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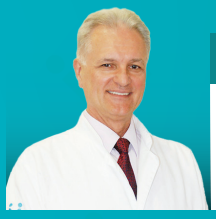

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This issue of *Ekonomika preduzeća* begins with four inspiring papers in the *Economic Growth and Development* section. In the first paper, an international team of authors, including *V. Dženopoljac, B. Georgievski, S. Cavagnetto* and *Q. Abidi,* observed the relationship between the components of national intellectual capital and human development index. The results of their panel data regression analysis for 12 countries confirmed that intellectual capital has a pivotal role in driving national competitiveness that must not be overlooked by policymakers. The next paper, written by *D. Vujović,* is dedicated to the impact of innovations on productivity and growth, with special emphasis on the evaluation of Serbia's innovation system design and performance according to relevant global indices. After an insightful analysis, the author provided some specific and viable proposals for supporting innovation efforts and achieving more tangible outcomes with regard to the nation's well-being. In the midst of a global energy crisis, *L. Madžar* in her paper deals with a strategic issue, the analysis of Serbian energy sector and the main trends shaping its productivity. According to the author, raising awareness of the urgency to improve energy efficiency and productivity is a prerequisite for the much-needed green transition, which requires commitment and collective action. The last paper in this section, written by *I. Domazet, D. Marjanović* and *D. Ahmetagić,* explored the impact of exports of high-tech products on the economic growth of Serbia, Bulgaria, Hungary and Romania. Although the examples of Serbia and Hungary show that economic growth is possible even without increasing the share of exports of high-tech products in total exports, the sustainability of such growth is something that decision makers must think about in the period ahead.

In the *Finance* section, a trio of authors, *I. Janković, V. Kovačević* and *I. Ljumović,* tackled one of the burning issues of our time, the so-called "green finance". Namely, the authors analyzed green bonds as relatively new fixed-income instruments in financing environmentally-friendly projects and their performance vis-à-vis ordinary municipal bonds. In the second paper in this section, the group of authors, including *M. Slijepčević, N. Popović Šević, S. Popović Pantić* and *A. Šević,* pointed out the role of relational marketing and its influence in the banking sector, particularly when it comes to providing banking services to micro, small to medium-sized enterprises, where the ability to build trust and loyalty is what makes the difference.

This time the *Management* section is devoted to the ideas for building a better healthcare system. A trio of authors, *J. Babić, V. Rajić* and *T. Rakonjac Antić*, examined the effects of the application of ISO standards on financial

performance in private hospitals based on the analysis of a sample of 44 private hospitals in Belgrade. The paper provides valuable inputs for a forward-thinking approach to providing more efficient health services.

This issue of *Ekonomika preduzeć*a concludes with the *Tourism* section. In their paper, *V. Vasić, B. Hristov Stančić* and *B. Zečević* investigated the factors affecting the occupancy rates of hotels, applying the dynamic panel analysis on a sample of 49 hotels in Spain observed over a period of 12 years. The findings of their study are quite indicative and could be useful to hotel managers. Based on an extensive empirical research covering 424 restaurants in the capital cities of the former Yugoslavia in the period 2015-2019, in the last paper of this issue *B. Živadinović* showed how regional cuisine and services look like through the prism of Tripadvisor as one the most influential hospitality websites.

Prof. Dragan Đuričin, Editor in Chief

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NATIONAL INTELLECTUAL CAPITAL: A COMPARATIVE LONGITUDINAL STUDY

Nacionalni intelektualni kapital – komparativna longitudinalna studija

Abstract

Since its inception, the intellectual capital (IC) framework, which developed from accounting and financial perspectives, focused primarily on firm-level analysis. There have been several important attempts in the literature to take IC to the macroeconomic level. The purpose of this paper is to assess the relationship between national intellectual capital, proxied with modified National Intellectual Capital Index (NICI) introduced by Bontis [7], and the Human Development Index (HDI), which became an important alternative to the traditional single dimensional measure of a country's development, like the gross domestic product [42]. The paper proposes a modified NICI suggested by Užienė [52]. The analysis includes panel data regression analysis for 12 countries. The dataset incorporated longitudinal data for weighted components of the NICI index for the period of 21 years (2000-2021). The results revealed that each of the elements of NICI, namely National Human Capital (NHC), National Market Capital (NMC), National Process Capital (NPC), and National Renewal Capital (NRC), exhibits significant impact on the levels of HDI in the said period. However, all elements, apart from NRC, show significant positive impact on HDI, pointing to the conclusion that these factors represent an important foundation for achieving and maintaining national competitiveness. Contrariwise, NRC was revealed to have the significant negative impact on HDI, opening the door to the question whether NRC is a real driver of national development, or just the effect of already reached development level.

Keywords: *national intellectual capital, panel data regression, fixed effects, panel data analysis*

Sažetak

Od svog uvođenja koncept intelektualnog kapitala (IK), koji je inicijalno nastao u oblasti računovodstva i finansija, uglavnom se fokusirao na mikro aspekte poslovanja. U literaturi se pojavio određeni broj pokušaja da se koncept IK prenese na makroekonomski nivo. Svrha ovog rada je da utvrdi odnos između nacionalnog IK, iskazanog kroz modifikovani indeks nacionalnog intelektualnog kapitala (engl. *National Intellectual Capital Index, NICI*), koji je formulisao i koristio Bontis [7], i indeksa ljudskog razvoja (engl. *Human Development Index, HDI*), koji je postao bitna alternativa tradicionalnom jednodimenzionalnom merilu razvoja jedne ekonomije, poput bruto društvenog proizvoda [42]. Ovaj rad predlaže primenu modifikovanog NICI indeksa, prema Užienė [52]. Empirijska analiza je obuhvatila panel data regresiju primenjenu na 12 zemalja. Podaci su po prirodi longitudinalni jer obuhvataju vremenski period od 21 godine (2000-2020). Rezultati istraživanja ukazuju na to da svaka od komponenti NICI indeksa, nacionalni ljudski kapital, nacionalni tržišni kapital, nacionalni procesni kapital i nacionalni kapital obnove, pokazuje značajan uticaj na HDI u obuhvaćenom periodu. Međutim, svi elementi, osim kapitala obnove, ukazuju na pozitivan efekat na HDI i na to da predstavljaju značajnu pokretačku snagu nacionalne konkurentnosti. Suprotno ovome, nacionalni kapital obnove ima značajan inverzan efekat na HDI, otvarajući vrata za pitanje u kojoj meri ovaj kapital predstavlja pokretač razvoja nacionalne ekonomije ili samo rezultat već postignutog nivoa razvoja.

Ključne reči: *nacionalni intelektualni kapital, panel data regresija, fiksni efekti, panel data analiza*

Introduction

The management of a company is significantly affected by the development stage of an economy, especially its technological and sociocultural characteristics. One of the main distinguishing features of the current era of last 60 or so years is that it is an outcome of two industrial revolutions: industrial revolution 3.0 and industrial revolution 4.0. The first one brought the beginnings of information era and the industrial revolution 4.0 accelerated its acceptance through the integration of physical and various cyber systems [10, p. 51]. With this continuing transformation, intellectual capital and intangible assets became one of the key components of economic growth, both on a company and on a country level. This continuous transformation recognizes intellectual capital (IC) as a competitiveness driver. As an important consequence, "knowledge society, knowledge economy, knowledge assets, knowledge management, and knowledge-based development – all these concepts have gained ground in the academic field as well as in public discussions" [30, pp. 343-344].

Intellectual capital, which is most frequently defined as knowledge-based value creation, shows the importance of acquiring, organizing, and disseminating knowledge in a company [5]. This additional knowledge, which is not shown in the financial statements of a company, is a vital resource for companies for three reasons [1]: a) it is essential for enterprises to create and store knowledge; b) firms' accumulated knowledge can increase in value through the replication of knowledge that is usable and valuable to the enterprise, which is done through sharing, categorizing, and codifying the available knowledge; c) an enterprise setting can influence the production and leveraging of knowledge through organizational norms, values, and culture. IC has been noted to create a comparative advantage to companies that invest in it significantly [18], [22]. While companies' financial statements fail to disclose investments in IC and only focus on the book value of intangible assets, the tangible effects of investments in IC are visible and crucial for company growth. As pointed out by Sumedrea [49] and Xu and Li [58], IC can be seen as a crisis buffer at a company level and at the national level. It can serve as a tool for stabilizing profitability and creating competitive advantage in the periods when the economy is unpredictable [2].

Up until the 1990s, the reigning paradigm in the strategic management analysis was oriented towards external opportunities and threats in the quest for competitive advantage and favorable position in the market [11]. However, thanks to the works of Wernerfelt [54], Barney [4], Peteraf [39] and other renowned authors in the field of strategy, the focus shifted drastically towards the internal environment as a main source of competitive advantage. In line with this resource-based view (RBV) of the firm perspective, IC is viewed and assessed as the hidden capital of an organization, consisting of various immaterial resources, roughly categorized into human, structural and relational capital [12]. It can represent shared and public knowledge when it is legally acknowledged and disclosed as an intangible asset, such as copyrights or patents. IC arises from the culture of the company, from interacting with stakeholders. Overall, IC represents total knowledge and immaterial resources that the company has created and accumulated over time.

From the micro perspective of IC, a national-level IC analysis emerged. Although the logic behind the two concepts is interconnected and indisputably related, certain distinctions must be understood and considered. For example, it is important to understand how to identify and grasp the real effects of national IC. Additionally, it is unclear to what extent a certain category of IC, or a certain IC driver can be considered as a value driver for an entire country. Moreover, it remains to be seen and investigated to what extent certain IC elements are the drivers of macroeconomic growth and to what extent they represent the results of a growing economy. For example, the investments in research and development (R&D), which will be discussed in this paper in more detail, are seen as the part of a country's renewal capital but its origin remains to be investigated in more detail.

The current paper is structured as follows. The first segment after the introduction deals with a literature review in the field of IC and, more specifically, it will shed some light on the existing concepts of national IC and its related measurement attempts. Within the literature review,

the authors will discuss the human development index (HDI), as one of the widely used comprehensive measures of economic development. The second part provides the methodology description that entails explaining the used methodology framework, definitions of used variables, description of the sample for the empirical research and data collection approach. The methodology part of the manuscript ends with hypotheses development stemming from the existing body of literature. The next part of the paper shows the empirical analysis results, with adjoining statistical methods used for this analysis. At the end of the paper, the authors present the most important conclusions and provide future avenues for research regarding the national IC.

Literature review

Microeconomic perspective of IC

There are several important literature streams that emerged within the last three decades of IC research. The first stream of IC literature development began in mid-1990s and mainly relied on the microeconomic perspective. The critical topics during this phase were appropriate definitions, modeling, measurement, and IC disclosure within the financial reports of companies. The researchers, such as Lev and Sougiannis [32], Edvinsson [14], Sveiby [50], Stewart [48], Bontis [6], Mouritsen et al. [38], among others, set the important definitions of IC as a driver of corporate performance and a prerequisite for attaining competitive advantage. Additionally, these authors managed to establish a relatively unanimous categorization of IC, with minor etymological variations. These categorizations mainly rely on a trichotomous division of IC into human, structural, and relational capital. Soon after establishing the IC models, definitions, and taxonomies, the macroeconomic perspective was brought to a macro level, by introducing the concept of national IC, initially by Bontis [7] who set the grounds for development of National Intellectual Capital Index (NICI). Soon afterwards, some scholars took the strategic perspective into account, by relying on RBV, knowledge-based theory [20], and dynamic capabilities framework of a firm [51]. In line with this, IC is defined as a sum of company's intangible assets, which reveals the true potential of an organization to create tangible outcomes. One of the main elements of IC is human capital, whose ability to create, store, and share knowledge is crucial for a firm's competitiveness. Thus, increased investment in education and knowledge leads to companies' improved performance [43]. This knowledge creation leads to the increase in competitive advantage through improved efficiency of workforce. Additionally, investments in IC lead to increased innovation [3].

