration (C). The assumption about the linear character of the relationship (1) is extremely simplified, and, in its essence, probably not completely correct, since some research has shown that this relationship is different[7]. Lončar and co-authors,[8] contributed to the examination of this connection in our

[3] The SCP paradigm represents one of the areas in competition theory that is causing a lot of controversy. For a review of the literature on this issue, see for example V. Njegomir et al., Liberalisation, Market Concentration and Performance in the Non-Life Insurance Industry of Ex-Yugoslavia, *Ekonomska misao i praksa*, 2011, 20(1).

[4] In the overall and (up to now) the only study of its kind in modern Serbia (i.e. the then Yugoslavia), a special attention was dedicated to the barrier analysis itself. See: B. Begović et al., *Antimonopolska politika u SR Jugoslaviji*, Belgrade: Center for Liberal-Democratic Studies, 2002.

[5] R. Bukvić, Novi pristupi ocenjivanju stepena koncentracije i konkurencije: primer sektora osiguranja u Srbiji, *XLVIII International Symposium on Operational Research*, SYM-OP-IS 2021, Beograd: Univerzitet u Beogradu, Matematički fakultet, 2021, pp. 93–98.

[6] R. Bukvić, Dekompozicija promena u koncentraciji u sektoru osiguranja u Srbiji 2011–2020: uticaj promena u strukturi tržišta i broju društava za osiguranje, *Ekonomski vidici*, 2022, 27(1–2).

[7] П. Ф. Воробьёв и С. Г. Светуньков. Новый подход к оценке уровня конкуренции, *Современная конкуренция*, 2016, 10(6)

[8] Lončar et al., Interplay Between Market Concentration and Competitive Dynamics in the Banking Sector: Evidence from Serbia, Croatia, Romania and the Czech Republic, *Ekonomika preduzeća*, 2016, 64(5–6).

literature, analysing the banking markets of Serbia, Croatia, Romania and the Czech Republic. Consideration of this relationship is not relevant for the purposes of our research.
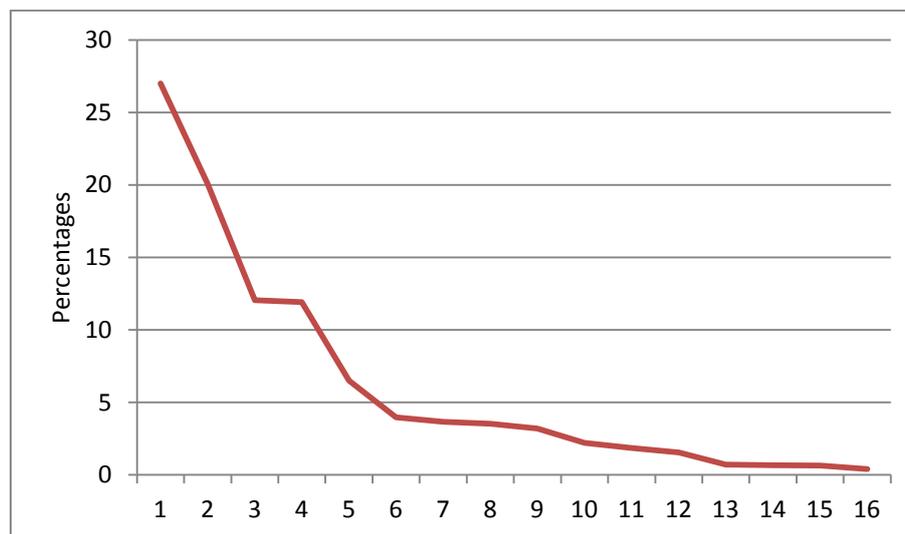
The level, i.e. the degree of concentration C in (1) is assessed through the share of individual market participants

$$s_i = \frac{Q_i}{Q} = \frac{Q_i}{\sum_{j=1}^{N} Q_j} \tag{2}$$

Where N means a number of participants on the market or a part of the market (branch, for example), Qi is the scope of production (physical or monetary, or some other scope - total property i.e. assets, equity, number of employees) of the i-th market participant. Figure 1 shows the ordered sequence (in descending value, i.e. si ≥ si+1) of the share of si firms in the market in the general case, i.e. when those values are unequal (when firms are not of equal strength). The curve (broken line) formed by the shares, presented on the vertical axis is concave to the horizontal axis and its specific shape depends on the share of individual companies, i.e. on the market structure. Note that the slope of this curved line changes from one point (from one firm) to another but remains negative (more precisely, non-positive) along the entire curve.

If the shares are arranged in descending order, as in Figure 1 (which is a usual procedure), accumulation of shares is triggered so as to assess the degree of concentration, obtaining a growing curved (broken) line, convex to the horizontal axis, with a positive slope along its entire length, but with a value decreasing with distance from the coordinate origin (Figure 2).[9] The values of the degree of concentration (1), determined by the accumulation of individual shares, will range from 1 (when there is only one participant in the market, so the entire production, sales, etc. and market power is concentrated with it) and 1/N, when there are N participants in the market, who are all equally strong. When N is large enough, the concentration approaches zero (C=1/N, C→0 when N→∞).

Figure 1. Declining market shares of Serbian insurance companies (excluding Kosovo and Metohija) in 2020 based on insurance premium total

A number of methods and indicators have been developed and used to assess the degree of concentration. At the beginning, two, somewhat inverse indicators, were most often used: the number of companies that cover a particular percentage (usually 80%) of the observed size (sales, revenues, assets, etc.)

