

**Preliminary communication**

**MEASURING MARKET CONCENTRATION IN MOBILE  
TELECOMMUNICATIONS MARKET IN SERBIA**

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**Abstract.** *Mobile telecommunications markets across the world are characterized by a modest number of suppliers and a large number of subscribers. Nevertheless, the degree of market concentration varies from country to country. The purpose of this paper is to establish a methodological framework for measuring and analysing market concentration in the mobile telecommunications market in Serbia. The degree of market concentration is calculated using the annual data for the period 2009-2014. The research is made by applying a set of statistical-mathematical methods for measuring market concentration, comparative analysis and descriptive statistics. The analysis finds that mobile telecommunications market in Serbia is highly concentrated and that the degree of concentration exceeds the average of European Union member states. The study is useful to Serbian authorities such as Commission for the Protection of Competition and Regulatory Agency for Electronic Communications and Postal Services, providing significant findings of structural features of the mobile telecommunications market in Serbia.*

**Key words:** *market concentration, mobile telecommunications market, Serbia*

INTRODUCTION

The telecommunications sector is one of the most vital industries and a significant factor of economic growth in many countries. The importance of this sector arises from its high technological intensity and the necessity of telecommunications infrastructure for the development of other sectors of the economy. This causal relation between the telecommunications industry and almost all other sectors of the economy emphasizes the

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need for a permanent monitoring of the current situation and the dynamics in the telecommunications sector. Such monitoring has become particularly important in the last twenty years, which are characterized by large and rapid changes in the field of information technologies.

The mobile telecommunications industry is one of the most important and the most dynamic fields of telecommunications sector. For the economy, mobile telecommunications are the necessity tool for the modernization and improvement of competitiveness. For the society, they represent a tool for better access to information and for improving the quality of life. From a broader perspective, mobile telecommunications industry through new methods of communication and social dialogue contributes to the development of democracy and the reduction of social and geographical discrimination. These are the reasons for continued growth of the demand for mobile services in last two decades.

In line with global trends, mobile telecommunications industry in Serbia is an important factor of growth, innovation and competitiveness of other industries. It is also the biggest revenue generator of the telecommunications sector in Serbia. Due to such important role in the development of other industries, prices and quality of mobile telecommunications services have a significant impact on the efficiency of economy and social welfare. As well as in other industries, prices and quality of services in the market are determined by the intensity of competition between market participants, i.e. mobile network operators (MNOs) in this case. One of the most commonly used indicators of the intensity of competition is market concentration, which is also used in this paper.

The purpose of this research is to provide an adequate methodological framework which can be applied in measuring and analysing market concentration in the mobile telecommunications market in Serbia. Using annual data for the period from 2009 to 2014, the paper estimates the degree of market concentration as an indicator of the intensity of competition between MNOs in Serbia. The research findings are useful to Serbian competition authority and regulatory agency for telecommunications, but also represent a good basis for analysis of the behaviour of market participants.

The first section provides a theoretical background and literature review. Previous empirical research on the competition in mobile telecommunication markets is shown in section two. Section three presents a research methodology and hypothesis. Research results are discussed in section four. The final section provides conclusions.

## 1. THEORETICAL BACKGROUND AND LITERATURE REVIEW – MEASURING MARKET CONCENTRATION

Numerous theoretical and empirical studies have shown that market concentration is an important indicator of market performance, which is mainly used at the beginning of market analysis. Precisely, measuring market concentration is recognized as an appropriate starting point for valuation of competition intensity in the market.

The causal relationship between market concentration and market performance (market power) is based on the traditional approach in industrial organization known as the structure-conduct-performance (SCP) paradigm. Due to the fact that behaviour is difficult or even impossible to observe directly, the focus of the SCP paradigm is on identifying structure variables that are observable and measurable and that are related with market power (Church,

Ware, 2000). One of the most commonly used variables for this purpose is market share, which is applied for measuring market concentration. “The importance of market share has been recognized in the classical and neoclassical literatures, and market share is deeply established in business practice as a compelling focus for company motives and strategies” (Shepherd, 1997, p. 72).