The microeconomic literature stream on IC led to numerous attempts towards measurement, which was especially challenging in terms of measuring IC in monetary value [40], [48]. Furthermore, the literature picked up and numerous empirical studies emerged trying to tie the IC with corporate performance [16], [21], [28], [29], [35], [53].

National intellectual capital

Logically easy to grasp and build was the idea of IC being viewed as the driver not only of corporate performance, but also the economic performance of a country. However, it is questionable to what extent microeconomic IC can be extended to a national level, which is why it is important to assess and interpret any national IC related research with caution as it still represents an area that needs more research [44], [45].

A starting point and foundation of the national intellectual capital framework was undertaken by Bontis, who asserted that national IC represents the "invisible wealth of a country" [7, p.13] and therefore requires a system of variables that would uncover and manage these assets. He proposed a measurement system of national IC, which was the National Intellectual Capital Index (NICI), specifically proposed for the countries in the Arab region. The index consists of four distinguished, but overlapping and interconnected, types of national capital. The first one is the National Human Capital (NHC), which is the sum of the intellectual wealth of its citizens. This type of capital has multiple dimensions, like knowledge about facts, laws, and principles, but also certain types of knowledge that are more difficult to assess, such as

specialized knowledge, teamwork, communication [24]. Some of the critical components of NHC are the quality of educational system, literacy levels, and long-life learning frameworks [7].

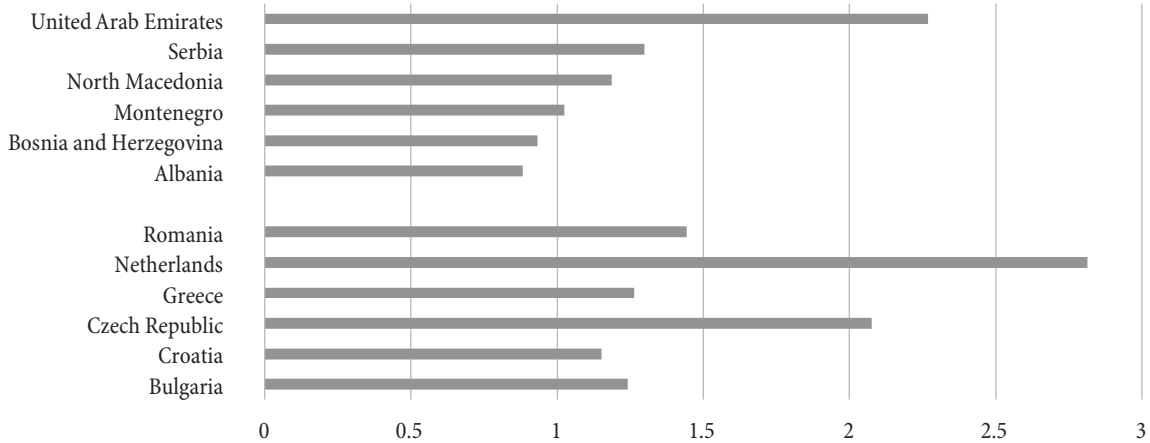
The next element of NICI is the National Market Capital (NMC), which is reflected in a country's existing framework within which businesses operate. Also, this type of capital includes the international business relations that are formed between domestic and foreign companies. NMC is formalized through laws, policies, procedures through which a country is assessed as a friendly environment for doing business. Finally, important segments of NMC are international relations and the volume and quality of a country's export activities [7].

The National Process Capital (NPC) is the third element of NICI, and it is embodied in a country's information and communications infrastructure, as well as in databases, laboratories and various other organizational structures that are meant to store and disseminate knowledge created by the human capital component. The ability of a country to develop, manage, maintain, and adapt to new technology trends is the building block of NPC. One of the important measures in this regard is the usage and quality of internet network and the internet literacy of citizens [7].

Human capital mainly carries the knowledge, process capital stores the knowledge for future use, while a country's renewal capital is the one that creates new knowledge, updates the old one and tries to make it useful for future economic growth of a country. The main components of NRC are research and development (R&D) expenditures, patents, scientific publications, number of researchers in the country and the like [7]. The NICI framework serves as the conceptual basis for this manuscript's empirical part.

There are other notable attempts in the literature that were aimed at framing the national IC and proposing a measurement model. One of these attempts is that of Lin and Edvinsson [34], who used various approaches to disclose information about national IC on 40 different countries in the world. They assessed these countries based on human capital, market capital, process capital, renewal capital, and financial capital. Another important attempt at comprehending the national IC was undertaken by Corrado et al. [8], who included computerized information (mainly computer software and digital data), innovative property (mainly scientific and non-scientific R&D, including search for minerals and natural resources), and economic competencies (mainly brand equity and firm-specific resources (human capital) [46, p. 168]. Finally, there are modified attempts at framing and quantifying national IC, one of which is that of Užienė [52], which serves as the measurement framework for the current research. Figure 1 depicts the difference in values between non-EU (including the United Arab Emirates) and EU countries in terms of NICI values in 2020. On average, these values do not show a consistent pattern. For example, in 2020 Serbia has a higher NICI index than Greece. This is largely due to Serbia's presence in international research and due to the quality of education.

Figure 1: NICI values for non-EU and EU countries, 2020



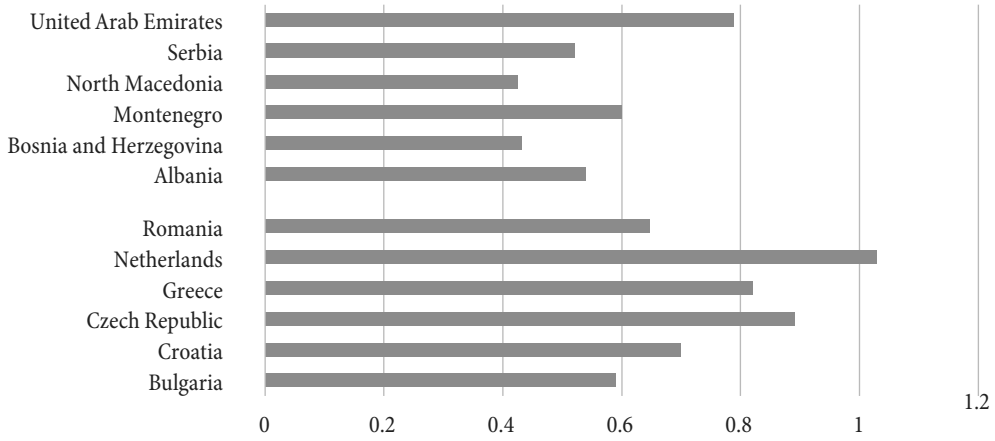
Human Development Index

The Human Development Index (HDI) was created by the United Nations Development Programme (UNDP) to broaden the spectrum of measuring the growth of a nation. The index has the purpose of including not only the measure of economic growth like GDP, but also the overall quality of life and knowledge within a country. Besides the GDP measure, HDI incorporates dimensions like the longevity of life and health, and the state of knowledge in a country. The first Human Development Report (HDR) was published in 1990, and it expanded the measurement of national growth, which predominantly used GDP or GDP per capita, to more inclusive measurement of human development [42]. However, HDI is often seen as an incomplete measure of human development because it leaves out many important elements. In order to encompass all elements that affect the quality of human development, HDI, besides the factors already incorporated, needs to include: mental well-being, empowerment, political freedom, social relations, community well-being, inequalities, work conditions, leisure conditions, political security, economic security, and environmental conditions [41, pp. 328-329]. The issue here is the measurement of all these missing components.

Despite its obvious shortcomings, HDI has been extensively used in the literature as a measure of national level development. For example, Khan et al. [31] assessed the possible gap between ICT, economic growth and human development in Pakistan, in the period between 1990 and 2014. The empirical results revealed that ICT affected HDI positively. Besides this, economic growth had a positive and significant impact on HDI. On the other hand, urbanization, trade, and foreign direct investments (FDI) had inverse effect on human development in Pakistan. In an empirical study conducted in Nigeria, the impact of FDI was assessed against HDI. The study pointed to the fact that FDI had a significant positive effect on HDI in the period 1972-2013. Furthermore, the authors stressed that this relationship is far from simple and that policymakers must take its complexity into account [19]. A study implemented in Indonesia between 1997 and 2016, assessed the relationship between Indonesian bank rate, foreign exchange rates, money supply, oil price, and gold prices on inflation. As the second order construct, the impact of inflation was addressed against HDI and poverty, which was determined to be positive and significant [59].

In terms of research studies that included Serbia, the literature is sparse and does not provide enough empirical evidence of the relationship between any component of intangible assets on a national level and HDI. However, Serbia is seen as a country that showed a moderate increase in HDI over the course of last three decades. This growth is slow and in recent years shows stagnating characteristics. Furthermore, Serbia still has a considerably lower position in the overall ranking compared to its neighbors and Central and Eastern European countries, such as Slovenia, the Czech Republic, Slovakia, Hungary, Croatia, Montenegro, Romania and Bulgaria [36, p. 13]. In the current sample, it can be observed that on average,

Figure 2: HDI between non-EU and EU countries, 2020



non-EU economies have lower values of HDI, except for the United Arab Emirates, which are a non-EU economy but belong to the group of world economies with higher economic growth (see Figure 2).

Methodology

Measurement framework

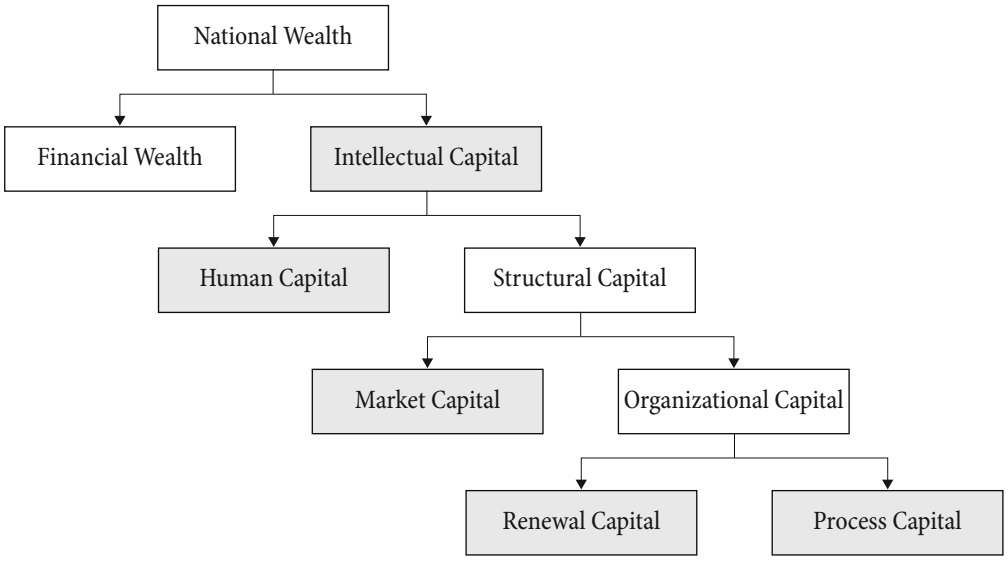
When comparing against other national economies, it is crucial to assess fundamental national level features, such as educational system, international trade, infrastructure, together with a country's renewal capabilities. All these features determine the national level of competitiveness and represent the elements of national intellectual capital [34]. The conceptual framework of the current research (see Figure 3) is built upon the categorization of national intellectual capital of Edvinsson and Malone [15], who asserted that national wealth consists of financial wealth and intellectual capital. Furthermore, the authors argued that intellectual capital has two subsegments, namely human capital and structural capital. In this approach, national human capital represents "knowledge, wisdom, expertise, intuition, and the ability of individuals to realize national tasks and goals" [34, p. 4]. Proxies for national human capital, as suggested by Užienė [52], include pupil-teacher ratio, employment rate, expenditure on healthcare, higher education enrolment, level of lifelong learning, knowledge of foreign languages, and level of emigration.