---

[9] This curve is known as the "concentration curve" from the 1940's studies by the Federal Trade Commission.
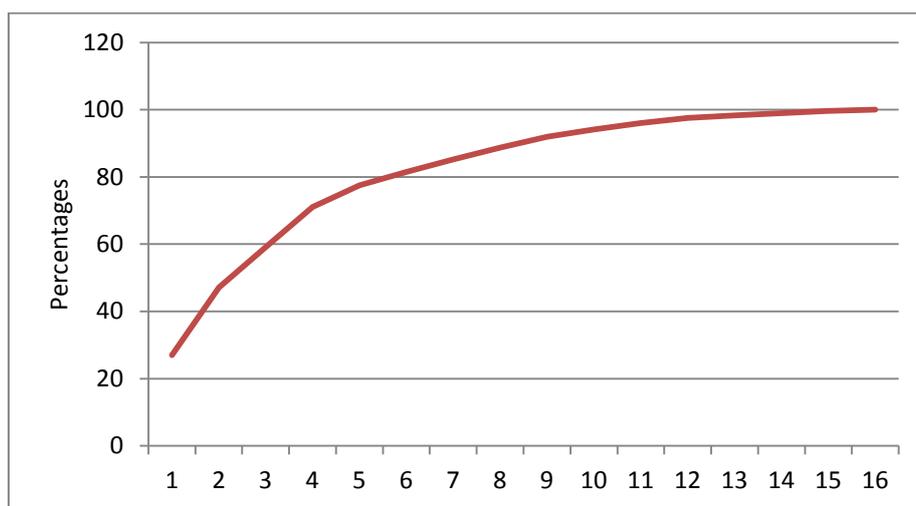
$$S_{m^*} = \sum_{j=1}^{m^*} s_j = 80\% \qquad\qquad (3)$$

where m* is the requested number of companies, and the aggregate share of a few major companies in the market

$$CRn = \sum_{j=1}^{n} s_j , \qquad\qquad (4)$$

whereat, in the case of the latter, 4 was most often taken as n in empirical analyses, although for such, or some other choice, as a rule, no explanation was given.[10] Regardless of how many participants (shares) are taken into account in the calculation of the coefficient (4), it is obvious that this indicator (as a simple sum of the shares of the first n, i.e. the largest, market participants) focuses on what is commonly called market "core", while neglecting its "periphery" where the boundary between these two parts of the market is not clearly defined.

Of the above indicators (3) and (4), the latter, known simply as the concentration coefficient (CRn), has remained in practical application. It has gained the greatest popularity over time, together with the Hirschman-Herfindahl coefficient (HH)[11], and has been most often used concentration indicator to this day.[12]

Figure 2. Cumulative shares: regulated sequence of shares of Serbian insurance companies (excluding Kosovo and Metohija) in 2020 based on the insurance premium total

Unlike the CRn concentration coefficient, the Hirschman-Herfindahl coefficient is determined by taking into account the market share of all market participants. Since the sum of

---

[10] In fact, number 4 is most often uncritically taken, patterned on the example of the monograph of the Temporary National Economic Committee (TNEC), in which, however, this number was selected for practical reasons, without theoretical explanations. See: M. A.Adelman, The Measurement of Industrial Concentration, *The Review of Economics and Statistics*, 1951, 33(4).

[11] This coefficient can often be found in literature under the name Herfindahl coefficient (index), although the primacy certainly belongs to Albert Hirschman, who used it in 1945, whereas Orris Herfindahl used it only in 1950. This is certainly one of the most famous examples of the so-called Stigler's law (or Stigler's law of eponymy, according to the paper of the same title from 1980), according to which "no scientific discovery is named after its inventor". Stigler himself believed that this law was discovered by Robert Merton (who called it the Matthew effect), so the law itself is also applicable to its formal author!

[12] Such estimates characterize the history of research in our local environment as well, where, from its very beginning in the late 1950s until the end of the existence of SFR Yugoslavia, exclusively the CRn concentration index was used to make an analysis. See: R. Bukvić, Istraživanja tržišnih struktura u privredi druge Jugoslavije, *Ekonomika*, 1999, 35 (1–2). The Hirschman-Herfindahl coefficient was first applied in the study of Begović et al., *Antimonopolska politika u SR Jugoslaviji*, Belgrade: Center for Liberal-Democratic Studies, 2002.

the shares of all participants by definition equals one, the squares of the corresponding shares are taken in the modelling of this coefficient

$$HH = \sum_{j=1}^{N} s_j^2 \qquad (5)$$

which actually means that the market shares of the participants are weighted by the shares themselves.

The concentration coefficient (4) is calculated simply and requires only a few pieces information. However, it has serious shortcomings (among other things, it can have the same value for a different distribution of shares within the "core"), which significantly limit its usability. It is often pointed out that the coefficient (5) does not have such shortcomings, which allegedly makes it much more acceptable. However, since its values fluctuate in the interval

$$\frac{1}{N} \leq HH \leq 1 \qquad (6)$$

it ensues that its minimum value depends on the number of market participants, so that the interpretation of the coefficient (5) is made significantly more difficult. This, of course, applies all the more to the coefficient (4). On the other hand, it is obvious that the HH coefficient attaches greater importance to participants with a larger share (the weight of each share, as already pointed out, is actually the share itself). However, of utmost importance is that the HH does not provide for a clear link between the distribution of shares and the degree of concentration, so it can have the same value for different market share confi gurations.[13]

In the practical implementation of the competition protection policy, when applying both of these indices (4) and (5), there are also problems of identifying types (forms) of competition based on their established values. They are (in practice, not in theory) resolved by arbitrary setting of limits (for example, in the Hirschman-Herfindahl coefficient, the usual limits were 0.10 and 0.18 for three types of markets: non-concentrated, moderately concentrated and highly concentrated markets[14]), in order to defi ne the type of competition in the given market based on the value of the coefficient (5), in the relevant segment.