Measuring market concentration is based on the calculation of the indicators of market concentration, which use market share as a variable. The importance of indicators of market concentration arises from their ability to describe structural performances of the market (Bikker, Haaf, 2002). There is a set of those indicators that are used in market analysis (see Marfels, 1971; Ferguson, Ferguson, 1994; Lipczynski, Wilson, Goddard, 2009; Pisanie, 2013). For the purposes of this paper, the following indicators of market concentration are theoretically elaborated below and applied in the empirical research: the N-firm concentration ratio, the Herfindahl-Hirschman index, the Entropy index, the Relative entropy index, the Hall-Tideman index, the Rosenbluth index, the Hannah-Kay index, the Comprehensive concentration index, the Gini coefficient and the Lorenz curve.

#### *a) The N-firm concentration ratio*

The degree of concentration measured over this indicator shows the cumulative market share of  $n$  leading companies in the relevant market. In other words, the concentration ratio represents the sum of market shares  $n$  leading enterprises, that shows what part of the entire sales revenue in the market realize selected group of  $n$  economic entities. As such, it is very easy to calculate and understand. Mathematically expressed as follows (Bikker, Haaf, 2002, p. 6):

$$CR_n = S_1 + S_2 + S_3 + \dots + S_n = \sum_{i=1}^n S_i \quad (1)$$

where  $S_i$  represents market share of the company  $i$  within the observed group of  $n$  companies.

The lower value of the concentration ratio indicates that the market share of  $n$  leading enterprises is small, because a large number of small firms operate in the observed market. On the contrary, the higher value of concentration ratio indicates a higher proportion of observed group in total sales in the relevant market. The boundaries between the higher forms of concentration are not strictly defined, but depend on the market that is analyzed.

#### *b) The Herfindahl-Hirschman index*

One of the most accurate and, consequently, the most commonly used indicators in the analysis of market concentration is the Herfindahl-Hirschman index. This is a summary indicator, which is defined as the sum of the squares of the market share of all firms in the relevant market.

The Herfindahl-Hirschman index (HHI) can be mathematically expressed by the following expression (Davis, Garcés, 2010, p. 288):

$$HHI = \sum_{i=1}^n (S_i)^2 \quad (2)$$

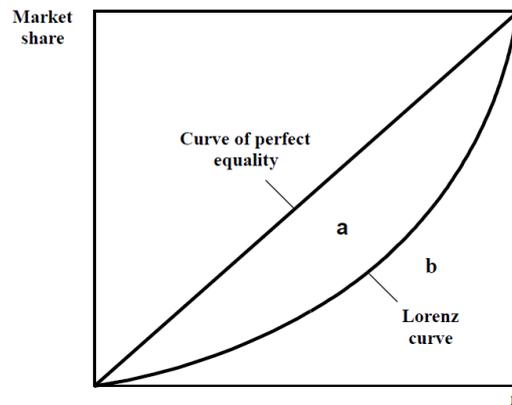
where  $S_i$  is the market share of companies within the observed group of  $n$  companies.

This indicator has at least two advantages over the previously described concentration ratio. First, it belongs to a group of summary indicators, and, therefore, provides more precise information than concentration ratio, because it takes into account the market share of all firms in the market. Second, due to the procedure of squaring market shares, companies with larger values of market share have special importance (higher weight).

Antimonopoly legislation of the European Union (EU) and United States (US) use HHI to classify the market in one of the following three categories (European Commission, 2004; U.S. Department of Justice, Federal Trade Commission, 2010): (1) Unconcentrated (EU: HHI below 0.10; US: HHI below 0.15); (2) Moderately concentrated (EU: HHI between 0.10 and 0.20; US: HHI between 0.15 and 0.25) and (3) Highly concentrated (EU: HHI above 0.20; US: HHI above 0.25).

### *c) The Lorenz curve and the Gini coefficient*

Lorenz curve is a tool for graphically displaying the degree of market concentration and detection of inequality in market share distribution. The essence is reflected in designing concentration curve (Lorenz curve) in the coordinate system with diagonal intersection (angle of  $45^\circ$ ), which starts from the coordinate start point and ends in the upper right corner (Figure 1). The abscissa shows the number of companies lined by market share value from the smallest to the largest, and the ordinate shows the total (cumulative) market share.



**Fig. 1** Lorenz curve for market with  $n$  participants  
Source: Lorenz, 1905

The diagonal intersection in the coordinate system represents perfect equality of market share distribution. On the other hand, the curve of perfect inequality, which corresponds to pure monopoly, would be identical in shape and size to the bottom horizontal (abscissa) and the right vertical line (a line that is parallel to the ordinate).