A nation's structural capital is based on a country's market capital and organizational capital, formed by renewal and process capital.

The component labeled as market capital of a nation is reflected in a country's internal relationships. These relationships include a country's ability to create a quality environment for international clients. Additionally, this form of national capital entails a country's investments in international relations and exports of quality goods and services. Finally, the market capital of a nation is drawn from existing laws, market institutions, and various social networks [7]. The current research draws the measures of market capital from Užienė [52], which include exports of goods and services, high-technology exports, level of higher education internationalization, income from tourism, and foreign direct investments.

Another important segment of structural capital is a country's organizational capital that contains renewal and process capital. The renewal capital is seen as national "future intellectual wealth" [7, p. 24]. This refers to a country's investments in further developing and sustaining national competitiveness. The major component revolves around a country's investment in research and development (R&D) activities in many areas. The investments in R&D not only support a country's financial wealth but also increase a

Figure 3: National intellectual capital



Source: [7, p. 13], [15]

country's efficiency as a whole [7]. However, usually in transitional or developing economies that constitute the majority of the sample in this study, this factor is largely underinvested and represents an important obstacle to future growth [27]. As proposed by Užienė [52], the possible measures of national renewal capital are the number of patent applications, number of R&D personnel and researchers, volume of R&D expenditure, number of trademark applications, new businesses started annually, and number of scientific publications.

Finally, an important driver of a country's wealth and growth is the process capital. This element of national intellectual capital represents "the non-human storehouses of knowledge" [7, p. 21], which supports a nation's human capital. The specific elements include information and communications technologies, hardware, software, different existing databases (statistical, registries, and the like), research laboratories, and other organizational structures that support development and storage of national human capital. Specific measurable components include level of internet usage, mobile cellular subscriptions, convenience of exporting, convenience of starting new business, government effectiveness, and income from intellectual property [52].

Variables definition

Selecting the adequate measures of each of the presented components of national intellectual capital was based on Užienė [52], the availability of data for selected countries over the analyzed period of 21 years and the authors' conception of the importance of each variable. The conceptual framework is mainly adapted from Edvinsson and Malone [15] and Bontis [7], while the approach to variables selection and calculation is adapted from Užienė [52]. To calculate the aggregate value of national intellectual capital, the authors applied the mentioned concept of National Intellectual Capital Index (NICI) and used the weighted values of selected measures.

As explained in earlier section of the paper, NICI represents the sum of National Human Capital (NHC), National Market Capital (NMC), National Process Capital (NPC), and National Renewal Capital (NRC). Each component of NICI was calculated as a weighted sum of individual available and logical measures. The weights of each NICI component are derived from an expert survey, which assigned appropriate weights to each measure to reflect its relative importance. The calculation also included the steps of variable standardization and calculation of cumulative indices. The standardization of variables was mandatory because the retrieved variables were heterogeneous and need to be standardized for the purposes of comparison. Standardization was performed in MS Excel by using the function STANDARDIZE that returns a normalized value (z-score) based on the mean and standard deviation. The used syntax for standardizing the variables was *=STANDARDIZE (x, mean, standard_dev)*. The next step in the process was transforming all the standardized values into a score that ranges from 0 to 1. This stage was conducted by minimizing and maximizing of standardized variables. As suggested by Užienė [52], minimizing and maximizing variables are converted in the following way:

$$r_{ij} = \frac{r_{ij}}{max\, r_{ij}} \#(1)$$

$$r_{ij} = \frac{min\, r_{ij}}{r_{ij}} \#(2)$$

Where r_{ij} is the value of variable *i*, alternative *j*, max r_{ij} is the maximum value of variable *i*, alternative *j*, and min r_{ij} is the minimum value of variable *i*, alternative *j*. The values are now standardized and transformed into 0-1 range. After this, a simple additive weighting method was used to calculate the cumulative values of all elements of NICI. Finally, the NICI value is calculated as the total score of its four elements. The same procedure was used for standardizing and transforming the values of Human Development Index (HDI) for the mentioned period.

Sample and data collection

The dataset consists of 21 years of data for 12 countries: Albania, Bulgaria, Bosnia and Herzegovina, Croatia, Greece, North Macedonia, Montenegro, Romania, Serbia, the United Arab Emirates, Czech Republic, and the Netherlands. The sample contains diverse countries,

among which European Union (EU) member countries are included (Bulgaria, Croatia, Czech Republic, Greece, the Netherlands, and Romania) as well as the countries in the Western Balkan region (Albania, Bulgaria, Bosnia and Herzegovina, Montenegro, North Macedonia, and Serbia). Additionally, the United Arab Emirates were included to diversify the sample and include an economy with very different principles, natural resources, and culture.

The data was collected from the World Bank Open Data website [57]. The used variables are listed in Table 1.

There are certain limitations to the selected measures. The first general issue stems from the conceptual link between micro measures of IC and transformed measures at macroeconomic level. There is no straightforward connection between the models used on a firm level [14], [40] and the ones developed for the measurement of national IC because the complexity of interrelations significantly increases for a country level analysis [34]. Additionally, different authors in the field of national IC are choosing different measurement models in an attempt to grasp as many contributing factors as they can to explain the relationship between various country capitals and long-term performance in terms of GDP, HDI, or some other measure. To overcome this obvious drawback, the current research employs a two-way fixed-effects model in which both individual and time effects were considered to control for the individual economy's differences and the time varying effect, similarly to that of Dženopoljac et al. [13].

Hypotheses development

There were several significant attempts to determine and quantify national intellectual capital in the literature [7], [25], [26], [30], [33], [37], [44], [47], [55]. However, this is not an easy task, which might be the reason why no significant study or approach has been discussed in almost a decade. Furthermore, the literature offers very few empirical studies in the field of national intellectual capital and even fewer when it comes to assessing the relationship between defined NICI and certain macroeconomic factors. In his initial work when developing the index, Bontis [7] attempted to assess the interrelationships between four elements of NICI and financial wealth of nations. More specifically, the research was done in the Arab region and included ten countries: Kuwait, Jordan, Tunisia, Egypt, Oman, Morocco, Saudi Arabia, Algeria, Yemen, and Sudan. In the mentioned research, the dependent variable that served as a proxy for nations' financial wealth was GDP per capital. Due to various sample limitations, the conclusion was more theoretical saying that national human capital represents the antecedent of overall national intellectual capital. Additionally, through complex internal relationships among analyzed NICI components, the author concludes that mainly thanks to national human capital and its development and support by other components of NICI, financial well-being of a country increases. In addition, the empirical study performed by Užienė [52] focused on determining the impact of NICI and its elements on GDP per capita, HDI, and World Competitiveness Scoreboard rank. The comprehensive empirical results obtained by Lin and Edvinsson [33] provide further proof towards the importance of national intellectual capital and predominantly, national human capital, for national wealth of nations. Research by Hervas-Oliver and Dalmau-Porta [25] revealed that a country's technological capability and governmental policy towards businesses are the key

Table 1: List of variables for measuring internal NICI constructs and their weights

National Human Capital (NHC)	**National Process Capital (NPC)**
Pupil-teacher ratio (0.15)	Individuals using the Internet (0.30)
Employment to population ratio (0.30)	Charges for the use of intellectual property (0.25)
Current health expenditure (0.20)	Mobile cellular subscriptions (0.10)
School enrollment, tertiary (0.35)	Ease of doing business score (0.35)
National Market Capital (NMC)	**National Renewal Capital (NRC)**
Foreign direct investment (0.20)	Patent applications (0.10)
High-technology exports (0.35)	Research and development expenditure (0.35)
International tourism, receipts (0.15)	Trademark applications (0.30)
Exports of goods and services (0.30)	New businesses registered (0.25)

factors of national IC and have impact on the levels of countries' IC and financial wealth of a nation. Ferreira and Hamilton [17, p. 16] assessed national intangible capital "as a residual, by subtracting the values of assets that the system of national accounts measures (produced capital and net financial assets) and estimates of the value of the stock of natural capital, from the value of comprehensive wealth". Presented in this way, the national intangible capital proved to be a crucial source of growth, especially within the high-income countries. Finally, the overall notion is that national intellectual capital represents a major factor for economic growth, whether all of its components affect this grow positively or not [44]. In line with the previous research, the current study proposes the following research hypotheses:

H1. National intellectual capital is positively related to human development index

- *H1a. National human capital is positively related to its human development index*
- *H1b. National market capital is positively related to its human development index*
- *H1c. National process capital is positively related to its human development index*
- *H1d. National renewal capital is positively related to its human development index*

Results

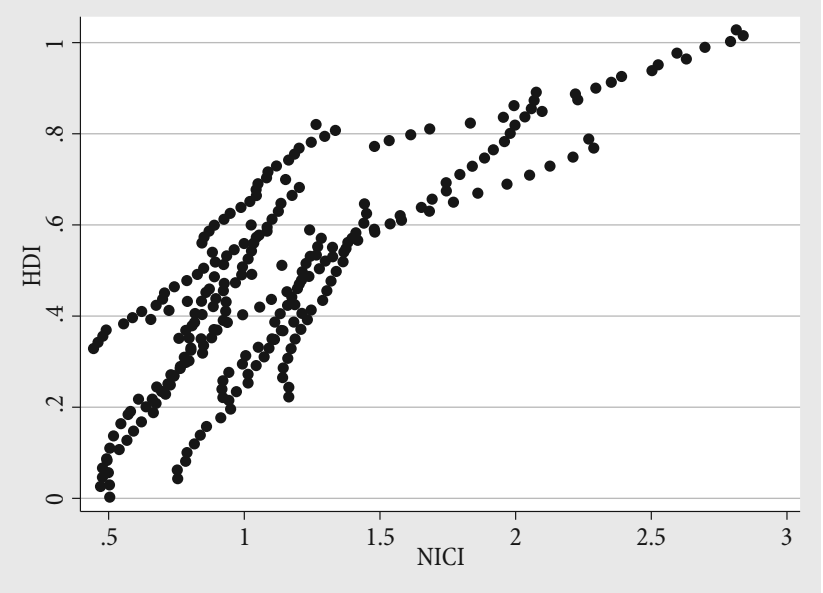
Descriptive statistics and correlation

In Table 2, the results of descriptive analysis for all considered variables in the study are presented. The data for the analyzed 21 years had the issue of missing data mainly due to the quality of national reporting systems in developing countries in the sample. For the missing data, a linear extrapolation formula was used: $Y(x) = b+(x-a)*(d-b)/(c-a)$. To ensure that the relationship between national intellectual capital and HDI was not changed due to the missing data, additional tests of the panel regression models were performed. Most of the missing data were caused by unavailability of data for the earlier years, but in most cases the data continued to be available once reported. Due to the later availability of data and since this did not cause any methodological weaknesses in resulting panel, the authors did not consider this as major issue for further analysis.

