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ADDITIVE MEASUREMENT OF MARKET CONCENTRATION

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Abstract. The main effect of globalization of the world markets is the increase of market concentration. The analysis and control of these processes largely depend on precise determination of the level of market concentration. Additive measures, evaluating the whole concentration curve, assess market concentration most effectively.

The analysis shows that all currently used measures, including the most widely used Herfindahl index, have some limitations and, therefore, cannot adequately describe the market state. This index is still widely used because it is easy to calculate. However, now, when calculation is computer-aided, this argument has hardly any sense. A possibility to assess the state of the market much more accurately, searching for new, more precise measures, has sense now.

The accuracy of some particular measures may be defined by the total difference between the relative value of market criterion bearers in the market and their value calculated by the formula of a particular concentration measure.

Keywords: market concentration, additive concentration measures.

1. Introduction

Today, the success of an enterprise depends on its ability to sell the products under the conditions of fierce competition rather than on its ability to manufacture goods. Therefore, the focus has shifted from production to marketing and market relations. Enterprises should notice in time new prospects of development and threats – to take use of the former and to avoid the latter. In this environment, the best way to success is to adapt to constantly changing market conditions. An enterprise can survive if the complexity and dynamics of the decisions made are adequate to the complexity and dynamics of the environment (Ansoft 1965; Ginevičius 1998, 2009).

One of the main principles, on which enterprise adaptation to constantly changing market conditions depends, is the increase of the scope of production or production concentration. It is influenced by both external and internal factors because reinforcement and extension of the market share largely depends on the increase of productivity. On the other hand, the long-term experience shows that the introduction of up-to-date machinery and advanced technologies and their effective use, in particular, is possible only by concentrating the production. Thus, fierce competition in the market gives rise to the need for production concentration. In turn, the growth of the scope of production causes the increase of productivity as well as competitiveness of an enterprise.

2. Additive measures of market concentration

Though the globalization process taking place in the world contributes to the concentration of production and markets, the problems of concentration measurement do not receive the attention they deserve. This is confirmed by the fact that rather outdated measures are used now for measuring concentration (Herfindahl 1950; Horwath 1970; Spuretling 1970; Häni 1987; Rosenbluth 1955, 1961; Hall, Tideman 1967).

Their drawbacks have been demonstrated more than once, however, new more accurate measures have not been offered (Häni 1987; Ginevičius 2005; Ginevičius, Čirba 2007). Searching for a better measure of concentration, it could be helpful to revise the commonly used ones, demonstrating why they cannot be fully acceptable.

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Actually, in all cases, concentration measurement is based on the concept of concentration curve. This curve can be obtained if we plot on the abscissa of the system of coordinates the market players (criterion bearers) in the descending order of their values and the respective additive values (the sums of criterion bearers) – on the ordinate (Piesch 1975).

The additive concentration measures cover all the criterion bearers' values of the ordinate of the concentration curve. The variants of these measures are obtained by applying various schemes of determining the significance of criterion bearers.

Due to its simplicity, Herfindahl index is most commonly used now for market concentration measurement. It is obtained by raising to the square and summing up relative values of criterion bearers (Herfindahl 1950):

$$HER = \sum_{i=1}^{n} P_i^2, \tag{1}$$

where *HER* is Herfindahl concentration index; P_i is a relative value of *i*-th criterion bearer in fractures of unity; *n* is the number of criterion bearers.

Considering the problem of Herfindahl index applicability, basic principles of determining the significance of criterion bearers should be analysed. It follows from the formula (1) that the criterion bearers which obtained a larger part of their sum are assigned a larger weight, while those, which obtained a smaller part of this sum, get a smaller weight. This is a natural result of weighting the criterion bearers with respect to each other, i.e. raising their values to the square. Then, for example, the relation between the values of two criterion bearers 2:1 is turned by the Herfindahl index to the relation 4:1, the relation 4:1 is turned to 16:1, etc. It follows that, actually, the value of *HER* is determined by the criterion bearers with large values, while the criterion bearers with small values, even in large number, have insignificant effect on the result. Thus, a measure distorts actual market concentration. Moreover, its insensitivity to the criterion bearers with small values makes it hardly suitable for investigations primarily aimed at determining the effect of small or new criterion bearers on the market structure. On the other hand, if the emphasis is placed on large market players in the competitive environment, the results yielded by Herfindahl index are rather accurate.