The Gini coefficient is a numerical indicator of market concentration, which is based on the Lorenz curve. Its value describes the position and the curvature of the Lorenz curve, by putting in ratio an area bounded by the curve of perfect equality and the Lorenz curve (area  $a$  in the Figure 1) with the entire area under the curve of perfect equality (area  $a+b$ ). Due to difficulties of measurement surface of irregular geometric shapes which can be formed by Lorenz curve,

another ratio for the Gini coefficient calculation was developed (Lipczynski et al., 2009, p. 205):

$$GC = \left\{ \frac{\sum_{N=1}^n \sum_{i=1}^N q_i}{0,5(n+1) \sum_{i=1}^n q_i} \right\} - 1 \quad (3)$$

where  $N$  represents the rank of companies lined from the largest to the smallest,  $n$  is the total number of observed companies, and  $q_i$  is total sale of company  $i$ .

#### ***d) The Entropy index and the Relative entropy index***

Unlike the HHI, which ignores companies whose market share is less than 1%, Entropy index gives relatively greater importance to small enterprises. It also belongs to a group of summary indicators. It is equal to the sum of the market share multiplied by the logarithm of their reciprocal values. It can be mathematically represented as follows (Lipczynski et al., 2009, p. 202):

$$EI = \sum_{i=1}^n S_i \log \frac{1}{S_i} \quad (4)$$

where  $S_i$  is the market share of the company  $i$  expressed in decimal numbers.

The value of entropy index is not limited as most of other concentration indicators  $[0,1]$ , but ranges from zero to  $\log n$ . A value of zero corresponds to the market with only one participant, and value of  $\log n$  represents the market with companies of comparable size.

Since the maximum value of the entropy index depends on the number of companies in the relevant market, this indicator does not allow the comparison of degrees of concentration in markets with different number of participants. With the aim to eliminate this disadvantage, the Relative entropy index (REI) is introduced. It represents the quotient of the measured entropy index and its upper limit value (logarithm of the number of companies in the relevant market), which can be expressed as the following form (Lipczynski et al., 2009, p. 203):

$$REI = \frac{EI}{\log n} \quad (5)$$

The value of REI ranges from 0 to 1. Value of 0 corresponds to pure monopoly, while the value of 1 represents a market in which companies have identical market shares. This indicator allows comparison of markets with different number of participants.

#### ***e) The Hall-Tideman index and the Rosenbluth index***

The Hall-Tideman index and the Rosenbluth index are almost identical indicators of market concentration, which emphasize the importance of the absolute number of companies in the relevant market. The main reason for this arises from the creators of the theory of these indicators that the entry of new competitors in a particular market is largely determined by the number of market participants. In other words, they assumed that market entry is relatively easy if it operates with a large number of small firms and it is relatively difficult if it operates with a

small number of large firms. The Hall-Tideman index is calculated using the formula (Bikker, Haaf, 2002, p. 10):

$$HTI = \frac{1}{(2 \sum_{i=1}^n i S_i - 1)} \quad (6)$$

where  $S_i$  is the market share of company  $i$ , and  $i$  represents the rank of that company, whereby the company with the largest market share has the rank  $i = 1$ , and company with the smallest market share has rank  $i = n$ .

The Rosenbluth index is calculated using the formula (Bikker, Haaf, 2002, p. 10):

$$HTI = \frac{1}{(2 \sum_{i=1}^n j S_i - 1)} \quad (7)$$

where  $S_i$  is the market share of company  $i$ , and  $j$  represents the rank of that company, whereby the company with the largest market share has the rank  $j = n$ , and company with the smallest market share has rank  $j = 1$ .

#### *f) The Hannah-Kay index*

The Hannah-Kay index is based on the HHI, so the characteristics of these two indicators are very similar. The Hannah-Kay index (HKI) is the sum of market shares of all companies in the market graded with exponent  $\alpha$ . It is calculated by the following formula (Lipczynski et al., 2009, p. 201):

$$HKI(\alpha) = \sum_{i=1}^n (S_i)^\alpha \quad (8)$$

where  $S_i$  is the market share of the company  $i$ , whereby  $\alpha > 0$ ,  $\alpha \neq 1$ .

The value of the exponent  $\alpha$  is arbitrarily determined and has great influence on the result. The low value of the exponent  $\alpha$  ( $\alpha < 2$ ) emphasizes the impact of small enterprises; and high values of this parameter ( $\alpha > 2$ ) emphasize the impact of large enterprises on the market concentration degree.