Table 2: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
HDI	252	.4839436	.2295874	.0026688	1.02807
NICI	252	1.16848	.5109132	.4444672	2.838758
NHC	252	.3950905	.0895133	.1744084	.6245142
NMC	252	.2573088	.139269	.0942305	.8523503
NPC	252	.3415961	.1970451	.0016076	.8948751
NRC	252	.1744846	.1568831	.008172	.5385972

Figure 4: Two-way scatter plot NICI-HDI



To further describe the data and possible relations between national intellectual capital and HDI for the mentioned 21-year period, we devised the two-way scatter plot that is presented in Figure 4.

The scatter plot reveals a strong and positive association between the analyzed variables. To further analyze the relationship between national intellectual capital and HDI, the correlation analysis is performed. The results of the correlation analysis are presented in Table 3. As it can be observed, there is a significant and strong positive correlation between all variables included.

Table 3: Correlation analysis

	NDI	NHC	NMC	NPC	NRC
HDI	1.0000				
NHC	0.8004	1.0000			
NMC	0.7857	0.7154	1.0000		
NPC	0.7616	0.6548	0.8439	1.0000	
NRC	0.6027	0.6112	0.6539	0.6016	1.0000

The strongest correlation was found between HDI and national human capital, as expected, while the national renewal capital exhibited the weakest correlation. The reason behind this is considered to be the fact that the sample mainly consists of transitional and developing economies, with the lower investments in R&D as compared to more developed economies, like the Netherlands.

In the final stage, the authors tested for the effects of multicollinearity among the used variables. Table 4 represents the results of testing the variance inflation factor (VIF).

Table 4: Variance inflation factor

Variable	VIF	1/VIF
NMC	4.37	0.228715
NPC	3.57	0.280263
NHC	2.24	0.447050
NRC	1.90	0.526036
Mean VIF	3.02	

The general rule of thumb for VIF values states that the regression model suffers from multicollinearity issue if VIF is higher than 5, but actually there is no perfect model to estimate the right cutoff values, they are merely suggested values [9]. In either case, the presented model has all values lower than 5, which suggests that some of the variables (e.g. NMC and NPC) are moderately autocorrelated but the others are not. This is useful for further analysis since conceptually, the elements of HDI (i.e. knowledge) are indirectly linked with the elements of NHC.

Panel data regression

Analysis of the collected data was performed with statistical software Stata 16. The analysis of time varying factors in longitudinal dataset, the regression analysis can be implemented through panel data regression with fixed effects or panel data regression with random effects. In general, the fixed effects panel regression is usually more suitable because it is a more convincing tool for estimating the *ceteris paribus* effect [56]. Additionally, the fixed effects approach controls for all time-related variations between the countries so that the resulting coefficients are not biased by these country-specific characteristics.

Table 5: Hausman test

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) fe	(B) re		
NHC	.1910327	.2466385	-.0556058	.
NMC	.2772807	.2568005	.0204802	.
NPC	.7107242	.6988719	.0118524	.
NRC	-.6505414	-.5899558	-.0605856	.0040915

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg
Test: Ho: difference in coefficients not systematic

chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 84.59
Prob>chi2 = 0.0000

However, a safer way in assessing which type of panel data regression to apply, the Hausman test was performed [23]. The results of the Hausman test are presented in Table 5. Given that, according to the Hausman test, the null hypothesis is that the preferred model of analysis is the random effects regression, while the alternate hypothesis is that the suitable model for analysis is fixed effects regression. According to this test if the *p*-value is small (less than 0.05), we reject the null hypothesis. This is the case with current data, so we accept the alternate hypothesis and apply the fixed effects panel data regression. The results of fixed effects panel regression analysis are presented in Table 6.

The two-way fixed effects panel data regression indicated in Table 5 has an R^2 of 0.8685, which means

that the variations in elements of national intellectual capital explain almost 87% of changes in HDI, which is high. This also confirms the goodness of fit for the selected regression model. Another confirmation of model fit can be seen in the indicator Prob>F=0.0000. If this number is lower than 0.05, the model is valid.

When observing the individual elements of national intellectual capital, we can see that all variables significantly impact the value of dependent variable, HDI because all of the *p* values are below 0.005. Moving to the nature of the relationship, we can determine that the strongest positive impact on HDI is exhibited by NPC or national process capital. This is followed by NMC and NHC, which has the lowest positive impact on HDI. Lastly, national renewal capital has inverse effect on HDI, which might seem like a contradictory conclusion. However, this conclusion is in line with the discussion by Lin and Edvinsson [33] in several aspects. The authors assert that national human capital is generally the trigger for national IC development, process capital is crucial for developing nations (which applies to most countries in the current sample), renewal capital is mainly important for highly developed economies, while national market capital is important factor for both developed and developing economies. In other words, the national renewal capital represents one of the crucial factors for a country's development, while for the transitional economies this factor might exhibit a contradictory effect due to its underdevelopment, or due to a country's heavy investments in this area that are expected to capitalize in the long run.

Conclusion and avenues for future research

The present study on the effects of components of national intellectual capital pointed to the conclusion that there is an evident positive long-term effect on the human development index. This suggests the need for macroeconomic decision makers to shift and maintain their focus on intangible elements of development. However, the effect varies depending on whether a country is labeled as developed or developing, in terms of the analyzed human development index. The developed countries' growth is primarily driven by the human and renewal capital, entailing education levels of a nation and country's investments in further deepening their knowledge base. In the case of developing economies, the renewal capital is not the key development trigger. This might be caused by the current low development levels of this sort of capital or by the fact that these investments possess significant lagging characteristic and thus have not yet been seen to reach the fruition phase. In other words, the investments might be impeding the current growth, but significant growth is expected when the investments in research and development are capitalized.

Table 6: Panel data regression with fixed effects

Fixed-effects (within) regression					**Number of obs** =	**252**
Group variable: Countrycode					**Number of groups** =	**12**
R-sq:						**Obs per group:**
within = 0.8685					**min** =	**21**
between = 0.2363					**avg** =	**21.0**
overall = 0.3873					**max** =	**21**
					F(4,236) =	**389.51**
corr(u_i, Xb) = -0.0024					**Prob > F** =	**0.0000**
HDI	**Coef.**	**Std. Err.**	**t**	**P>|t|**	**[95% Conf. Interval]**	
NHC	.1910327	.0946267	2.02	0.045	.0046117	.3774537
NMC	.2772807	.0689162	4.02	0.000	.1415112	.4130502
NPC	.7107242	.0348267	20.41	0.000	.6421133	.7793351
NRC	-.6505414	.0683644	-9.52	0.000	-.7852238	-.515859
_cons	.2078504	.0292703	7.10	0.000	.150186	.2655149
sigma_u	.18245806					
sigma_e	.04197093					
rho	.94974513	(fraction of variance due to u_i)				
F test that all u_i=0: F(11, 236) = 147.17					Prob > F = 0.0000	

Serbia is seen as developing country in terms of human capital index value and rank in 2022, which ranks it at 64th position worldwide. In terms of NICI, Serbia ranks relatively good, compared to its counterparts in European Union (like Greece for example). This does not provide a solid basis for future growth, nor does it guarantee. This is caused by a complex relationship between NICI components and overall country-level growth and development. The important notion is that IC represents an important factor of economic growth. Even if not all NICI components affect HDI positively, they are all important ingredients, especially for developed economies. Developing economies still need to invest in all forms of IC to reach a higher development stage. "Some IC components function as pillars, some as drivers for economic growth in developed economies, and these pillars and drivers are different in economies on dissimilar economic levels" [44, p. 174], which makes the entire IC analysis a complex matter for policymakers. Finally, policymakers need to be aware of national IC in order to invest in it and develop it further, which is why the authors here try to bring the topic of national IC to their attention.

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INNOVATIONS, PRODUCTIVITY AND GROWTH: REFORM AND POLICY CHALLENGES FOR SERBIA

Inovacije, produktivnost i rast – reformski i ekonomsko-politički izazovi Srbije

Abstract

The economic annihilation caused by the wars, sanctions and hyperinflation has elevated the issue of restoring previous income and welfare levels to the very top of political and social agenda. Consequently, all efforts during the past two decades were focused on reviving economic growth. Initially the main source of growth was consumer demand financed by external grants and privatization proceeds, followed by industrial revival and new jobs financed by external borrowing and strong FDI flows. In recent years it is becoming increasingly clear that higher sustainable rates of growth needed for income convergence with Europe and improved standards of living can only be achieved with production, organizational and process innovations. This paper reviews the elaborate structure of the present national innovation system in Serbia and concludes that more than 120 academic and almost 80 R&D institutions are competing for very limited resources of around 0.9% of GDP, produce declining innovation output and do not collaborate with the enterprise sector to increase productivity and growth. To have a better impact on productivity, long-run growth and well-being of all citizens, innovation funding must be doubled, innovation priorities must be identified based on empirical evidence and R&D and innovation performance must be evaluated based on results.

Keywords: *innovation, productivity, economic growth, research and development, patents*

Sažetak

Ekonomska katastrofa prouzrokovana ratovima, sankcijama i hiperinflacijom stavila je pitanje vraćanja prethodnog nivoa dohotka i blagostanja na sam vrh političke i društvene agende. Posledično, svi napori u protekle dve decenije bili su usmereni na oživljavanje privrednog rasta. U početku je glavni izvor rasta bila potrošačka tražnja finansirana grantovima i prihodima od privatizacije, nakon čega je to mesto preuzelo oživljavanje industrije i otvaranje novih radnih mesta finansirano spoljnim kreditima i snažnim prilivom SDI. Poslednjih godina postaje sve jasnije da se veće održive stope rasta potrebne za približavanje prihoda s Evropom i poboljšani životni standard mogu postići samo uz pomoć proizvodnih, organizacionih i procesnih inovacija. Ovaj rad daje pregled razuđene strukture sadašnjeg nacionalnog inovacijskog sistema u Srbiji i zaključuje da više od 120 akademskih i gotovo 80 istraživačko-razvojnih institucija konkuriše za vrlo ograničene resurse od oko 0,9% BDP-a, proizvode opadajući inovacioni autput i ne sarađuju sa preduzećima da bi se povećala produktivnost i ekonomski rast. Da bi imale bolji uticaj na produktivnost, dugoročni rast i dobrobit svih građana, potrebno je udvostručiti finansiranje inovacija, prioriteti finansiranja i podržavanja inovacija moraju biti ustanovljeni na empiriji, a performanse istraživanja i razvoja i inovacija moraju se ocenjivati na osnovu rezultata.