The next additive measure of concentration is the Horwath index (Horwath 1970):

$$HOR = P_1 + \sum_{i=2}^{n} P_i^2 \ (2 - P_i), \tag{2}$$

where *HOR* is Horwath index; P_1 is the market share of the largest criterion bearer.

The Horwath index assigns larger weights to all market players compared to Herfindahl index. The main emphasis is placed on the largest criterion bearer, whose absolute value is presented in the measure. Unlike *HER,* the Horwath index, due to some peculiarities of the criterion bearer's weight determination, does not accumulate the value in the lower variation interval, ranging from 0 to 1. In this way, the threat of improper evaluation of actual market concentration is also avoided. On the contrary, a trend of accumulating the points in the middle or upper part of the interval can be observed (Häni 1987). The situation is balanced by assigning a larger weight to smaller criterion bearers, compensating the domination of large criterion bearers.

The structure of the Horwath index is not ideal. First, its division into discrete and additive parts is not well grounded. It is also not clear why only one, the largest criterion bearer, but not two or three of them, is taken into consideration in the discrete part of formula (2). The determination of the criterion bearer's significance in the additive part of the formula (2) is not clear either. Its values range from 1,5 to 2 for larger criterion bearers, while the value of smaller criterion bearers is equal to 2.

Another additive concentration measure is entropy (Spuretling 1970):

$$ENT = -\sum_{i=1}^{n} P_i \ln P_i, \tag{3}$$

where *ENT* is the measure of entropy.

A measure of entropy also provides for a different approach to determining weights of criterion bearers, compared to that used in Herfindahl index, which is based on the entropy's logarithm rather than their value. As a result, the significance of larger criterion bearers is decreased, while that of the smaller ones is respectively increased.

The value of entropy's measure, *ENT*, shows the information which may be generally expected when one of all events happens. The question arises, why this concept of the information theory may be used as a concentration measure. The relationship between the competition level and entropy is evident in the case of pure monopoly because, in the absence of competition, a monopolist should not worry that a customer would not choose his product. When the number of suppliers increases, implying that the competition is getting more fierce, the uncertainty of the supplier, who cannot be sure that a customer will choose his particular product (service), is increasing. Moreover, the above uncertainty also depends on the relative size of a supplying enterprise. Thus, entropy may be treated as a measure of competition, depending on market structure and performance, and strongly affected by a concentration measure (Horowitz, A. R., Horowitz, J. 1968).

The analysis of entropy's measure shows that its theoretical basis differs considerably from measures based on the concentration curve. This makes its interpretation and comparison with them more complicated.

One more additive concentration measure is the index suggested by Häni (Häni 1987):

$$EXP = \prod_{i=1}^{n} P_i^{P_i}, \tag{4}$$

where *EXP* is the index offered by Häni.

A comparison of Herfindahl and Häni's indices shows that the latter only differently evaluates the significance of large and small criterion bearers. In particular, Herfindahl index is more sensitive to large criterion bearers, while Häni's index – to small ones. This affects the capacities of calculating the indices. To calculate the latter index, a distribution of the value of all criterion bearers of the market should be known. To obtain an approximate but relatively precise value of Herfindahl index, a 'reduced' distribution of the concentration curve is sufficient. The empirical study of Häni's index shows that the concentration of points can be observed at the lower part of the interval of the expected values (0:I), similar to the case of *HER* index. The calculated values are usually smaller than the respective values of Herfindahl index. Thus, the probability that intuitively real level of concentration will be underestimated increases.