#### *g) The Comprehensive concentration index (the Horvath index)*

The Comprehensive concentration index, which is also called the Horvath index, originates from the need to explore the problem of market concentration versus market share dispersion (Horvath, 1970). In other words, Horvat has developed a new indicator on the criticism of the indices that have been used, and which are mainly based on measuring equality in the dispersion of market share. In order to eliminate these deficiencies, Horvat has developed a Comprehensive concentration index, which is calculated using the formula (Horvath, 1970, p. 446):

$$CCI = S_1 + \sum_{i=2}^n (S_i)^2 (2 - S_i) \quad (9)$$

where  $S_1$  is the market share of the largest company within the observed group of  $n$  companies.

The share of the largest company stands out from the sum of the squares of the market share of all other firms in the relevant market and multiplier which represents a proportionate share of these companies. The Horvath index value ranges from 0 to 1. In a market with a large number of approximately equal participants value of the index tends to 0, while the value of 1 corresponds to market of pure monopoly.

## 2. EMPIRICAL RESEARCH ON THE COMPETITION IN MOBILE TELECOMMUNICATIONS MARKETS

There are numerous empirical studies on the state of competition in the mobile telecommunications markets worldwide. From a large body of these studies, it is possible to identify a set of different variables through which the state of competition in the mobile telecommunications market could be evaluated. Dörrenbacher (2000) proposes turnover and operating income, Curwen and Whalley (2006) estimate internationalization according to the number of subscribers and countries in which the mobile operator is present, while Grzybowski (2008) compares the competitiveness of mobile industry across the EU through country-specific price elasticity and conjectural variations.

Early empirical studies on mobile telecommunications market have predominantly analyzed the state of competition in duopolistic market structures. Due to the fact that many countries such as the United States, the United Kingdom and Sweden had only two MNOs for a long time, researchers' attention onto duopolistic structures was expected. For instance, Parker and Röller (1997) analyze duopolistic competition in the US mobile telecommunications industry in the period 1984-1988 and show that the prices are significantly above competitive levels. Similar as Parker and Röller (1997), Busse (2000) finds that tacitly collude between two MNOs in the US market could increase prices in the range from 7% to 10%. Also, conclusions about stable, high prices in duopolistic market structure as a consequence of tacit collusion are reached by Stoetzer and Tewes (1996) in the German market and Valletti and Cave (1998) in the UK market.

Later studies pay close attention to the internationalization of the mobile telecommunications industry and the progress of market concentration. For example, Gerpott and Jakopin (2005) analyze internationalization data of 14 European MNOs in the period 1997-2003. They found that subscriber-based market share of these 14 operators amounted to 80.2% across 27 European countries in 2003. They also found that the average foreign revenue share increased from 11.4% in 1997 to 46.2% in 2003. Whalley and Curwen (2012) analyze incumbency and market share of MNOs in 49 European countries including Serbia. The analysis shows that in most European countries the incumbent remains to be the largest operator measured by subscribers-based market share. These authors also found that many European markets were highly concentrated in 2010, which was the main barrier to new entrants. Finally, Sung (2014) explores market concentration of mobile telecommunications market in 24 OECD member states in the period 1998-2011. The results of the study of the whole sample period indicate a positive relationship between market concentration, prices and profits: more concentrated market allows higher prices and profits. Such research results suggest market concentration as a useful indicator of market performance.

### 3. RESEARCH METHODOLOGY AND HYPOTHESIS

The purpose of this research is to measure and analyze the degree of market concentration of mobile telecommunications market in Serbia in the period 2009-2014. In accordance with the purpose of research, the authors tested the following hypotheses:

- H1: *Mobile telecommunications market in Serbia is characterized by a high degree of concentration.*
- H2: *The degree of market concentration has a downward trend in the observed period.*
- H3: *The degree of market concentration in Serbia is higher than the average degree of market concentration in EU member states.*

Measuring market concentration is based on data retrieved from the official periodical publication of Regulatory Agency for Electronic Communications and Postal Services of the Republic of Serbia published in 2015 (Pregled tržišta telekomunikacija i poštanskih usluga u Republici Srbiji u 2014. godini, Regulatorna agencija za elektronske komunikacije i poštanske usluge R. Srbije – RATEL, 2015) for Serbian market and on data retrieved from Mariniello and Salemi (2015) for EU member states.

In order to test the basic hypothesis, following research methods are used in the paper: a set of statistical-mathematical methods for measuring market concentration, comparative analysis and descriptive statistics.