Ključne reči: *inovacije, produktivnost, ekonomski rast, istraživanje i razvoj, patenti*

Introduction: Definition of innovations

Innovation is a relatively new term dating back to the beginning of the 17th century[1], although the concept of innovation existed for thousands of years. Innovations have marked the history of human development over the last four millennia. Technological innovations were the basis of critical production and survival knowledge of such importance that the two key periods preceding the new era were named after innovative metal processing technologies: the Bronze Age (from 2200 to 750 BC) and the Iron Age (from 700 BC to the beginning of the new era).

During the time of classical civilizations (Greece, Rome, Persia, Byzantium, China), the field of innovation expanded to the sphere of organization of the state and the army. Technological innovations once again took the center stage during the First and Second Industrial Revolutions, which were the basis for the emergence of a capitalist market economy and, to a large extent, of the competing non-market planned economies. Innovation brought new sources of energy, changed the production technology and organization as well as the concept of management. It enabled unprecedented growth in productivity, income levels and the living standards. More specifically, innovations enabled:

- New energy sources (steam engine, electric motor, internal combustion engine, nuclear power);
- New industrial machines that (partly) replaced human labor;
- New means of transport (train, steam ships, cars, planes);
- New means of communication (telegraph, telephone, radio).

Indirectly, these innovations radically changed not only the way of life (industrialization, urbanization) but also changed political organization and introduced decision-making based on representative democracies (i.e. political parties and elections). Nevertheless, for many decades the definition and common understanding of innovation were limited to a one-way causal link: from invention - to innovation of a product, process or technology.

Today, the meaning and content of INNOVATION have expanded to

- INCLUDE application of inventions, new ideas, novel approaches
- TO create new value
- IN production, application, assimilation, exploitation
- WITHIN enterprise, economy, society, global world
- BY renewing existing or developing
- NEW products, services, processes, technologies, markets, management methods
- RELATING to inputs, outputs and/or results/outcomes.

It should be emphasized that innovations can be:

- Sustaining – when they improve existing products and/or processes (and coexist with them) or
- Disruptive – if they introduce new products and/or processes that substantially change the way a specific need is met and thus displace old technology/organization/management.

In short, innovation always means the direct or indirect application of inventions (i.e. inventions, new ideas, innovations, etc.) to new products, technology, processes, organization, but also a new way of management, communication or decision-making. Application is a key word here, which means confirmation of invention/innovation on the market (through commercialization) or confirmation/acceptance in society. Without implementation, inventions only increase the fund of knowledge but do not represent innovation at the time. It happened many times in history, though, that cumulative effect of many ideas, concepts and inventions eventually leads to quantum leaps in innovations many years later. For example, theoretical breakthroughs and inventions in nuclear physics enabled applied research and innovations based on nuclear power (ranging from atomic arms to nuclear power stations, submarine engines, and use of radiation for medical treatment).

Source and historical significance of innovation

China had one of the most developed economies in the world before the First and Second Industrial Revolutions.

1 The first formal mention of the term is found in F. Bacon in the book "On Innovations" published in 1625. The book deals with the emergence of new biological species rather than economic and social issues.

Thanks to, among other things, innovations, Western Europe, the United States and Japan have sharply increased productivity, accelerated economic growth and overtaken China in terms of output, income and quality of living standards. This poses many questions: To what extent have innovations contributed to faster economic growth? How can one measure the effectiveness and impact of innovations? What is the role of the market, and the state in the process of creating innovations? What type of companies (enterprises) are likely to become main national and global innovators? How does productivity growth enabled by innovations affect the wages, the level of knowledge and the income inequality within and across countries? What policies encourage innovation, productivity, economic growth and international competitiveness?

Measuring (supply of and demand for) innovation is becoming a central issue today. Patents and IPR (intellectual property rights) are potentially the key to answering the question of encouraging and measuring innovation. In 2019, three Stanford professors Stephen Haber, Edward Lazear and Amit Seru [7] discussed the issue of empirical measurement of innovation levels and effectiveness, the link between innovation and productivity growth (and, hence, economic growth), and the effects of productivity growth on inequality (in income and wealth distribution). Their research confirmed that the new innovation firms founded in the "Silicon Valley" are indeed the main modern source of innovation, but it also showed that existing firms are very innovative and active in registering new quality patents. Their research also showed that both private and public companies contribute to innovation, and that universities and state institutions can be very innovative.

The main objective of their empirical research was to develop an indicator of "high quality innovation". They used "big data analysis" to screen 9 million patents registered in the United States over the past two centuries and identify the occurrence of keywords in the technical description of the patents.

The analysis showed that:

- *Patents with essential innovations* (true novelties) frequently contained *new keywords* and had relatively small presence of older keywords found in previous patents;
- *Important patents* introduced new keywords which were *often repeated* in later (newer) patents;
- *High quality innovations/patents* met both criteria. They introduced new keywords that were often repeated in later patents. In other words, they brought fresh innovations that proved to be important as they affected later patents.

The resulting list of "high quality patents" proved to be quite similar to the list of patents that have already been recognized as significant patents in the economic and business literature. Their research showed that big data analysis can be used to identify and promote high quality patents and innovations, and set priorities in R&D field based on modern empirical research with minimal time lags.

Source of innovation: Where do innovations come from?

Inventions and ideas and related innovations are created either by individuals (individual research) or organized groups (or networks) of researchers. Innovations are confirmed (or validated) either in the market or outside the market (in social groups or society as a whole, by individual country or a group of countries such as the EU, or by a global society).

More precisely, based on authorship we have:

- Individual innovations where the authors of inventions, as the basis of innovation, are either an individual or a small team engaged in a scientific research organization or a small company, or an individual researcher (such as Tesla), or
- Network innovations where inventions and innovations are the result of an organized collective effort of coordinated teams working on the same task.

According to the method or place of validation, we have:

- Market innovations where inventions/innovations are validated/confirmed either in the market by selling or assigning copyrights to an invention/innovation, or
- Non-market innovations where inventions, ideas and related inventions are not valorized directly in

the market but represent a public good (part of the knowledge fund or info sphere) which is confirmed by acceptance in social groups or society as a whole.

By combining the two criteria of "authorship" and "place of validation" we get the following classification of innovations (see Table 1).

By mapping all known inventions/innovations since the middle of the 18th century until today, three long-term tendencies have been observed:

- *First,* a dramatic increase in the number of innovations over time;
- *Second,* a growing share of network innovations that are the result of the organized work of a large number of professional research teams (second and fourth quadrant); and
- *Third,* a huge increase in the number of innovations that were not confirmed in the market through sales of products, technologies or organizational solutions, but through widespread acceptance in society (third and fourth quadrant).

On this basis, Johnson [8] concludes that an efficient and healthy modern national innovation system (NIS) must have a dynamic and well-organized fourth quadrant – of non-market network innovations that have a huge positive impact on raising intangible sources of productivity growth at the level of society as a whole and the development of the knowledge society.

Empirical research surveyed by Reamer [12] shows that innovations generate the best effects in an open ecosystem characterized by the free flow of ideas, knowledge and information through unregulated (or minimally regulated) and free market and social channels. Conversely, there is strong evidence that controlled and limited channels stifle ideas and innovations based on them. This is where the principles of free market economy clash with the innovation incentive system based on patents, IPRs and copyrights in general. As Schumpeter and, later, Baumol [3] argued, in an ideal market economy (with full competition), the immediate financial interest of innovators encourages the generation of inventions and innovations at an optimal level. Patents and other forms of protection of copyright and other property rights play a key role. But in practice we rarely find ideal conditions and, hence, the reliance on patents and intellectual property rights can help but also hinder the optimal generation of ideas and the spread of innovations.

Most of the new ideas that changed the paradigm of scientific ideas, applied research and technological innovations in the so-called Third Industrial Revolution have deep roots in academic research - that is, inventions that are in the fourth quadrant. In addition, an open network of academic research (which is confirmed by reviews and published) often creates or is the basis for creating knowledge platforms on which applied individual and group research with market verification is based. In other words, inventions and innovations from the fourth quadrant have a strong positive effect on the performance

Table 1: Classification of innovations

MARKET	Individual researchers or entrepreneurs private SMEs *Use of patents to protect IPRs* Examples: Tesla coil, dynamite, AC motor, transistor, vulcanized rubber **Market – Individual 1**	Research teams or institutes market competition of private firms *Use of patents to protect IPRs* Examples: airplane, refrigerator, telegraph, radio, laser, jet engine, automobile, PC **2 Market – Network**
NONMARKET	**Non-market – Individual 3** Individual researchers or entrepreneurs philanthropists *Share inventions, ideas free of charge* Examples: nitroglycerine, ecosystem, CT scan, Atomic theory, WWW Internet	**4 Non-market – Network** Academic organizations financed by the budget or grants *Share inventions, ideas free of charge* Examples: radar, computer, Germ theory, GPS, EKG, aspirin, penicillin, DNA, MRI
	INDIVIDUAL	**NETWORK**

Source: Reamer [12] and Johnson [8]

of the second quadrant (market-oriented group/network research), but also individual research (i.e. first and third quadrant). This is especially true for the so-called general purpose technologies (GPT) that have wide application and huge potential impact on organizational and managerial efficiency. This accelerates the effect of innovation on productivity and economic growth as it allows earlier diffusion (narrows the coverage and shortens patent protection time) and the effect of innovation on business practices and corporate structure in industrial production[2] and in services[3] (including logistics).

The theoretical question of how to properly integrate innovations into economic growth theory is surveyed in Grossman and Helpman [6]. The practical policy question is how to find the best relationship between the patent and IPR protection and the beneficial development and diffusion of innovations with effects on economic growth and human well-being (i.e. quality of life).

Effects of innovation on productivity and economic growth

The net effects of innovation on employment, productivity and income growth were positive during the First and much of the Second Industrial Revolution. The result was a dramatic improvement in standards and quality of life (mass introduction of household appliances). In the period 1947-1975, productivity and the real income of families in America grew at almost the same rate, indicating an equal distribution of the effects of economic prosperity based, among other things, largely on innovation (see Figure 1). After 1975, productivity grew noticeably faster than real household income. This shows that capital owners and individuals with special abilities (in management, arts, sports, science, etc.) reap most of the effects of cumulative productivity growth, while the real average income of the population stagnates or even declines.

Consequently, innovation is one of the factors that contributed to much faster growth of income of owners and individuals with special knowledge/abilities, increasing inequality not only due to less favorable income ratio of rich and poor, but also due to stagnation or decline in real middle income (expressed in median) and service families.

To some extent, the statistically recorded decline in real wages and incomes was partially offset by rising purchasing power for consumer goods and services from sectors with fast-innovation, especially information, communications, and computer services. At the same time rising real costs of housing, transportation, health services, higher education, culture and sports, etc. neutralized much of these gains.