Another additive concentration measure is Rosenbluth index (Hall, Tideman 1967; Rosenbluth 1955, 1961):

$$ROS = \frac{1}{2\sum_{i=1}^{n} iP_i - 1}, \tag{5}$$

where *ROS* is Rosenbluth concentration index.

Rosenbluth index provides for the following principle of ranking the criterion bearers: the larger the total number of criterion bearers, the larger weight is assigned to small criterion bearers. Therefore, this index is more sensitive to their number rather than value. It can be shown that when the leading criterion bearer has more than 50 % of their sum total, while the number of the criterion bearers is growing, the value of *ROS* index is rapidly approaching zero. Thus, despite the evident monopolistic nature of the market, a distorted picture of actual market concentration is shown.

A comparison of the reflection of actual markets by Rosenbluth's and Herfindahl indices reveals the differences caused by different approaches to weight determination. The empirical studies performed also show that the differences in values of indices, considered both from the perspective of their absolute values and the correlation of ranks, are significant (Hall, Tideman 1967). Both of the indices, like Häni's index, tend to accumulate the criterion bearer's points at the lower part of the interval (0:1). Therefore, all of them are fraught with the threat that, intuitively, the concentration will be evaluated too low. Greater differences between *HER* and *ROS* indices may be also expected, when large criterion bearers will dominate in the market structure and their total number will be large at the same time (Häni 1987).

The so-called *GIN* index (Ginevičius 2005) was also offered as a concentration measure:

$$GIN = \sum_{i=1}^{n} \frac{P_i}{1 + n\,(1 - P_i)}. \tag{6}$$

This index is intended to assess two basic market indicators, the value and the number of the criterion bearers, properly, i.e. in a balanced way. The author of the concentration index thinks that all indices offered, except Rosenbluth index, have one common drawback – they do not emphasize (or emphasize insufficiently) an essential market attribute, the number of criterion bearers. However, this particular value reflects the interrelations between market players and customers characteristic of market economy, implying that the larger the number of suppliers, the stronger the competition and the higher the uncertainty because a supplier cannot be sure in this environment that a customer would choose his product (service) rather than the product of his competitor. It is clear that this uncertainty depends on the relative value of the supplying firm, therefore, in the formula, every criterion bearer is reduced by a coefficient reflecting its weight, depending on the number of market players as well.

On the other hand, the considered index has other drawbacks. For example, given a highly concentrated market, consisting of only two criterion bearers, with the first one possessing 90 % of all market shares, the value of *GIN* index is equal to 0.786. It is evident that this value is not adequate to the real state, i.e. it is too small.

Therefore, more accurate but computationally complicated measure of concentration (Ginevičius, Čirba

2007) was offered:

$$GIS = \left(1 + \sum_{i=1}^{n-1} \frac{P_{i+1}}{P_1} \cdot \frac{n+2-2(n-1)(P_{i+1}-P_i)}{n+2-n(P_{i+1}-P_i)}\right) P_1^2. \quad (7)$$

In reviewing concentration indices, the drawbacks observed by other authors (Häni 1987) were also considered. In addition to the considered disadvantages, more comprehensive analysis of concentration indices revealed some other more significant drawbacks associated with the problems of their application (Ginevičius, Čirba 2007).

One of concentration measure characteristics is that, when the value of any criterion bearer P_i is growing, their value should also increase. However, Horwath's index *HOR* and a measure of entropy *ENT* do not satisfy this condition. For example, we have two P_1 and P_2 ($P_1 = p$; $P_2 = 1 - p$). In this case:

$$HOR = p^3 - p^2 + 1, \quad (8)$$

$$ENT = -p \ln p - (1-p) \ln(1-p). \quad (9)$$

The graphs drawn according to formulas (8) and (9) are presented in Fig. 1.

As shown in Fig. 1, min $HOR = HOR\left(\frac{2}{3}\right) = \frac{23}{27} = 0.852$.