### 4. RESEARCH RESULTS AND DISCUSSION

Mobile telecommunications services in the Republic of Serbia in the period 2009-2014 were provided by three MNOs: *Telekom Srbija a.d. – Mobilna telefonija Srbije MTS*, *Telenor d.o.o.* and *Vip mobile d.o.o.* All three operators are licensed for public mobile telecommunications services in accordance with GSM/GSM1800 and UMTS/IMT-2000 standards.

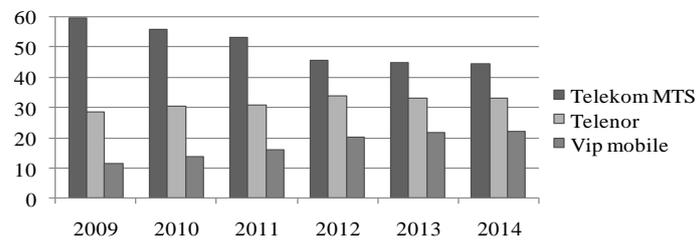
*Telekom Srbija a.d. – Mobilna telefonija Srbije MTS* is majority owned by the Republic of Serbia. The company started to provide mobile telecommunications services in August 1998, through a network based on the GSM standards. *Mobilna telefonija Srbije* had 4,062 base stations in Serbia at the end of 2014. Beside Serbian market, *Mobilna telefonija Srbije* is through subsidiary companies present as a MNO in the Republic of Srpska and Montenegro.

Norwegian company *Telenor d.o.o.* is a part of the *Telenor Group*, which operates in 13 countries in Europe (including Hungary, Montenegro and Bulgaria) and Asia, and in another 17 countries around the world through ownership stake in *VimpelCom*. *Telenor* has operated in the Serbian market since July 2006, after it bought *Mobi63* company. There were 3,398 *Telenor*'s base stations in Serbia in 2014.

Austrian *Vip mobile d.o.o.* is the owner of third license for mobile telecommunications network and services in Serbia since December 2006. *Vip mobile* is a member of *Telekom Austria Group*, which is present in eight countries in Europe, including Croatia, Bulgaria and Macedonia. *Vip mobile* had 2,966 base stations in Serbia at the end of 2014.

According to RATEL (2015), the total number of mobile phone users in Serbia has been growing steadily in recent years. The number of users in 2014 exceeds the total population and amounts to 9,344,977, i.e. the penetration in observed year is 130.76%. Postpaid users accounted for 47% and prepaid users 53% of the total number of subscribers in 2014.

Figure 2 shows the market share of MNOs in Serbia according to total number of subscribers in the period 2009-2014.



**Fig. 2** Market share of MNOs in Serbia according to total number of subscribers; 2009-2014

Source: RATEL, 2015, p. 68

The relative positions of the operators in the observed period has not changed (Figure 2). According to total number of subscribers, *Mobilna telefonija Srbije* has the largest market share in the entire period. *Telenor* held second position, while *Vip mobile* has the lowest market share in every observed year. Nevertheless, data from Figure 2 show that the divergence between the market share of operators in the period 2009-2014 decreased continuously, i.e. that distribution of total number of subscribers was becoming more and more equitable from year to year.

Measuring the concentration of mobile telecommunications market in this paper is based on market share indicator. Although it is possible to calculate market concentration according to the number of subscribers, the authors have chosen revenue as more appropriate indicator of market conditions. This indicator is computed as the quotient of the revenue earned by the participant and total revenue of all participants in the observed market. Total realized revenue (in millions of euros) and market share of MNOs in Serbia in the period 2009-2014 are presented in Table 1.

**Table 1** Total realized revenue (in millions of euros) and market share of MNOs in Serbia; 2009-2014

Year	Indicator	Telekom Srbija a.d. (MTS)	Telenor d.o.o.	Vip mobile d.o.o.	Total
2009	Revenue	419.15	334.82	72.75	826.74
	Market share	0.507	0.405	0.088	1
2010	Revenue	336.14	326.14	106.92	769.2
	Market share	0.437	0.424	0.139	1
2011	Revenue	328.52	369.16	149.02	846.7
	Market share	0.388	0.436	0.176	1
2012	Revenue	323.85	360.4	165.75	850
	Market share	0.381	0.424	0.195	1
2013	Revenue	324.75	359.86	193.1	877.7
	Market share	0.37	0.41	0.22	1
2014	Revenue	311.67	341.32	193.95	846.94
	Market share	0.368	0.403	0.229	1

Source: Author's calculation based on data of RATEL, 2015, p. 63 and p. 68

*Telekom Srbija MTS* had the largest market share in 2009 and 2010, but *Telenor* has taken a leading position in 2011 (Table 1). As well as in the case of number of subscribers, *Vip mobile* has the lowest market share in the entire period. Nevertheless, market share should not be the only indicator of competitive conditions in the analysis of market concentration. Considering that fact, the authors use all indicators of market concentration elaborated in theoretical background in the analysis of mobile telecommunications market.