In this paper, we will first focus on the mentioned coefficients and the results obtained by their application, primarily the HH coefficient. We presented a more detailed overview of other coefficients and results in a recent announcement,[15] including different approaches to the logic of aggregating market shares into one issue, followed by some other, less popular and used coefficients (Gini, Rosenbluth, Tideman-Hall, etc.). The reason for this reduction lies in the desire to determine the factors that led to changes in the degree of concentration based on the results obtained in the previous paper, i.e. to differentiate the impact of changes in the number of insurance companies and market distribution among them on the concentration.

Namely, as has been pointed out many times[16], and can be confirmed by elementary transformations of the coefficient (5), the Hirschman-Herfindahl coefficient can be represented by the following formula:

$$HH = N\sigma^2 + \frac{1}{N} \qquad (7)$$

---

[13] И. А. Смарагдов и В. Н. Сидорейко, Индексы рыночной концентрации: неоднозначная информативность, *Концепт*, 2015, 9.

[14] This division was established in the United States, in the 1997 Guide to Horizontal Mergers, to be replaced by the 0.15 and 0.25 limits in 2010, see Horizontal Merger Guidelines (1997) and Horizontal Merger Guidelines (2010). In other countries where the Hirschman-Herfindahl index is used for these purposes, different limits can be found, but they are certainly arbitrary.

[15] R. Bukvić, Novi pristupi ocenjivanju stepena koncentracije i konkurencije: primer sektora osiguranja u Srbiji, *XLVIII International Symposium on Operational Research*, SYM-OP-IS 2021, Beograd: Univerzitet u Beogradu, Matematički fakultet, 2021, стр. 93–98.

[16] С. Б. Авдашева и Н. М. Розанова, *Теория организации отраслевых рынков*, Москва: Издательство Магистр, 1998; И. А. Смарагдов и В. Н. Сидорейко, Индексы рыночной концентрации: неоднозначная информативность, *Концепт*, 2015, 9.

where σ² is a variance of market shares sᵢ and N is the number of companies in the market. This fact has two contradictory consequences. On the one hand, it turns out that this leads to ambiguities in the interpretation of the value of the coefficient, which should not be ignored.[17] The second consequence relates to the fact that expression (7) provides for an opportunity to differentiate between the impact of the market share variance (i.e. changes in market structure) and the number of market participants on the changes in the degree of concentration.[18] The last circumstance was used for the research the results of which are presented in our previous paper[19], so that, in this paper, we expand the research by applying a different procedure.

III. CONCENTRATION IN SERBIAN INSURANCE SECTOR 2011–2020

The insurance market in Serbia has undergone relatively significant changes in the past decade, which primarily reflect in the number of insurance companies.[20] The insurance market in Serbia has undergone relatively significant changes in the past decade, which primarily refl ect in the number of insurance companies years), with a clear tendency to decrease, which is more than significant in percentage terms. Among these companies, four deal exclusively with reinsurance. In the following analyses, we focused on insurance companies, according to the data of the National Bank of Serbia, presented in the reports on total premium and premium allocation of insurance companies for the observed years, as was the case in our previous researches.[21]

Due to the specifi cs of competition in this sector, as we have already pointed out in the previous works, it is inadequate to use the earned income as a criterion, as is usual in the real sector (with physical volume of production which has no counterpart here), so that it is necessary to first select a variable according to which the concentration and competition will be determined. According to the current regulations (Law on Protection of Competition, Art. 7), the total premium for all lines of insurance applies to assess the degree of concentration in this sector.[22] On this occasion, we also opted for this variable, although for certain purposes, of course, it would be desirable to use other variables as well (total non-life insurance premium and total life insurance premium), as was, for example, done by Maja Dimić.[23] Total premium was applied by other authors as well. For example Maksimović and Kostić.[24]

In this part of the paper, we will point out at some of the relevant results, only one of which we presented in a previous paper.[25] We will keep the focus mainly on the mentioned indices - the concentration coeffi cient and the Hirschman-Herfindahl coefficient, but they will be

[17] According to the hypothetical example given by Смарагдов и Сидорейко (Индексы рыночной концентрации: неоднозначная информативность, *Концепт*, 2015, 9), even in the case of equal competencies (market shares) of all participants in the market, the coefficient value HH shall be 0.2 for five market players and 0. 1 for 10 players. In the first case, so, according to the above mentioned limits, market would be classified as highly concentrated and in the second – non-concentrated!

[18] С. Б. Авдашева и Н. М. Розанова. *Теория организации отраслевых рынков*, Москва: Издательство Магистр, 1998.

[19] R. Bukvić, Dekompozicija promena u koncentraciji u sektoru osiguranja u Srbiji 2011–2020: uticaj promena u strukturi tržišta i broju društava za osiguranje, *Ekonomski vidici*, 2021, 26(3–4).

[20] The insurance sector is observed without data for Kosovo and Metohija, which are not available in the data of the National Bank of Serbia.

[21] R. Bukvić, Novi pristupi ocenjivanju stepena koncentracije i konkurencije: primer sektora osiguranja u Srbiji,, *XLVIII International Symposium on Operational Research*, SYM-OP-IS 2021, Beograd: Univerzitet u Beogradu, Matematički fakultet, 2021, pp. 93–98. and R. Bukvić, Dekompozicija promena u koncentraciji u sektoru osiguranja u Srbiji 2011–2020: uticaj promena u strukturi tržišta i broju društava za osiguranje, *Ekonomski vidici*, 2022, 27(1–2).

[22] Drugi argumenti za korišćenje ove promenljive dati su u: M. Kostić, Analiza koncentracije ponude u sektoru osiguranja Srbije, *Industrija*, 2009, 37(2).