Other concentration measures, when we have two equivalent bearers ($P_1 = P_2 = 0.5$), obtain the value of 0.5, and, when one of the bearers is growing, their value is increasing, i.e., when $P_1 = 0.5$, then, *HER*(0.5) = *ROS*(0.5) = *EXP*(0.5) = *GIN*(0.5) = 0.5.

In Fig. 1 we can see that the maximum value of the entropy's measure is equal to 0.69, and when the bearer P_1 is growing, the value of the measure is decreasing. The analysis of concentration measures has shown

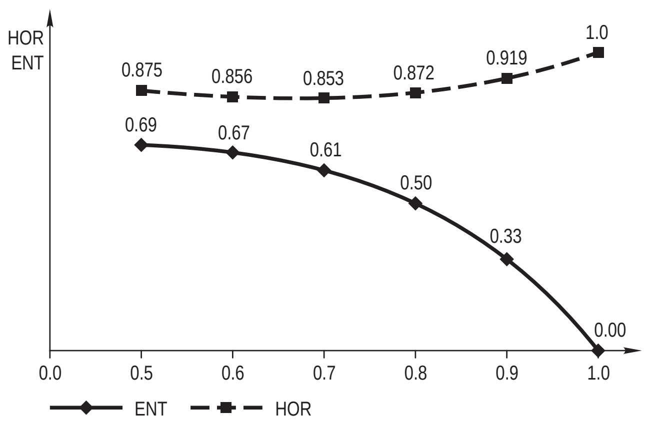

Fig. 1. Graphical representation of Horwath and concentration indices and entropy's measure, when $P_i = 2$

their another characteristic: if the criterion bearers are of the same magnitude, the relative weight of each bearer in the value of the measure is the same, being equal to the criterion bearer's value. To check if *ROS* index satisfies this condition, it is expressed as follows:

$$\sum_{i=1}^{n} iP_i = \frac{1+ROS}{2\,ROS}. \quad (10)$$

By using formula (10), we can approximately estimate a relative input of each criterion bearer into the value of *ROS* index. Suppose that we have four equivalent criterion bearers, i.e. $P_1 = P_2 = P_3 = P_4 = 0.25$. By using formula (10), let us determine a relative input of each bearer into the value of concentration index *ROS* (Table 1).

Table 1. Relative input of criterion bearers into the value of concentration index ROS, when $P_i = 0.25$

ROS	Values of bearers			
	0.25	0.25	0.25	0.25
0,25	Relative input of bearers into index value			
	0.1	0.2	0.3	0.4

Thus, the concentration index *ROS*, unlike other indices, does not satisfy the above condition.

3. Assessing the accuracy of market concentration measures

The review of market concentration measures made according to the scheme adopted in the literature on the problem, when all measures are compared to the most commonly used Herfindahl index, revealed their and *HER* index drawbacks. The main of these drawbacks is that all of the indices provide a distorted (usually, better or worse) view of the actual market. To consider the problem of the accuracy of a particular concentration measure, the concepts of actual and calculated market concentration should be defined. The actual market concentration level is reflected by the relationship between the absolute or relative values of criterion bearers. For example, if we take a hypothetical market of four criterion bearers with absolute values of 40 %, 30 %, 20 % and 10 % and the respective relative values of 0.4; 0.3; 0.2 and 0.1, the real state of this market will be shown by the relation 4 : 3 : 2 : 1. The calculated market concentration will be obtained if we take the relation of the criterion bearer's value transformed according to the respective formula of concentration measure (Table 2).

Table 2. The structure of market concentration depending on the formula used in calculation

Concentration measure	Relationships between the values of criterion bearers			
	criterion bearers			
	first	second	third	fourth
Herfindahl index	16.0	9.0	4.0	1.0
Horwath index	21.1	8.1	3.8	1.0
Entropy index	1.6	1.6	1.4	1.0
Rosenbluth index	1.0	1.5	1.5	1.0
GIN index	5.4	3.6	2.2	1.0
GIS index	3.9	2.8	1.9	1.0
GRS	4.0	3.0	2.0	1.0

As shown in Table 2, each of the considered indices provides a different view of market concentration, deviating from the real state to a various extent. Therefore, the accuracy of a particular concentration measure should be assessed.