The values of concentration indicators of the mobile telecommunications market in Serbia in the period 2009-2014 are presented in Table 2 and Figure 3.

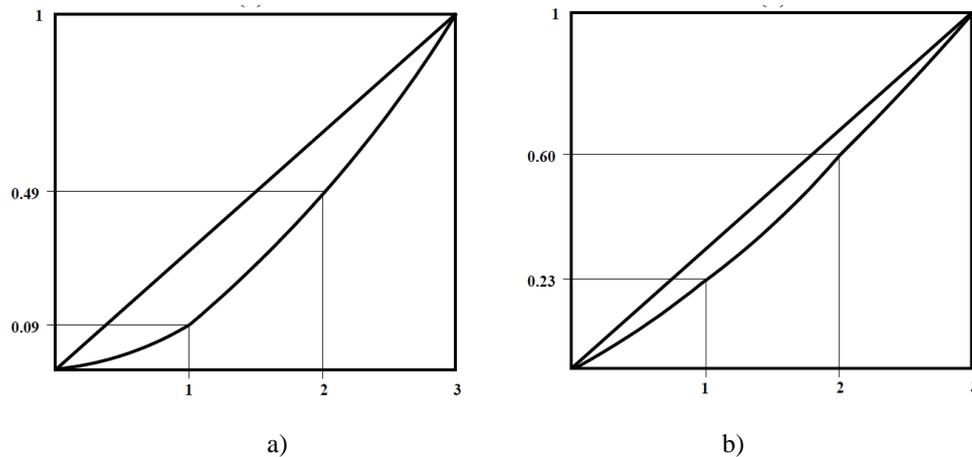
**Table 2** The values of concentration indicators of the mobile telecommunications market in Serbia; 2009-2014

Concentration indicator	Range	2009	2010	2011	2012	2013	2014
Concentration ratio of two largest firms	$0 < CR_n \leq 1$	0.91	0.86	0.82	0.81	0.78	0.77
Herfindahl-Hirschman index	$1/n \leq HHI \leq 1$	0.43	0.39	0.37	0.36	0.35	0.35
Entropy index	$0 \leq EI \leq \log n$	0.92	1.00	1.04	1.05	1.07	1.07
Relative entropy index	$0 \leq REI \leq 1$	0.84	0.91	0.94	0.96	0.97	0.98
Hall-Tideman index	$0 < HTI \leq 1$	0.46	0.42	0.40	0.39	0.38	0.38
Rosenbluth index	$0 < RI \leq 1$	0.26	0.28	0.28	0.29	0.30	0.30
Hannah-Kay index ( $\alpha = 2,5$ )	$1/S_1 \leq HKI \leq n$	0.29	0.25	0.23	0.22	0.21	0.21
Comprehensive concentration index	$0 < CCI \leq 1$	0.78	0.76	0.74	0.73	0.72	0.72
Gini coefficient	$0 \leq GC \leq 1$	0.21	0.15	0.11	0.09	0.07	0.07
Concentration ratio of two largest firms	$0 < CR_n \leq 1$	0.91	0.86	0.82	0.81	0.78	0.77

Source: Author's calculation

The results of all indicators of market concentration presented in Table 2 confirm the existence of a relatively stable oligopolistic market structure in the mobile telecommunications market in Serbia in the period 2009-2014. According to the market classification system of EU and US which is based on the value of HHI (see theoretical background of this paper), the mobile telecommunications market in Serbia is classified in the group of highly concentrated markets. It is particularly important to note that the degree of market concentration significantly exceeds the lower limit of the high concentration zone (EU: HHI above 0.20; US: HHI above 0.25). The value of HHI of mobile telecommunications market is in the range from 0.35 to 0.43. The highest degree of market concentration is recorded in 2009, and the lowest in 2014. Trend of constant decline of market concentration degree from 2009 to 2014 indicates a permanent increase of competition intensity in the mobile telecommunications market in Serbia.