[23] M. Dimić. *Analiza nivoa koncentracije u bankarskom sektoru i u sektoru osiguranja u zemljama centralne i istočne Evrope*, doktorska disertacija, Beograd: Univerzitet Singidunum, 2015.

[24] Lj. Maksimović and M. Kostić. Limitations in the Application of Concentration Indicators, *Ekonomika preduzeća*, 2012, 60(3–4); M. Kostić et al., The limitations of competition in the insurance markets of Slovenia, Croatia and Serbia, *Economic Research - Ekonomska Istraživanja*, 2016, 29(1).

[25] R. Bukvić, Novi pristupi ocenjivanju stepena koncentracije i konkurencije: primer sektora osiguranja u Srbiji, *XLVIII International Symposium on Operational Research*, SYM-OP-IS 2021, Beograd: Univerzitet u Beogradu, Matematički fakultet, 2021, стр. 93–98.

supplemented by other indicators. Table 1 shows the values of the CRn concentration index in four variants and the Hirschman-Herfindahl index in the observed ten-year period. All values are given in percentages, so the shares (2) are multiplied by 100. This of course changes nothing when it comes to obtained results and their construing.

Table 1. Values of concentration index CR3, CR4, CR5 and CR8 and Hirschman-Herfindahl index in Serbian insurance sector* 2011–2020

Year	CR3	CR4	CR5	CR8	HH	Year	CR3	CR4	CR5	CR8	HH
2011	63.1	72.1	77.4	88.6	1551	2016	59.5	70.2	74.9	86.2	1496
2012	62.4	71.6	77.3	87.5	1596	2017	59.8	71.5	77.2	88.6	1543
2013	59.8	70.3	75.8	85.6	1495	2018	61.0	72.6	78.4	89.7	1597
2014	60.6	70.8	76.5	87.7	1495	2019	59.7	71.4	77.8	89.3	1545
2015	61.2	70.9	76.1	87.5	1558	2020	59.1	71.0	77.6	88.7	1526

* Without Kosovo and Metohija.
Source: calculated on the basis of data from the National Bank of Serbia in the publications of Total premium and premium allocation of insurance companies, for the respective years

The presented indices indicate a (relatively) high level of concentration, regardless of the fact that the already highlighted problem of determining the boundaries between low, medium and high concentration (or any other classification) does not actually allow the precise determination of this level. The values of the CR3 index are, with minor oscillations, around 60%, the CR4 concentration indices cover just over 70% of the total premium, and CR5 over ¾, so it can be considered the commonly called "the core" lies within these limits. This will be confirmed by the results from Table 4, obtained by another methodological procedure. Within such a specific core, two companies stand out, with shares in 2020 of 27% and 20%, respectively. On the other hand, in full accordance with this, it is obvious that the CR8 index has low informative value for our needs (practically, in all years, close to 90), which we normally expect, given the relatively small number of participants (insurance companies) and significant market shares of the leaders (see Figure 1). What can still be noticed and should be underlined is the fact that, in the entire observed period, there is no clear tendency in the fluctuations of the values of these coefficients.

Table 2. Market classifi cation by level of concentration in the Russian Federation

Market classification	Value of the CR3 index	Value of the Hirschman-Herfindahl index (HH)
Low concentrated market	CR3≤45	HH≤1000
Moderately concentrated market	45<CR3<70	1000<HH<2000
High concentrated market	CR3>70	HH>2000

Source: Федеральная антимонопольная служба, Об утверждении Порядка проведения анализа состояния конкуренции на товарном рынке (с изменениями на 20 июля 2016 года) от 28 апреля 2010 года Н 220, 2016

The values of the Hirschman-Herfindahl index provide a somewhat different picture. If we accept the value of this index of 1800 as the border between moderate and highly concentrated market, the market in the Serbian insurance sector in the past decade would be classified as moderately concentrated. This is, obviously, to some extent contrary to the impression given by the values of the CRn index.[26] Based on that, the idea arises that the use of one indicator (index) is insufficient for market classification, but it is necessary to combine several data. Thus, for example, in the antitrust practice of the Federal Antimonopoly Service in

---

[26] It should be emphasized that the values of the Hirschman-Herfindahl index presented here are significantly lower than in the years preceding the analyzed period (over 2,000 in 2006, 2007 and 2008, slightly above 1,800 in 2009 and above 1,600 in 2010), which is not included in time within the framework of our analysis. Author's recalculation based on the same source of the National Bank of Serbia.

Russia, two indicators are used in parallel, namely the CR3 and HH indices (see Table 2). As can be seen, the boundaries set there would allow for an unambiguous classifi cation of our insurance market as moderately concentrated.

For the purposes of the analysis in the next section, it will be necessary to calculate the values of the generalized entropy index[27]

$$GEI = \frac{1}{N}\frac{1}{\alpha(\alpha-1)}\sum_{i=1}^{N}\left[\left(\frac{s_i}{\bar{s}}\right)^{\alpha} - 1\right], \quad \forall \alpha \neq 0, 1 \tag{8}$$

$$GEI = \frac{1}{N}\sum_{i=1}^{N} ln\left(\frac{\bar{s}}{s_i}\right), \quad \alpha = 0 \tag{9}$$

$$GEI = \frac{1}{N}\sum_{i=1}^{N}\left[\left(\frac{s_i}{\bar{s}}\right)ln\left(\frac{s_i}{\bar{s}}\right)\right], \quad \alpha = 1 \tag{10}$$

which will, obviously, take different values for different figures of the parameter α. In this case, higher values of the parameter give greater importance (weight) to higher value of the variable, and vice versa. Later in the text, we decided on five characteristic values of this parameter (0.5; 1; 1.5; 2; 2.5).