Let us assume that the smaller the total difference between the criterion bearer's relative value in the market and their relative value calculated based on the considered market concentration measure, the more accurate is the market concentration measure, reflecting the real state of market concentration (Ginevičius 2005):

$$R_j = \sum_{i=1}^{n} | P_{ij} - P_{ij}^* |, \qquad (11)$$

where R_j is the criterion of accuracy of *j*-th concentration measure; P_i^* is a relative value of *i*-th criterion bearer according to the formula of *j*-th concentration measure.

A concentration measure will be most accurate, when it ideally reflects the situation in the market, i.e. when $R_j = 0$.

Based on the data presented in Table 2 and using the formulas (1–6), we will find the values of the criterion R_j (Table 3).

As shown in Table 3, none of concentration measures is absolutely precise because the total difference between the relative value of the criterion bearers of the market considered and their value according to the formula of concentration measure is more than zero in all of them. This stimulates the search for a more accurate concentration measure.

4. Offering a measure of market concentration

Let us take Herfindahl index as a basis for the measure sought. It has been mentioned that its main drawback is that the assignment of the weights w_i to criterion bearers is not grounded in theoretical reasoning. Let us assume that w_i should satisfy the following conditions:

1. The value of the measure *GRS* sought ranges from 0 to 1, i.e. $0 \leq GRS \leq 1$;
2. If all criterion bearers are equal, i.e. when $P_i = \frac{1}{n}$, $i = 1, 2, 3, \ldots, n$, then, $GRS = \frac{1}{n}$;
3. The value of *R* should be smaller than its value calculated using other well-known concentration coefficients.

In searching for a market concentration measure, we will rely on the concept often used in calculating complicated functions, i.e. functions developed as a series in powers. They are known as the first two or three members in the Taylor's series, which are actually first- or second-power polynomials (Fichtengolcas 1967). For this purpose, the expression $GRS = an^2 + bn + c$ is not suitable because, in this case, the conditions 1–3 will not be met. It follows that the relations between

Table 3. Comparison of the accuracy of concentration measures

Concentration index	Concentration index value	Relative value of criterion bearers in the formula of concentration measure				R
		P_1^*	P_2^*	P_3^*	P_4^*	
HER	0.300	0.533	0.300	0.133	0.033	0.268
HOR	0.644	0.621	0.238	0.112	0.030	0.442
ENT	1.280	0.286	0.282	0.251	0.180	0.263
ROS	0.333	0.200	0.300	0.300	0.200	0.400
GIN	0.266	0.442	0.297	0.180	0.083	0.082
GIS	0.397	0.403	0.291	0.202	0.104	0.018
GRS	0.398	0.399	0.299	0.201	0.101	0.000

two second-power polynomials (square trinomials) are well suited for calculating a concentration index:

$$GRS = \sum_{i=1}^{n} \frac{a_1 n^2 + b_1 n + c_1}{a_2 n^2 + b_2 n + c_2} \cdot P_i, \quad (12)$$

where $a_1, a_2, b_1, b_2, c_1, c_2$ are constant values or values depending on P_i $(1 \leq i \leq n)$.

The development of the function as the Taylor's series allows the constant values to be expressed as first- or second-power members, i.e. P_i^2, $P_i P_j$, P_i, P_j. The value of the index j is fixed. Otherwise, formula (1) would be too complicated because each member of the sum, including the value of a concentration index, would depend on j. In this case, the summation should be made over the index j, and a double sum would be obtained. The right-hand side of the formula (12) would become too complicated. Meanwhile, our aim is to obtain a relatively simple expression of market concentration, which, satisfying the third condition, would be more accurate than the existing measures. Let us equate the value of index j to unity because P_1, i.e. the values of the largest criterion bearer, is always larger than P_i, the values of other criterion bearers. It is clear that the value of the coefficient sought should be more 'sensitive' to the market share of the first market player.