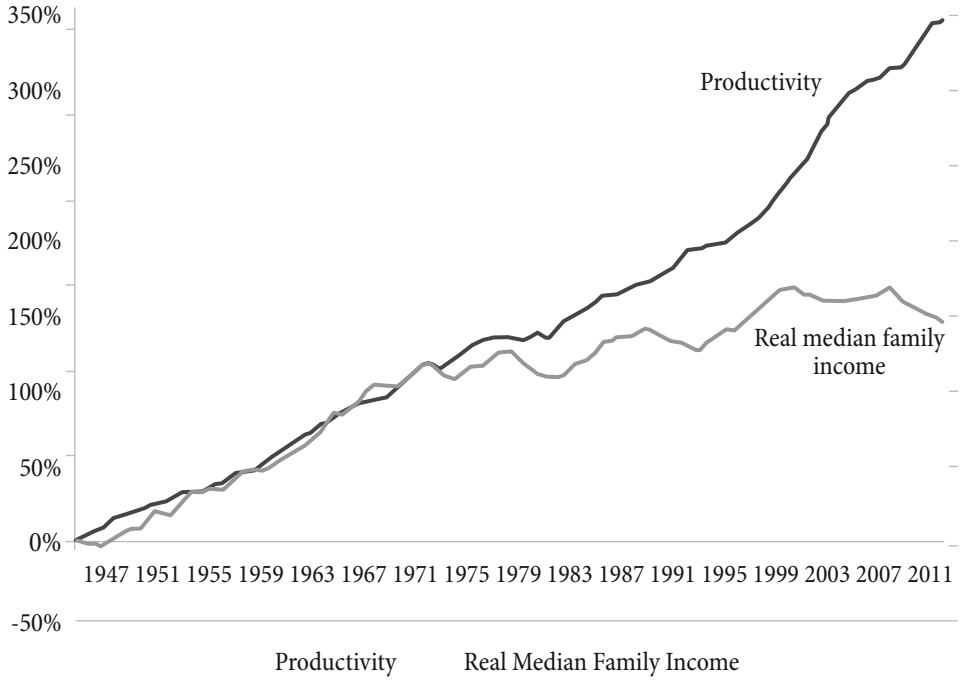
The main reason driving such changes in real prices could be attributed to predictable effects of innovations and new technologies aimed at automation. Coupled with strong globalization processes in trade and production, this has led to increased productivity and reduced employment per unit of GDP, while massively shifting standard high-paying jobs to lower-income countries. Lower and middle management jobs have followed the same trend. Over time, this reduced the demand for this profile of workers and enabled the management to noticeably reduce both the salaries/wages and other benefits provided within employment contract. This has increased inequality and produced far-reaching changes in the structure of labor demand, demand for innovation and investment in general with far reaching effects on economic growth and the well-being of most people.

These effects should be taken into account when defining innovation strategy and policy. As Acemoglu [1] and Restrepo [2] have shown convincingly, innovation policy directly affects not only average productivity growth but also the scope and nature of automation, and thus the effects on employment. Obviously, the interest of investors and owners remains profit maximization. Depending on the scope and nature of innovation, productivity growth can be achieved either through automation (i.e. labor replacement by machines) or by using new technology

2 The example of the moving assembly line in the automotive and other branches of industry shows this best. It has been 30 years between the confirmation of innovations and their application in factories. The resulting doubling in productivity could have happened much earlier had this general-purpose technology been supported in the right way.

3 A good example here is the introduction of integrated information systems at the level of production and service value chains that have enabled more efficient management of inventories and production in accordance with the dynamics of sales and demand.

Figure 1: Productivity and real median family income growth, 1947-2011



Source: Reamer [12]

and/or processes to increase employee efficiency and productivity. To illustrate this, let us assume that there are two types of product/process innovations with the same combined total net benefits (including R&D cost, investment cost and the reduction in operating costs including labor). In the first case, improved productivity is achieved through innovation that involves higher level of automation which requires higher investment cost which is compensated by a greater reduction in the number of employees. In the second case the same improvement in productivity is achieved through innovation that enhances labor efficiency (and hence wages). In the first case most of the effects of increased productivity are appropriated by the owners, while in the second case the effects of productivity growth are shared more evenly by owners and employees.

That is why we cannot assume that inventions and innovations alone lead to an increase in the well-being of all residents even when they increase economic growth and GDP. In principle, the effects of innovation on increasing inequality can be balanced through tax policy, but this approach is much more complicated politically. It is better to use innovation policy to promote innovations (products, processes, technologies) that have desirable effects on equality, social and environmental sustainability.

In short, Reamer [12] based on a detailed analysis of empirical and applied policy literature concludes that inventions and innovations play a central role in promoting economic growth.

- There is no dilemma for economic historians: accelerating economic growth during the First and Second Industrial Revolutions would not have been possible without key technological and organizational innovations.
- Analysis of the contribution of innovation to economic growth (innovation accounting) indicates the great importance of new (innovated) products and processes enabled by investments in research and development that increase the efficiency of (physical and human) capital and intangible assets.
- Macroeconometric analysis points to strong links between R&D investment and economic growth. The results of this analysis for 19 EU countries confirm strong ties, but show that the direction of these influences is not unambiguously determined.
- Microeconomic empirical (econometric) analysis based on firm data unequivocally shows that firms that innovate not only achieve faster productivity growth, but also create more jobs, earn higher wages for employees and higher profits for owners.

- Schumpeter's theory (and Baumol's reinterpretation) according to which innovations are the basis of the so-called creative destruction that displaces old products, processes and technologies and gives net positive effects on employment and economic growth is valid in ideal conditions of perfect competition and free markets, but not in real conditions.

It is important to understand in more detail how inventions and innovations affect economic growth, and how this impact affects the well-being of all residents/people. It is equally important to know which institutional assumptions and measures of direct support and economic policy optimally help the development of such inventions and innovations.

Characteristics of a good national innovation system (NSI). A good national innovation system according to Johnson (2010) has the following characteristics:

- Significant public investment in research and development (provide theoretical and practical arguments);
- Incentive system in which companies develop and/or apply a combination of new products, processes and organizational solutions that give the highest growth rate of companies (measured by production and employment);
- Allocation and mobility (reallocation) of resources in line with innovation in order to achieve optimal results in productivity growth; and
- Meets the following criteria:
  1) has educated/qualified workforce,
  2) demonstrates high level of entrepreneurship,
  3) adopts patent policy that secures balance between the protection of intellectual property and the free availability of innovative information,
  4) follows organizational solutions that support the development of networks,
  5) promotes reliable statistical data on key dimensions of innovation,[4]
  6) pursues principles of inclusive and sustainable economic development, and
  7) favors strong democratic institutions, including freedom of speech, rule of law, civilized relations and decency, and the right to research and experiment in the field of technological, organizational, institutional, business and social inventions and innovations.

Impact of innovation on GDP: Econometric result for EU countries

An empirical study of the impact of innovation on p/c GDP growth in 19 EU countries during the 1989-2014 period was done by Maradana et al. [10]. The study conducted co-integration tests between the following six independent variables and GDP p/c growth rate:

- The number of resident patents (Case 1) and non-resident patents (Case 2);
- R&D expenditures (Case 3) and the number of R&D researchers (Case 4);
- High-tech exports (Case 5); and
- Scientific and technical journal articles (Case 6).

Granger causality tests were conducted (for all 19 countries and the EU, and for each of the six cases) to establish the direction of causality. In 50, out of 120 regression results, the study found unidirectional causal relationship (UCR) between innovation and economic growth. This supports the supply-leading hypothesis where innovations precede economic growth.

- Expectedly, the UCR occurred most frequently (in 21 out of 40 regressions) in combined cases 3 and 4 estimating the impact of R&D expenditures and the number of researchers on p/c GDP growth rate.
- UCR was confirmed in 18 out of 40 regressions in combined cases 1 and 2, thus confirming that patents have a strong role in promoting innovations which in turn have a positive impact on growth.
- Only 11 out of 40 regressions which passed the UCR granger test were found in cases 5 and 6.

In 38, out of 120 regression results, the study found reverse causal relationship (RCR) between innovation and economic growth. This supports the demand-following hypothesis where p/c GDP growth precedes innovations.

4 Including data on inventions, innovations, R&D, investments in intangible assets, SME development, benefits of digitalization, financing of SMEs and startups, etc.

- The RCR occurrence was distributed more evenly across the six cases with the highest frequency (15 out of 40 regression) found in cases 5 and 6, frequently (in 21 out of 40 regressions) in combined cases 3 and 4 estimating the impact of R&D expenditures and the number of researchers on p/c GDP growth rate.

Finally, in 22 out of 120 regression results, the study found bi-directional causal relationship (BCR) between innovation and economic growth. This supports the hypothesis of mutual interdependence between p/c GDP growth and innovations. This is the dominant form of causal relationship at the level of EU (in 4 out of 6 cases).[5]

In short, the results of the study confirm that the level and structure of innovations measured through patents, R&D inputs, hi-tech export performance and scientific and technical publications, had a decisive role in stimulating economic growth. In nine countries (Belgium, Finland, France, Hungary, Italy, Netherlands, Romania, Sweden, UK), innovation precedes p/c GDP growth and thus supports the hypothesis of the leading role of "innovation supply". In four countries (Denmark, Ireland, Norway, Spain), per capita economic growth precedes innovation and thus supports the reverse causality hypothesis with the leading role being attributed to "demand for innovation". In six remaining countries (Austria, Czech Republic, Germany, Greece, Poland, Portugal), innovation and per capita GDP are either mutually interdependent, confirming the hypothesis of a feedback loop between supply and demand in relation to innovation and growth, or cannot be determined based on the six tested cases.

In line with these results, the study recommends that in designing policies to promote per capita growth, special attention should be given to their impact on innovations. For example, it would be desirable for policies aimed at increasing foreign direct investment (FDI) to also attract production, technological and organizational innovations. In other words, the state should play an active role in supporting and attracting FDIs that bring not only new jobs and GDP growth, but also innovation as the basis for future growth. Based on the experience of the EU countries, this is best achieved by:

First, actively promoting the idea of the importance of innovation for (social, resource and environmental) sustainable long-term growth. This becomes increasingly important if simple policy interventions have already been exhausted (reduction of unemployment and relocation of labor from agriculture and extensive activities to modern industry and services) and future economic growth hinges on achieving a more efficient combination of inputs, productivity growth and better products and services.

Second, the state must support and nurture general innovations both:

- Indirectly, by creating a favorable environment for companies that are willing to invest more (in growth and development) and innovate; and
- Directly:
  - (a) by financing research (and development) in the public sector (in state universities, in public and state-owned enterprises and in state institutes), and
  - (b) by supporting private investment in research and development and innovation through tax incentives, subsidies and grants.

Third, the state should tailor sectoral support for innovations depending on the country's development needs and competitive advantages. This requires finding the right balance between support for improving national innovation system and (direct and indirect) support for innovations targeting specific groups or actors in the innovation process. Veugelers and Schweiger [13] show that this combination can only be found based on country specific empirical studies and frequent updates as it evolves over time.

Serbia: Innovation system design and performance

Serbia has a very elaborate institutional system in the areas of science, R&D, and innovation. At the highest level are the Government and the responsible ministry (Ministry of Education, Science and Technological

5 To complete the picture it should be noted that in 8 regressions no causal relationship between innovations and growth could be established. For details see Maradana et al. [10].

Development - MESTD). Other ministries are responsible for important areas of science, research and development (energy, infrastructure, environment, agriculture, defense, economy, finance etc.).

According to the Law on Ministries, the Ministry of Education and Science has broad powers in defining and implementing the strategy and policy of scientific research and innovation. The Ministry is assisted in defining and implementing the relevant strategy and policy by the National Council for Scientific and Technological Development.

Within the MESTD ministry, three sectors deal with science, research, development and innovation issues. The division of responsibilities between science, research and development, and innovation is not always clear. Especially on the transition of basic research to applied research and further to innovation.