Table 3. Generalized entropy index, variance of market shares and number of companies in Serbian insurance sector* 2011–2020

Year	Value of the generalized entropy index					Variance of market shares	Number of companies
	α						
	0.5	1	1.5	2	2.5		
2011	1.012	0.930	1.024	1.284	1.786	48,543	23
2012	0.984	0.952	1.085	1.415	2.062	49.119	24
2013	0.910	0.890	1.009	1.294	1.843	44.942	24
2014	0.850	0.805	0.878	1.070	1.430	48.535	21
2015	0.825	0.783	0.860	1.058	1.428	52.907	20
2016	0.731	0.699	0.763	0.921	1.209	51.010	19
2017	0.693	0.651	0.693	0.812	1.029	56.169	17
2018	0.671	0.632	0.670	0.778	0.976	60.776	16
2019	0.644	0.606	0.639	0.736	0.912	57.481	16
2020	0.606	0.585	0.623	0.721	0.896	56.316	16

* Without Kosovo and Metohija.
Source: calculated on the basis of data of the National Bank of Serbia in the publications of Total premium and premium allocation of insurance companies, for respective years

As presented in the Table 3, the index value tendencies for all selected values of the parameter α show a clear downward trend, indicating a reduction in inequality in the market shares distribution. Reducing the value of the index by almost half from the beginning of 2011 is very indicative, regardless of the fact that the values in 2020 are still quite far from the theoretical minimum (= 0), as would be the case if all market participants were fully equal.

On the other hand, the values of the coeffi cients in the Table 1 indicate the possibility of the existence of an oligopolistic structure, with grouping high market shares within smaller groups of companies. In order to verify this assumption, we will apply a diff erent methodological procedure, as is usual in the practice of the relevant body in the European Union. This is the Linda index (more precisely, the index system), named after its author, Remó Linda, an associate of the EU Commission in Brussels.[28] The general formula for the calculation of these indexes

---

[27] F. A. Cowell, *Measuring Inequality: techniques for the social sciences*, New York: Wiley, 1977.
[28] R. Linda, *Methodology of concentration analysis applied to the study of industries and markets*, Commission of the European Communities, Brussels, 1976.

$$IL_m = \frac{1}{m(m-1)} \sum_{i=1}^{m-1} \frac{m-i}{i} \cdot \frac{CR_i}{CR_m - CR_i} \qquad (11)$$

has been developed and gives a separate expression for any one m value. Linda indexes are intended precisely to check the existence of oligopolistic structures, using no a priori, i.e. arbitrarily established limits. Instead, the values of the index themselves indicate whether or not there is an oligopoly in a given market. In the case of a market of perfect (full) competition, the values of this index are constantly declining ($IL_{m+1} > IL_m$ for all m). If such pattern is breached, this is a signal that there is an oligopoly on the given market. According to theoretical considerations, it can be tight (3 to 5) or loose (7 to 8 companies).

As can be seen in the Table 4, the values of the Linda index show the existence of a tight oligopoly, practically in all years of the observed period, regardless of particular variations over the years. Many of these values, namely, are interrupted in most cases in the fifth index ($IL_5 > IL_4$), in some years even earlier, which leads to the above conclusion, where the oligopoly has in most years been formed by four companies, while in the two years (2015 and 2016) the structure has been approaching duopoly.

Table 4. Values of Linda index in Serbian insurance sector* 2011–2020

IL	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
IL2	0.7089	0.7272	0.7011	0.5840	0.5759	0.5772	0.6302	0.6434	0.6150	0.6723
IL3	0.4703	0.5966	0.5828	0.5240	0.6102	0.5977	0.6107	0.6175	0.6042	0.6056
IL4	0.4911	0.5403	0.4840	0.4692			0.4620	0.4718	0.4586	0.4548
IL5		0.5488	0.5189	0.4997			0.5009	0.5066	0.4736	0.4661

* Without Kosovo and Metohija.
Source: calculated on the basis of data of the National Bank of Serbia in the publications of Total premium and premium allocation of insurance companies, for respective years

By applying the method of breaking down into cores, as a new procedure[29], the first, basic core comprised two leading companies.[30] As can be seen, this procedure gives even stricter results, setting out only two companies; which is a particularly striking result in recent years, when, according to the results referred to under the Table 2, a tight oligopolistic structure consisting of four companies was established.

IV. DECOMPOSITION OF FACTORS OF CHANGE IN CONCENTRATION

As pointed out below, we are dealing with the problems of decomposition of changes in concentration during the observed period. First, the necessary theoretical and methodological notes will be given, followed by an empirical analysis that will show the appropriate influence of two relevant components (factors) - namely the market structure and number of market participants - on concentration changes. In the theoretical domain, we will rely on the works of Hannah and Kay and Encaoua and Jacquemin[31]. The starting point for the following considerations is, on the one hand, the fact that the HH index can be decomposed into two parts, as already pointed out and presented by expression (7), and on the other hand, the fact that the HH index is actually a special case of general class concentration index (Hannah-Kay indexes).

---

[29] See, for example: И. А. Смарагдов и Е. И. Нестерова, Структура российского страхового рынка и конкуренция на нём, *Концепт*, 2015, 4.
[30] R. Bukvić, Novi pristupi ocenjivanju stepena koncentracije i konkurencije: primer sektora osiguranja u Srbiji, *XLVIII International Symposium on Operational Research*, SYM-OP-IS 2021, Beograd: Univerzitet u Beogradu, Matematički fakultet, 2021, стр. 93–98.
[31] L. Hannah & J. A. Kay, *Concentration in Modern Industry. Theory, measurement and the U. K. experience*, London – Basingstoke: The Macmillan Press Ltd., 1977; D. Encaoua and A. Jacquemin, Degree of Monopoly, Indices of Concentration and Threat of Entry, *International Economic Review*, 1980, 21(1), 87–105.