For further investigation it is necessary to determine what power should be assigned to the coefficients of formula (12). If it is not smaller than two, each coefficient will also get a complicated expression. Therefore, formula (12) will also become more complicated. Suppose, the constant a_1 is expressed as:

$$a_1 = a_{11} P_i + a_{12} P_i P_1 + a_{13} P_i^2 + a_{14} P_1^2 + a_{15} P_1 + a_{16}. \quad (13)$$

We have six new constants in this formula. In the formula (12), we also have six constants, therefore, in general, there are 36 new constants. As a result, the concentration formula has become unsuitable for calculations. In addition, trying to satisfy the second condition and using a method of undetermined coefficients, we get a system of six linear equations with 36 unknowns. Despite the fact that this system has many unknown coefficients equal to zero or unity, it has a plenty of solutions, which makes the choice of constants a very complicated task.

The first condition states that coefficient a_1 should be smaller than a_2. Otherwise, when the number of criterion bearers in the market is sufficiently large, particularly when one of them is dominant, the value of the numerator of the first member of the sum in formula (12) will be larger than the denominator's value, and the concentration coefficient will not satisfy the first condition, i.e. it will be larger than unity. The calculations show that, in this case, it is sufficient to multiply a_1 by P_1 because $P_1 < 1$.

Thus, limiting the weight of criterion bearers P_i by the first and the second powers and assuming the condition that, in formula (12), the expression of the numerator and denominator with respect to P_i will be a square trinomial, we will obtain the following version of the coefficient *GRS*:

$$GRS = \sum_{i=1}^{n} \frac{a_1 n^2 P_1 + b_1 P_i^2 + c_1 n P_1 P_i}{a_2 n^2 + b_2 n P_1 P_i + c_2 P_i^2} P_i. \quad (14)$$

The values of the coefficients a_i, b_i, c_i $(i = 1, 2)$ will be obtained based on the second condition. By substituting $P_i = \frac{1}{n}$, $i = 1, 2, \ldots, n$, into formula (14), we will get:

$$GRS = \sum_{i=1}^{n} \frac{a_1 n^2 \frac{1}{n} + b_1 \frac{1}{n^2} + c_1 n \frac{1}{n^2}}{a_2 n^2 + b_2 n \frac{1}{n^2} + c_2 \frac{1}{n^2}} \frac{1}{n} = \frac{1}{n}, \quad (15)$$

or

$$\sum_{i=1}^{n} \frac{a_1 n^3 + b_1 + c_1 n}{a_2 n^4 + b_2 n + c_2} = 1. \quad (16)$$

It follows that

$$\frac{a_1 n^3 + b_1 + c_1 n}{a_2 n^4 + b_2 n + c_2} = \frac{1}{n},$$

and

$$a_1 n^4 + b_1 n + c_1 n^2 = a_2 n^4 + b_2 n + c_2. \quad (17)$$

By equating the coefficients to the same n degrees, we will get:

$$a_1 = a_2; b_1 = b_2; c_1 = 0; c_2 = 0. \quad (18)$$

By substituting the obtained relationships (18) into formula (14), we obtain:

$$GRS = \sum_{i=1}^{n} \frac{a_1 n^2 P_1 + b_1 P_i^2}{a_1 n^2 + b_1 n P_1 P_i} P_i. \quad (19)$$

By factoring out a_1 from formula (19) and introducing $a = \frac{b_1}{a_1}$ we will get:

$$K = \sum_{i=1}^{n} \frac{n^2 P_1 + a P_i^2}{n^2 + a n P_1 P_i} P_i. \quad (20)$$

The concentration coefficient calculated by formula (20) will satisfy the second condition for any a values, however, the first condition will not be met for all *a* values. If P_1 is about unity, a member of the sum in formula (20) may be larger than unity. The same also applies to the value of GRS. For example, in the case, when $a = -1$, $P_1 = 0.95$ and $P_2 = 0.05$, we get:

$$GRS = 1.254 + 0.049 = 1.303 > 1.$$

In the opposite case, when $a = 5$, $P_1 = 0.95$ and $P_2 = 0.05$, we will obtain:

$$GRS = 0.606 + 0.043 = 0.649,$$

i.e. the value of concentration coefficient is too small. Both examples show that the parameter *a* should satisfy the condition $-1 < a < 5$.