In the wider field of science, research and development, and innovation, Serbia has the Science Fund, the Development Fund and the Academy of Sciences and Arts (SANU), 38 scientific institutes (8 of them within SANU) and 35 research and development institutes, 22 centers of excellence, 123 faculties and/or universities, and 12,000 researchers.

In addition, according to MESTD official internet site, the Innovation Fund directly deals with 139 innovation organizations, 16 companies to support innovation activities (including 4 science and technology parks and business incubators), as well as 209 registered individual innovators (of which only 87 are active today and 122 have been deleted from the register). The Development Agency of Serbia (RAS) and the Chambers of Commerce also deal with and support R&D and innovation organizations. Innovations are also supported by technology transfer centers, the Intellectual Property Office, the Office of Information Technology and e-Government, and the Institute for Standardization.

During the past ten years, numerous very impressive results have been achieved in scientific and research work. The number of publications in scientific journals has increased significantly. The number of patents as well. Hundreds of scientific and innovation projects have been completed on the basis of funding from domestic and foreign sources through the Science Fund and the Innovation Fund.

Serbia's performance based on the Global Innovation Index

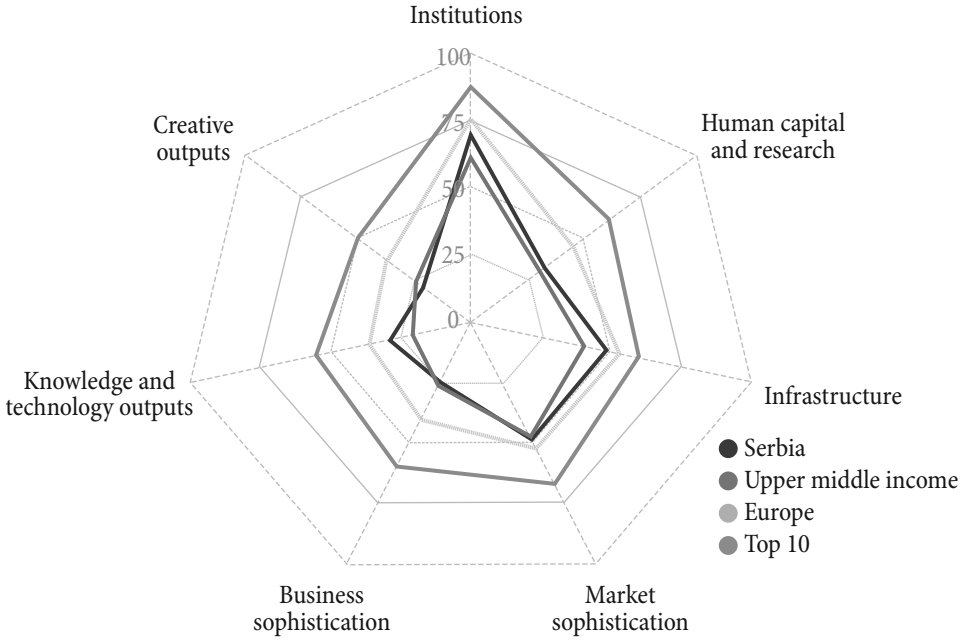
According to the Global Innovation Index (GII) for 2021 (see WIPO [15]), Serbia is slightly above the regression line depicting the effect of innovation on economic development (measured by GDP per capita expressed in purchasing power parity). This positive effect is certainly the result of increased investment in science, research and development, and innovation. Unfortunately, the efficiency of these investments was not as good: In terms of the ratio of innovation inputs and outputs, Serbia is below the regression line. This means that increased innovation investment was not well targeted either due to incorrect choice of priorities or due to muffled redirection of resources in line with recognized priorities. In practice, both factors probably worked.

According to GII estimates for 2021, Serbia ranks 54th in the overall innovation indicator. On the side of providing inputs for innovation, it has a better ranking (50th place) than on the side of innovation output (57th place), which indicates a lower average efficiency of using limited and quite expensive innovation resources. Moreover, there has been a relative deterioration in this aspect of performance compared to the GII 2020 report, indicating a decline in marginal effectiveness which should be taken into account when considering how to allocate innovation resources and measure the achieved innovation results.

It is important to emphasize that Serbia has better relative performance in relation to the group of countries with similar income levels (eighth place among 34 middle-income countries globally) than in relation to its region (Europe) where it ranks 34th from a total of 39 countries. This can be clearly seen in Figure 2, which gives a comparative overview of the score achieved by Serbia in each of the seven pillars of the GII index in relation to the score of countries with comparable middle incomes, Europe and ten countries leaders in innovation.

Compared to the group of middle-income countries, Serbia has better performance in all pillars of the GII

Figure 2: Serbia's relative performance across seven GII pillars, 2021



Source: GII 2021 [15]

index except in "business development" (where it lags behind marginally[6]) and "creative outputs" (where the lag is more noticeable).

Out of ten advantages of Serbia identified in the GII index 2021 report, the most significant for the national innovation system are: exports of IT services and creative services, ISO certification, FDI, number of articles in scientific journals, industry diversification, low tariff rates, and a favorable small student-professor ratio. These indicators can represent true advantages in the broad innovation area under a certain set conditions. But these conditions do not always hold.

For example, higher FDIs are beneficial for innovations if they bring new jobs, modern technology and better management practices. But if they bring low paying jobs, inferior technology and organization, and contribute to excessive diversification which lowers competitiveness, higher FDIs may not be well aligned with progress in innovations. Likewise, higher number of papers in scientific and technical journals can be an indicator of progress in creating inventions and innovations. But it can also indicate a weakness (a gap or discontinuity) in the process of developing ideas leading to applied innovations if the growing number of published scientific and technical papers grows in relation to the number of registered patents and (production and process) innovations. The same applies to a good average student-teacher ratio if it is not a result of a planned improvement in the education system but rather a consequence of low birth rates and migration from rural areas. Therefore, the perceived advantages based on better numerical values of selected indicators should be critically evaluated to ensure their effective impact on the quality of innovation system.

Furthermore, some perceived shortcomings should be viewed in the relevant context. For example, out of eleven indicator weaknesses identified in the GII index 2021, as many as eight are strongly connected and, taken together, suggest an unsatisfactory state of innovations at the microeconomic/corporate level. For some dimensions (covered by indicators such as enterprise expenditures on R&D, hiring researchers, spending on software and intangible assets, and brand value) companies bear full responsibility. For other dimensions (such as low capitalization, poor cluster development, and energy

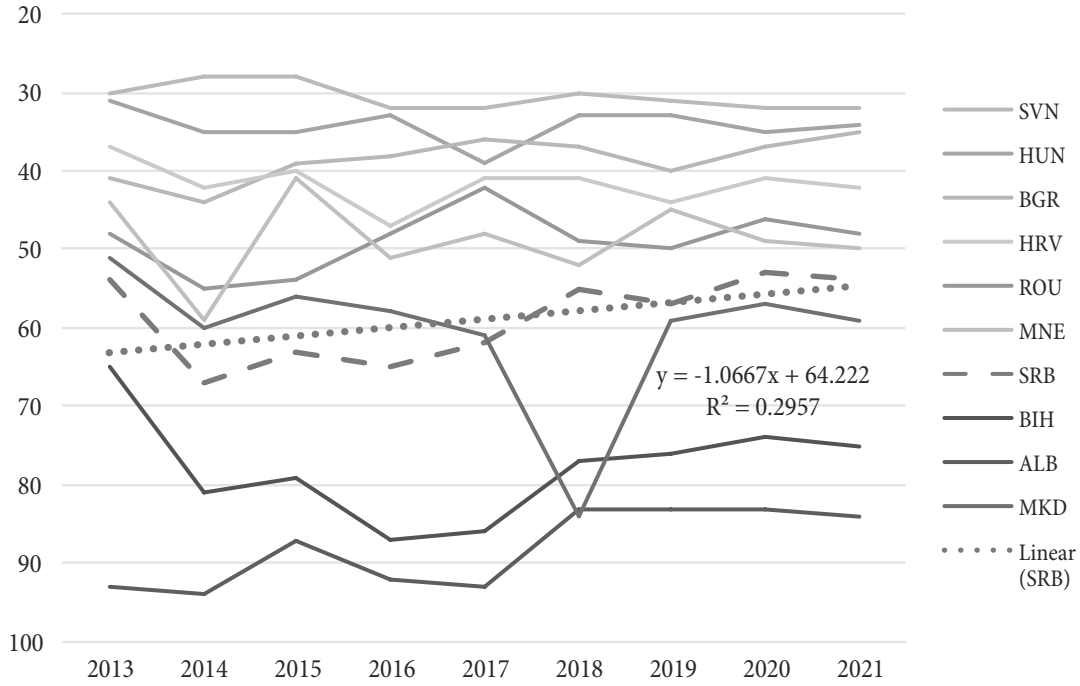
6 Although marginal in the numerical score, the lag in "business development" is serious in substance, as it stems from six strategically important factors: 1. low GERD (gross R&D expenditure) of companies (78th place), 2. weak cooperation between business and universities in R&D (85th place), 3. low level of cluster development (107th place), 4. relatively small number of joint ventures and PPP projects (80th place), 5. low imports of hi-tech equipment and products (75th place), and 6. small number of researchers employed in companies (64th place).

inefficiency) the responsibility is mostly at the country level.

This, of course, complicates the process of identifying the causes of identified weaknesses, setting priorities, and finding the right set of reforms and practical policy measures to support innovations with the highest impact on productivity, economic growth and sustainable development.

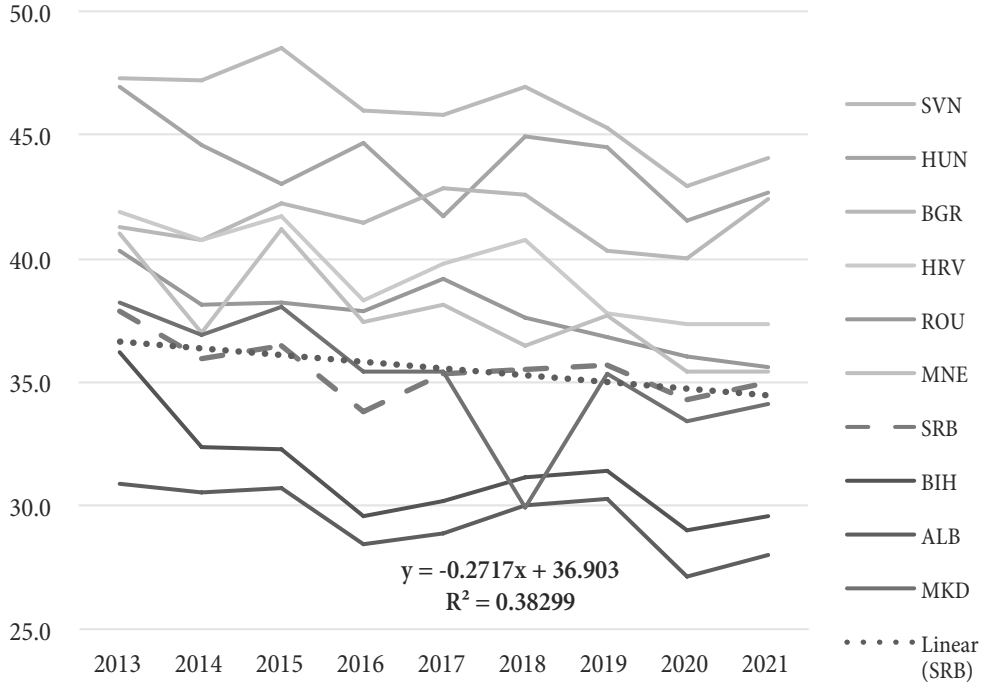
The following figures 3-12 are based on the GII WIPO database for the 2013-2021 period. We selected the following group of nine countries as regional leaders and comparators to Serbia (Slovenia, Hungary, Croatia, Bulgaria,