In our previous paper[32], we started from expression (7) and analysed the dynamics (rates) of changes in the HH index and its corresponding components: the structure of market shares and the number of insurance companies. The results showed that the directions of changes in the value of the coefficients HH and the variance of market shares coincide throughout the entire period, without exceptions, while, on the other hand, such dependence cannot be established between the changes in the number of insurance companies and this coefficient. Based on this fact, it could be concluded that the direction of the Hirschman-Herfindahl coefficient was mainly caused by changes in the market structure, i.e. that changes in the number of insurance companies did not unambiguously aff ect changes in the value of the concentration coefficient. This finding was confirmed by the correlation coefficients: the correlation between the value of the HH index and the variance of market shares in the observed ten-year period was 0.476, whereas between the value of the HH index and the number of companies -0.110. Although the sample (i.e. the series) is small, it can be deemed that these results are very illustrative and confirm the above statement.

Having in mind the mentioned divergent tendencies (negative correlation) of the number of firms and the value of the concentration index, an attempt to quantify both components of changes in the HH index and determine the degree of explanation of the changes thereof, analogous to the procedure applied by Bajo-Rubio and Salas[33] concentration for the economic activities of Spain, could not give fully satisfactory results. In this paper, we have therefore partially modifi ed the approach, opting for the decomposition procedure based on the Hannah-Kay index.

The general class of the Hannah-Kay concentration index can be represented, starting from the expression for the equivalent number[34], in the form (9) and (10)

$$HKI = (\sum_{i=1}^{N} s_i^{\alpha})^{\frac{1}{\alpha-1}}, \quad \alpha > 0; \ \alpha \neq 1 \tag{12}$$

$$HKI = exp[s_i ln s_i], \quad \alpha = 1 \tag{13}$$

where α may take various positive values. From (12) one can easily see that, for α=2, the Hannah-Kay index is turned into the well-known Hirschman-Herfindahl index (5).

Hannah-Kay indices are calculated and presented in Table 5, for the same values of the parameter α as in Table 2. Of course, higher values of the parameter lead to higher values of market shares as well, and these form the basis for calculation of the coefficients. As can be seen in the table, there are no clear index tendencies, so nothing can be concluded about the concentration fluctuations in the observed period.

As Bajo and Salas have shown, the Hannah-Kay indexes (12) and (13) may also be presented through a generalized index of entropy in the form of expressions (14) and (15)

$$HKI = \frac{[1+\alpha(\alpha-1)GEI]^{1/\alpha-1}}{N}, \quad \alpha > 0 ; \ \alpha \neq 1 \tag{14}$$

$$HKI = \frac{exp GEI}{N} \tag{15}$$

where GEI is a generalized entropy index, defined by expressions (8) – (10), i.e. as a general case

$$HKI(\alpha) = \frac{\varphi[GEI(\alpha)]}{N}, \forall \alpha > 0 \tag{16}$$

[32] R. Bukvić, Dekompozicija promena u koncentraciji u sektoru osiguranja u Srbiji 2011–2020: uticaj promena u strukturi tržišta i broju društava za osiguranje, *Ekonomski vidici*, 2022, 27(1–2).

[33] O. Bajo & R. Salas, Inequality foundations of concentration measures: An application to the Hannah-Kay indices, *Spanish Economic Review*, 2002, 4(4). Also: O. Bajo-Rubio & R. Salas, Decomposing Change in Industry Concentration, *The Empirical Economics Letters*, 2004, 3(6).

[34] L. Hannah & J. A. Kay, *Concentration in Modern Industry. Theory, measurement and the U. K. experience*, London – Basingstoke: The Macmillan Press Ltd., 1977, p. 55.

where φ[GEI(α)] is a component of inequality in (14) and/or (15), which is a growing function of a general entropy index.

Table 5. Values of the Hannah-Kay index in the Serbian insurance sector* 2011–2020

Year	α				
	0.5	1	1.5	2	2.5
2011	0.078	0.110	0.136	0.155	0.169
2012	0.073	0.108	0.137	0.160	0.177
2013	0.070	0.101	0.129	0.150	0.165
2014	0.077	0.107	0.131	0.150	0.164
2015	0.079	0.109	0.135	0.156	0.172
2016	0.079	0.106	0.130	0.150	0.165
2017	0.086	0.113	0.136	0.154	0.169
2018	0.090	0.118	0.141	0.160	0.174
2019	0.089	0.115	0.137	0.154	0.168
2020	0.087	0.112	0.135	0.153	0.167

* Without Kosovo and Metohija.
Source: calculated on the basis of data of the National Bank of Serbia in the publications of Total premium and premium allocation of insurance companies, for respective years

From (16), the change in concentration can be decomposed in two parts[35]

$$\frac{\Delta HKI(\alpha)}{HKI(\alpha)} \approx \frac{\Delta \varphi[GEI(\alpha)]}{\varphi[GEI(\alpha)]} - \frac{\Delta N}{N} \tag{17}$$

The expression (16) allows for the final decomposition of changes in concentration presented in the following table (Table 6). As can be seen, the changes in the values of the Hannah-Kay index were more than successfully explained by the above analysis: the minimum percentage of explained relative changes amounts to 87.5%. Of course, the approximately correct expression (17) led in some cases to deviations upwards, but they also range within practically minimal amounts. It can be noticed that most of the changes in the degree of concentration are explained by changes in the market structure (structure of market shares), while changes in the degree of concentration and changes in the number of companies are divergent.

On the whole, we can state that the decomposition of the Hannah-Kay index according to the described procedure is a further step in explaining the factors that led to changes in concentration in the insurance sector compared to our previous paper in which the decomposition of the index (5) as per the developed formula (7) showed that changes in the degree of concentration in the insurance sector in Serbia in the past decade were affected by the structure of the distribution of market shares, while a number of companies sustained no significant impact.