It follows from the analysis of the above two cases reflecting the market structure that it is sufficient to develop a system of inequalities to be satisfied by the parameter *a* for a case, when there are two criterion bearers in the market, with the significances of one being about the unity.

Thus, we will make a system of inequalities for the case, when $P_1 = 0.95$, and $P_2 = 0.05$. It should be noted that this case is similar to that when confidence intervals are determined in statistical calculations, with the confidence level $\alpha = 0.95$ (Čekanavičius, Murauskas 2000)

In making the first inequality, let us rely on a relatively simple and accurate *GIN* value for the considered case ($GIN = 0.88 \approx 0.9$) (Ginevičius 2005). In developing the second inequality, we will base ourselves on the fact that the index value, calculated using a number of the available concentration measures, is smaller than P_1 (except for *ENT* index, whose value for the case, when the values of criterion bearers are 0.4; 0.3; 0.2 and 0.1, respectively, is equal to 1.2821, and $HOR = 0.644$, which is the least accurate in reflecting the market state).

Thus, we get the following system of inequalities:

$$\begin{cases} \dfrac{4 \cdot 0.95 + a \cdot 0.95^2}{4 + 2a \cdot 0.95^2} \cdot 0,95 + \dfrac{4 \cdot 0.95 + a_1 \cdot 0.05^2}{4 + 2a \cdot 0.95 \cdot 0.05} \cdot 0.05 \geq 0.90, \\ \dfrac{4 \cdot 0.95 + a \cdot 0.95^2}{4 + 2a \cdot 0.95^2} \cdot 0,95 + \dfrac{4 \cdot 0.95 + a \cdot 0.05^2}{4 + 2a \cdot 0.95 \cdot 0.05} \cdot 0.05 < 0.95. \end{cases}$$

By solving this system of inequalities, we obtain that the parameter *a* should meet the condition $0 < a < 0.3$.

It follows from the above case, when $a = 5$; $P_1 = 0.95$; $P_2 = 0.05$, that 0.3 should be taken as the value of the parameter *a*. By substituting it into the formula (20), we will get:

$$GRS = \sum_{i=1}^{n} \frac{n^2 P_1 + 0,3 P_i^2}{n^2 + 0,3 n P_1 P_i} P_i. \qquad (21)$$

Now, we should check if the suggested concentration coefficient reflects the situation on the market more accurately than other commonly used measures. For this purpose, we will use formula (11). For example, let us analyse the already considered hypothecary market, consisting of four criterion bearers. Their absolute values are 40 %, 30 %, 20 % and 10 %, while relative values are 0.4; 0.3; 0.2; 0.1, respectively. The calculation results of market concentration measures and the value of R_j are given in Table 3.

As shown in Table 3, the suggested measure of market concentration, *GRS*, is most accurate, yielding almost ideal results (only the fourth number after the point is significant). This allows the authors to offer this index for use both in the research into the problem of market concentration and in practical calculations.

5. Conclusions

Various methods are currently used for measuring market concentration. Herfindahl index is one of the most widely known additive measures. However, this and other units of measure are far from being ideal, giving the distorted view of the market. The smaller the total difference between the relative value of the criterion bearer in the market and relative value calculated by the formula of an additive measure, the more accurate is the additive measure. A new formula suggested in the paper yields, actually, zero deviation, therefore, it may be used both in theoretical research and practical calculations.

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