The values of the Concentration ratio of two largest firms, the Entropy index, the Relative entropy index, the Hall-Tideman index, the Rosenbluth index, the Hannah-Kay index, the Comprehensive concentration index and the Gini coefficient presented in Table 2 point out to the same conclusion as well as in the case of HHI. Analysis of these values shows that the highest degree of market concentration is recorded in 2009, and the lowest in 2014, but also that there is a trend of constant decline of market concentration degree from 2009 to 2014.



**Fig. 3** The Lorenz curve of the mobile telecommunications market in Serbia: (a) 2009; (b) 2014

Source: Author's presentation

Comparison of the Lorenz curve position in 2009 and in 2014 (Figure 3) also indicates significant decrease of market concentration degree from 2009 to 2014, i.e. significant approaching of the Lorenz curve to the diagonal intersection in the coordinate system which represents perfect equality of market share distribution.

Table 3 shows the results of descriptive statistics for values of concentration indicators of the mobile telecommunications market in Serbia in the period 2009-2014.

**Table 3** Results of descriptive statistics for values of concentration indicators of the mobile telecommunications market in Serbia; 2009-2014

Concentration indicator	N	Minimum	Maximum	Mean	Standard deviation	Coefficient of variation
Concentration ratio of two largest firms	6	0.77	0.91	0.8250	0.0524	0.0636
Herfindahl-Hirschman index	6	0.35	0.43	0.3750	0.0308	0.0822
Entropy index	6	0.92	1.07	1.0250	0.0575	0.0561
Relative entropy index	6	0.84	0.98	0.9333	0.0520	0.0557
Hall-Tideman index	6	0.38	0.46	0.4050	0.0308	0.0761
Rosenbluth index	6	0.26	0.30	0.2850	0.0152	0.0532
Hannah-Kay index ( $\alpha = 2,5$ )	6	0.21	0.29	0.2350	0.0308	0.1312
Comprehensive concentration index	6	0.72	0.78	0.7417	0.0240	0.0324
Gini coefficient	6	0.07	0.21	0.1167	0.0547	0.4684
Concentration ratio of two largest firms	6	0.77	0.91	0.8250	0.0524	0.0636

Source: Author's calculation (SPSS 22)

The values of all indicators of market concentration except the Gini coefficient do not deviate from the mean a lot (Table 2 and Table 3). In such circumstances standard deviation and coefficient of variation is low. That points out that there is low heterogeneity and variability of values of concentration indicators. However, coefficient of variation of the Gini coefficient

amounts 0.4684. Such value of coefficient of variation indicates moderate variability of the Gini coefficient values in the observed period.

Results of descriptive statistics presented in Table 3 confirm that there was a relatively stable oligopolistic market structure in the mobile telecommunications market in Serbia in the period 2009-2014, with a moderate change of the Gini coefficient value and small changes of values of all other concentration indicators.

In order to examine the degree of market concentration of mobile telecommunications market in Serbia in comparative perspective, Table 4 presents subscriber-based HHI value of the mobile telecommunications market and the number of MNOs in Serbia and EU member states in 2014.

**Table 4** Subscriber-based HHI value of mobile telecommunications market and the number of MNOs in Serbia and EU member states; 2014

Range	Subscriber-based HHI value and the number of MNOs
$HHI \leq 0.3000$	Poland 0.2562 (4); United Kingdom 0.2771 (4); Italy: 0.2854 (4)
$0.3000 \leq HHI < 0.3500$	France: 0.3122 (4); Romania: 0.3155 (4); Spain: 0.3179 (4); Sweden: 0.3213 (4); Germany: 0.3362 (3); Finland: 0.3449 (3); Lithuania: 0.3459 (3); Denmark: 0.3475 (4); Czech R.: 0.3482 (3)
$0.3500 \leq HHI < 0.4000$	Netherlands: 0.3500 (3); Belgium: 0.3507 (3); Hungary: 0.3539 (3); Slovakia: 0.3540 (3); Austria: 0.3542 (3); Estonia: 0.3567 (3); Bulgaria: 0.3572 (3); Serbia: 0.3579 (3); Ireland: 0.3657 (3); Latvia: 0.3682 (3); Portugal: 0.3822 (3); Greece: 0.3749 (3); Croatia: 0.3954 (3)
$HHI \geq 0.4000$	Luxembourg: 0.4155 (4); Slovenia: 0.4438 (3)

Note: the number of MNOs for every country is shown in the brackets next to HHI value. Countries are listed according to HHI value: from the lowest to the highest. Malta and Cyprus are not included.