---

[35] O. Bajo & R. Salas, Inequality foundations of concentration measures: An application to the Hannah-Kay indices, *Spanish Economic Review*, 2002, 4(4). Такође: O. Bajo-Rubio & R. Salas, Decomposing Change in Industry Concentration, *The Empirical Economics Letters*, 2004, 3(6)

Table 6. Decomposition of changes in concentration in Serbian insurance sector* 2011–2020.

	HK(0.5)					HK(1)					HK(1.5)				
	Relative changes			Explained		Relative changes			Explained		Relative changes			Explained	
Year	HKI	φ(GE)	N	Total	%	HKI	φ(GE)	N	Total	%	HKI	φ(GE)	N	Total	%
	1	2	3	4=2-3	5=4/1	1	2	3	4=2-3	5=4/1	1	2	3	4=2-3	5=4/1
2011	-0.008	0.037	0.045	-0.009	104.5	0.013	0.059	0.045	0.013	104.5	0.019	0.065	0.045	0.019	104.5
2012	-0.06	-0.019	0.043	-0.062	104.3	-0.02	0.022	0.043	-0.021	104.3	0.009	0.053	0.043	0.009	104.3
2013	-0.047	-0.047	0	-0.047	100	-0.06	-0.06	0	-0.06	100	-0.062	-0.062	0	-0.062	100
2014	0.1	-0.038	-0.125	0.087	87.5	0.05	-0.081	-0.125	0.044	87.5	0.018	-0.109	-0.125	0.016	87.5
2015	0.033	-0.016	-0.048	0.032	95.2	0.027	-0.022	-0.048	0.026	95.2	0.033	-0.016	-0.048	0.032	95.2
2016	-0.007	-0.057	-0.05	-0.007	95	-0.032	-0.081	-0.05	-0.031	95	-0.039	-0.087	-0.05	-0.037	95
2017	0.092	-0.023	-0.105	0.082	89.5	0.065	-0.047	-0.105	0.058	89.5	0.044	-0.065	-0.105	0.04	89.5
2018	0.048	-0.013	-0.059	0.046	94.1	0.043	-0.019	-0.059	0.04	94.1	0.038	-0.023	-0.059	0.036	94.1
2019	-0.016	-0.016	0	-0.016	100	-0.025	-0.025	0	-0.025	100	-0.03	-0.03	0	-0.03	100
2020	-0.022	-0.022	0	-0.022	100	-0.021	-0.021	0	-0.021	100	-0.016	-0.016	0	-0.016	100

	HK(2)					HK(2.5)				
	Relative changes			Explained		Relative changes			Explained	
Year	HKI	φ(GE)	N	Total	%	HKI	φ(GE)	N	Total	%
	1	2	3	4=2-3	5=4/1	1	2	3	4=2-3	5=4/1
2011	0.02	0.066	0.045	0.021	104.5	0.021	0.068	0.045	0.022	104.5
2012	0.029	0.073	0.043	0.03	104.3	0.042	0.088	0.043	0.044	104.3
2013	-0.063	-0.063	0	-0.063	100	-0.064	-0.064	0	-0.064	100
2014	0	-0.125	-0.125	0	87.5	-0.012	-0.135	-0.125	-0.01	87.5
2015	0.042	-0.008	-0.048	0.04	95.2	0.049	-0.001	-0.048	0.047	95.2
2016	-0.04	-0.088	-0.05	-0.038	95	-0.04	-0.088	-0.05	-0.038	95
2017	0.032	-0.077	-0.105	0.028	89.5	0.025	-0.083	-0.105	0.022	89.5
2018	0.035	-0.026	-0.059	0.033	94.1	0.033	-0.027	-0.059	0.031	94.1
2019	-0.033	-0.033	0	-0.033	100	-0.034	-0.034	0	-0.034	100
2020	-0.012	-0.012	0	-0.012	100	-0.009	-0.009	0	-0.009	100

* Without Kosovo and Metohija.

Source: calculated on the basis of data of the National Bank of Serbia in the publications of Total premium and premium allocation of insurance companies, for respective years

V. CONCLUSION

Modern economic theory considers competition an indispensable factor in increasing business efficiency, both in the real sector of the economy and in infrastructure, in particular in the financial sector, and within it, in the insurance sector. The financial sector is more and more treated as such in the papers of local researchers, where the concentration and competition are analysed by both standard and more recent methods. A number of such researches, as well as the applied methodological procedures the banking sector, by now exceeds the one of the insurance sector. This situation, nevertheless, is gradually changing.

In this paper, we analysed the degree and changes in concentration and decompensated the degree of concentration in the insurance sector in Serbia in the last decade. In addition to the results obtained in the previous research[36] by applying the standard coefficients, i.e. methods (primarily the concentration coefficient and the Hirschman-Herfindahl index, but also some other approaches), we used the results obtained by calculating the Hannah-Kay index and the generalized entropy index. On the one hand, these results indicated a (relatively) high level of concentration and suggested that there was an oligopolistic market structure, with a "tight" oligopoly structure. During the period observed, significant changes occurred in the degree of concentration (and competition), but there is a certain fluctuation of the calculated indicators.

In the second part of the paper, the Hannah-Kay index was decomposed. It should be underlined that during the past decade, a number of insurance companies decreased significantly (from 23 in 2011, and/or 24 in 2012 and 2013, to 16 in the last three years), which by definition could not be considered a positive indicator when it comes to competition. However, by decomposing the value of the Hannah-Kay index, according to the well-known derived formula of this indicator on the components of inequality and the number of companies, the changes in the number of companies revealed not to have any signifi cant impact on the degree of concentration, but its value was mostly affected by the distribution of market shares of active companies. Therefore, we emphasize that the relatively significant reduction in the number of insurance companies did not result in a (significant) increased degree of concentration in this sector.