*Source:* Author's calculation based on data of Mariniello, Salemi, 2015, p. 4 for EU member states and on data of RATEL, 2015, p. 68 for Serbia

Mobile telecommunications market in Serbia is positioned in a group of EU markets whose value of HHI is in the range between 0.3500 and 0.4000 (Table 4). Serbia is ranked at 20<sup>th</sup> place, i.e. Serbian HHI (0.3579) is higher than the HHI of 19 EU member states and lower than the HHI of 7 EU member states. Also, the HHI value of Serbian market is higher than the average HHI value of EU member states (0.3473).

All countries from Table 4 have 3 or 4 MNOs. There are 9 countries with 4 operators and 18 countries with 3 operators. Serbia is in a group of countries with 3 operators. Obviously, countries with 4 operators such as Poland, United Kingdom, Italy and others have a lower HHI compared to the countries with 3 operators such as Serbia. However, that is not a strict rule in this analysis. For example, Luxembourg with 4 operators has much higher HHI value (0.4155) than Serbia (0.3579) and all other countries excluding Slovenia which has the highest HHI value (0.4438).

## CONCLUSION

Empirical research of the mobile telecommunications market in Serbia in the period 2009-2014 proposes verification of all hypotheses. The analysis finds a high degree of concentration of supply in the market, but also the existence of oligopolistic market structure

which is characterized by a replacement between two MNOs on the leading position by revenue-based market share in the observed period (confirmed H1). The values of all indicators of market concentration show that the highest degree of market concentration is reached in 2009, and the lowest in 2014, but also that there is a trend of constant decline of market concentration degree from 2009 to 2014 (confirmed H2). The downward trend of market concentration indicates a permanent increase of competition intensity in the mobile telecommunications market in Serbia. Results of descriptive statistics substantiate a relatively stable oligopoly with a moderate change of the Gini coefficient value and small changes of values of all other indicators of market concentration. It is also obtained that the degree of market concentration of the mobile telecommunications market in Serbia expressed in subscriber-based HHI value is higher than the average degree of market concentration in EU member states in 2014 (confirmed H3). According to HHI value, Serbia is ranked at 20<sup>th</sup> place among the 26 EU countries, and it belongs to the group of 18 countries with 3 MNOs.

The conclusions of the paper can contribute to better understanding of the application of indicators of market concentration in qualitative analysis of competitive conditions in the market. The limitations of the study arise from the shortcomings of indicators of market concentration, i.e. its properties such as referring only to certain companies (N-firm concentration ratio) or measuring only equality in the total market share distribution (Gini coefficient and Lorenz curve). Because of these shortcomings, but also because of the purpose of indicators of market concentration, the findings of this research must be seen as a first step in the qualitative analysis of competitive conditions in the mobile telecommunications market in Serbia. It is necessary to apply an additional set of methods and models to reach the final conclusions on the competition intensity between market participants and their behaviour.

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## MERENJE TRŽIŠNE KONCENTRACIJE NA TRŽIŠTU MOBILNIH TELEKOMUNIKACIJA U SRBIJI

*Tržišta mobilnih telekomunikacija širom sveta karakteriše skroman broj ponuđača i veliki broj pretplatnika. Ipak, stepen tržišne koncentracije varira od zemlje do zemlje. Svrha ovog rada jeste utvrđivanje metodološkog okvira za merenje i analiziranje tržišne koncentracije na tržištu mobilnih telekomunikacija u Srbiji. Stepem tržišne koncentracije je izračunat korišćenjem godišnjih podataka za period 2009-2014. godina. Istraživanje se vrši primenom skupa statističko-matematičkih metoda za merenje tržišne koncentracije, komparativne analize i deskriptivne statistike. Analiza otkriva da je tržište mobilnih telekomunikacija u Srbiji visoko koncentrisano i da stepen koncentracije premašuje prosek zemalja članica Evropske unije. Rad je koristan državnim organima Srbije, kao što su Komisija za zaštitu konkurencije i Regulatorna agencija za elektronske komunikacije i poštansku delatnost, jer pruža značajne rezultate strukturnih karakteristika mobilnog telekomunikacionog tržišta u Srbiji.*

Ključne reči: *tržišna koncentracija, tržište mobilnih telekomunikacija, Srbija*