Finally, given the relatively small number of studies of concentration and competition in the insurance sector in local environment, it is necessary to recommend further research and recommend, of course, the application of other approaches as well.

LITERATURE

Авдашева, Светлана Борисовна и Надежда Михайловна Розанова. *Теория организации отраслевых рынков*, Москва: Издательство Магистр, 1998.

Begović, Boris, Rajko Bukvić, Boško Mijatović, Marko Paunović, Robert Sepi and Dragor Hiber. *Antimonopolska politika u SR Jugoslaviji*, Belgrade: Center for Liberal-Democratic Studies, 2002.

Bukvić, Rajko M. Dekompozicija promena u koncentraciji u sektoru osiguranja u Srbiji 2011–2020: uticaj promena u strukturi tržišta i broju društava za osiguranje, *Ekonomski vidici*, 2022, 27(1–2), 35–52.

Bukvić, Rajko M. Novi pristupi ocenjivanju stepena koncentracije i konkurencije: primer sektora osiguranja u Srbiji, *XLVIII International Symposium on Operational Research*, SYM-OP-IS 2021 Banja Koviljača, 20–23 septembar 2021, Zbornik radova, ur. Dragan Urošević, Milan Dražić, Zorica Stanimirović, Beograd: Univerzitet u Beogradu, Matematički fakultet, 2021, pp. 93–98.

Воробьёв, Павел Фёдорович и Сергей Геннадьевич Светуньков. Новый подход к оценке уровня конкуренции, *Современная конкуренция*, 2016, 10(6), 5–19.

Смарагдов, Игорь Андреевич и Екатерина Игоревна Нестерова. Структура российского страхового рынка и конкуренция на нём, *Концепт*, 2015, 4, 1–7.

---

[36] R. M. Bukvić, Novi pristupi ocenjivanju stepena koncentracije i konkurencije: primer sektora osiguranja u Srbiji, *XLVIII International Symposium on Operational Research*, SYM-OP-IS 2021 Beograd: Univerzitet u Beogradu, Matematički fakultet, 2021, pp. 93–98.

Смарагдов, Игорь Андреевич и Вера Николаевна Сидорейко. Индексы рыночной концентрации: неоднозначная информативность, *Концепт*, 2015, 9, 1–8.

Федеральная антимонопольная служба. Об утверждении Порядка проведения анализа состояния конкуренции на товарном рынке (с изменениями на 20 июля 2016 года) от 28 апреля 2010 года N 220, http://docs.cntd.ru/document/902215421

Adelman, Morris Albert. The Measurement of Industrial Concentration, *The Review of Economics and Statistics*, 1951, 33(4), 269–296.

Bajo, Oscar & Rafael Salas. Inequality foundations of concentration measures: An application to the Hannah-Kay indices, *Spanish Economic Review*, 2002, 4(4), 311–316.

Bajo-Rubio, Oscar & Rafael Salas. Decomposing Change in Industry Concentration, *The Empirical Economics Letters*, 2004, 3(6), 311–319.

Bukvić, Rajko. Istraživanja tržišnih struktura u privredi druge Jugoslavije, *Ekonomika*, 1999, 35(1–2), 4–16.

Cowell, Frank A. *Measuring Inequality: techniques for the social sciences*, New York: Wiley, 1977.

Dimić, Maja. *Analiza nivoa koncentracije u bankarskom sektoru i u sektoru osiguranja u zemljama centralne i istočne Evrope*, doktorska disertacija, Beograd: Univerzitet Singidunum, 2015.

Encaoua, David and Alexis Jacquemin. Degree of Monopoly, Indices of Concentration and Threat of Entry, *International Economic Review*, 1980, 21(1), 87–105.

Hannah, Leslie & John A. Kay. *Concentration in Modern Industry. Theory, measurement and the U. K. experience*, London – Basingstoke: The Macmillan Press Ltd., 1977.

Horizontal Merger Guidelines, U.S. Department of Justice and the Federal Trade Commission, Issued: April 2, 1992, Revised: April 8, 1997. www.justice.gov/atr/public/guidelines/hmg.pdf

Horizontal Merger Guidelines, U.S. Department of Justice and the Federal Trade Commission, Issued: August 19, 2010. www.justice.gov/atr/public/guidelines/hmg-2010.pdf

Kostić, Milan. Analiza koncentracije ponude u sektoru osiguranja Srbije, *Industrija*, 2009, 37(2), 59–77.

Kostić, Milan; Ljiljana Maksimović, Boban Stojanović. The limitations of competition in the insurance markets of Slovenia, Croatia and Serbia, *Economic Research - Ekonomska Istraživanja*, 2016, 29(1), 395–418.

Linda, Rémo. Methodology of concentration analysis applied to the study of industries and markets, Commission of the European Communities, Brussels, 1976.

Lončar, Dragan; Aleksandra Đorđević, Milena Lazić, Siniša Milošević, Vesna Rajić. Interplay Between Market Concentration and Competitive Dynamics in the Banking Sector: Evidence from Serbia, Croatia, Romania and the Czech Republic, *Ekonomika preduzeća*, 2016, 64(5–6), 332–346.

Maksimović, Ljiljana and Milan Kostić. Limitations in the Application of Concentration Indicators, *Ekonomika preduzeća*, 2012, 60(3–4), 199–205.

Njegomir, Vladimir; Dragan Stojić, Dragan Marković. Liberalisation, Market Concentration and Performance in the Non-Life Insurance Industry of Ex-Yugoslavia, *Ekonomska misao i praksa*, 2011, 20(1), 21–39.