Figure 3: GII Rank, 2013-2021



Source: GII database, author's calculations

Figure 4: GII Score, 2013-2021



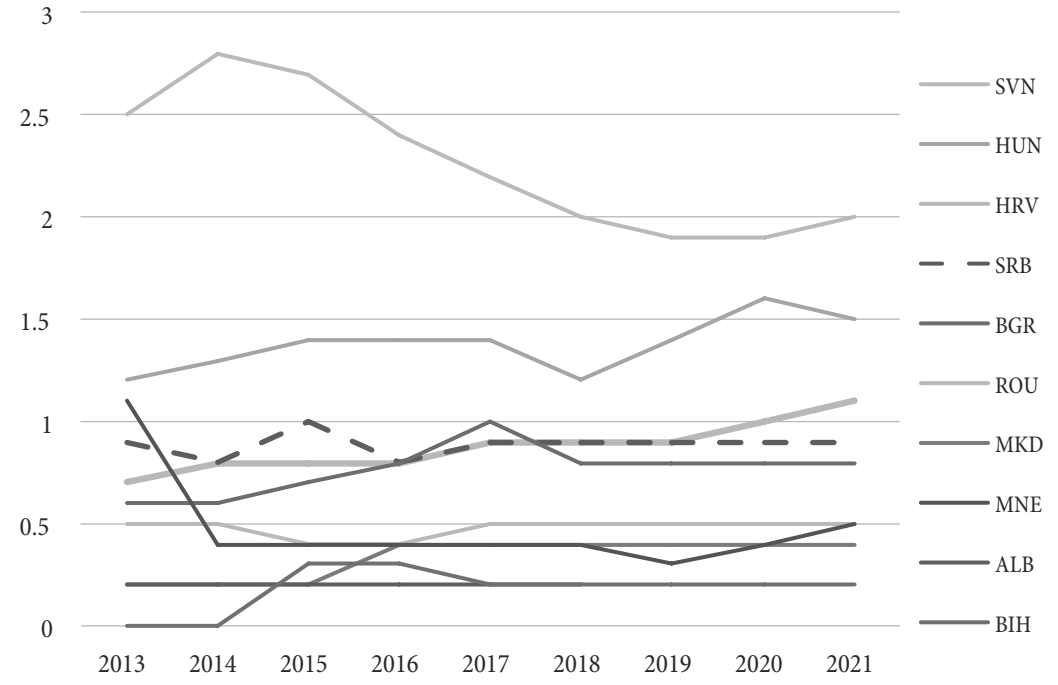
Source: GII database, author's calculations

Romania, North Macedonia, Montenegro, Bosnia and Herzegovina, Albania). The choice of indices was motivated by our primary objective to illustrate Serbia's innovation performance based on GII index, innovation Input and Output subindices, as well as some of the key indicators capturing financing, research potential and output.

In terms of key GII performance indicators Serbia consistently improved its overall GII rank (see Figure 3) despite the less stable and declining trend of the overall GII score (see Figure 4).

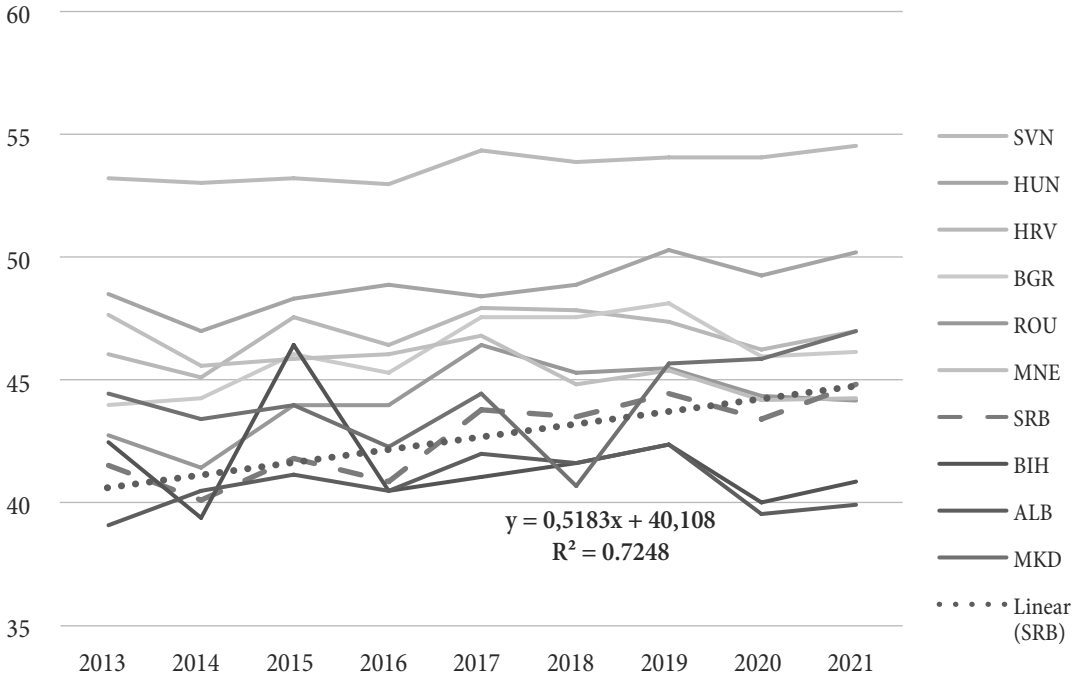
Gross expenditures on R&D (GERD) remained flat at about 0.9 percent of GDP during the entire period (see

Figure 5: GERD, 2013-2021



Source: GII database, author's calculations

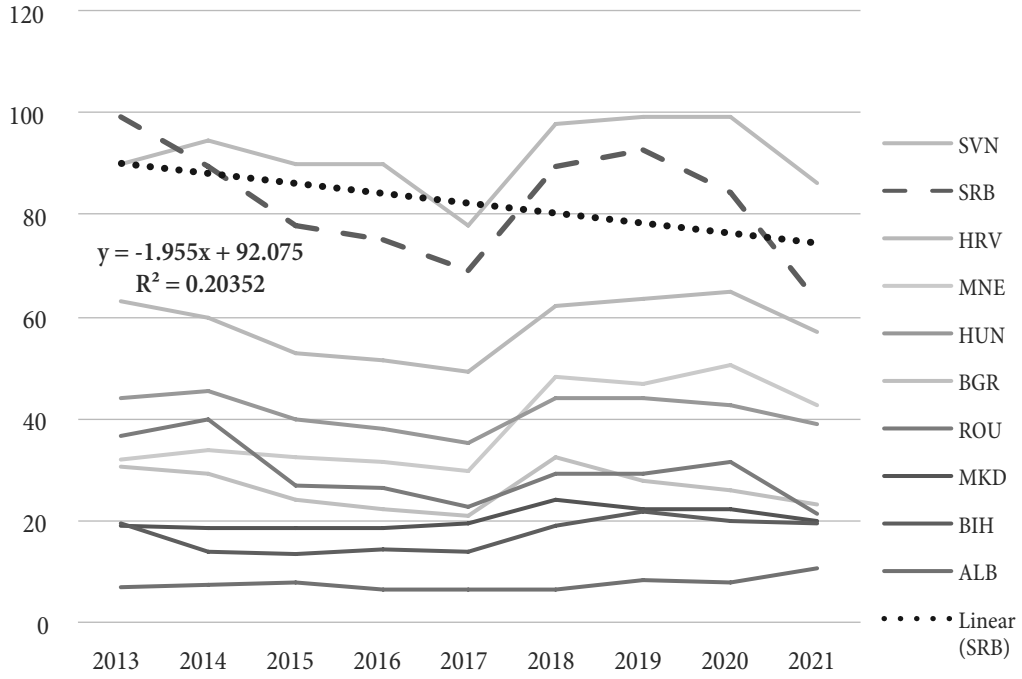
Figure 6: Innovation inputs GII methodology, 2013-2021



Source: GII database, author's calculations

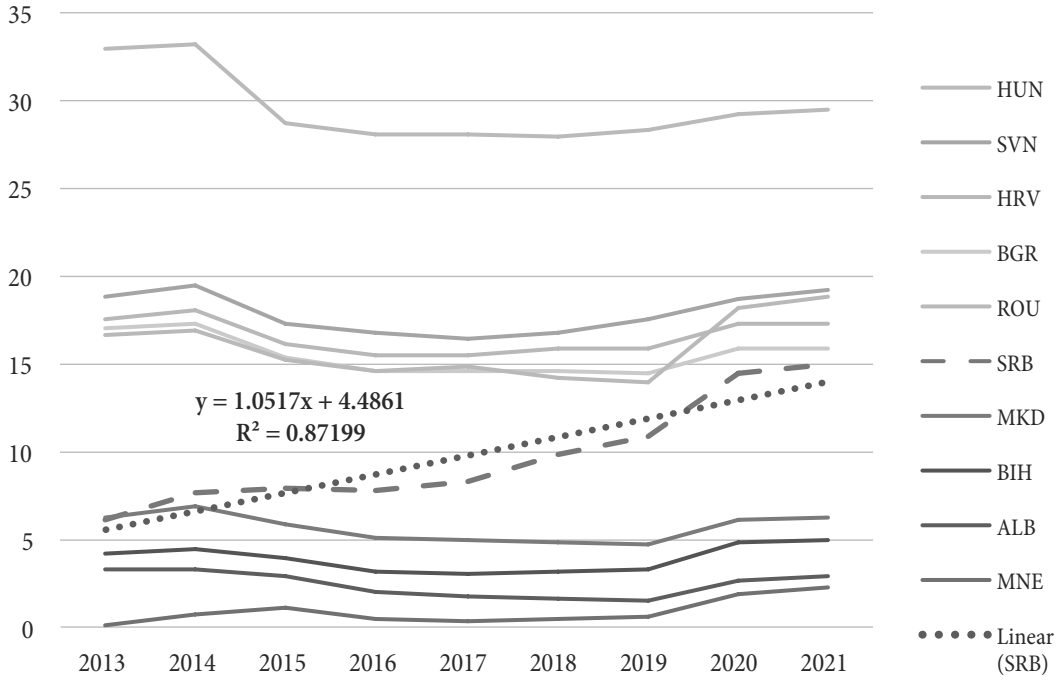
Figure 5), but consolidated innovation inputs (based on the GII methodology) consistently improved (see Figure 6) despite somewhat diverse dynamics in the four most important indicators: (1) the number of STJ publications followed a declining trend but still retained a very high second position among the selected comparator countries (see Figure 7), and (2) had a stronger impact as the H index measuring citations increased sharply (see Figure 8) allowing Serbia to close the gap vis-à-vis regional leaders. The number of researchers also increased (see Figure 9), while the number of registered patents fluctuated around a low and declining trend line (see

Figure 7: Publications in scientific and technical journals, 2013-2021



Source: GII database, author's calculations

Figure 8: Citable documents H index, 2013-2021

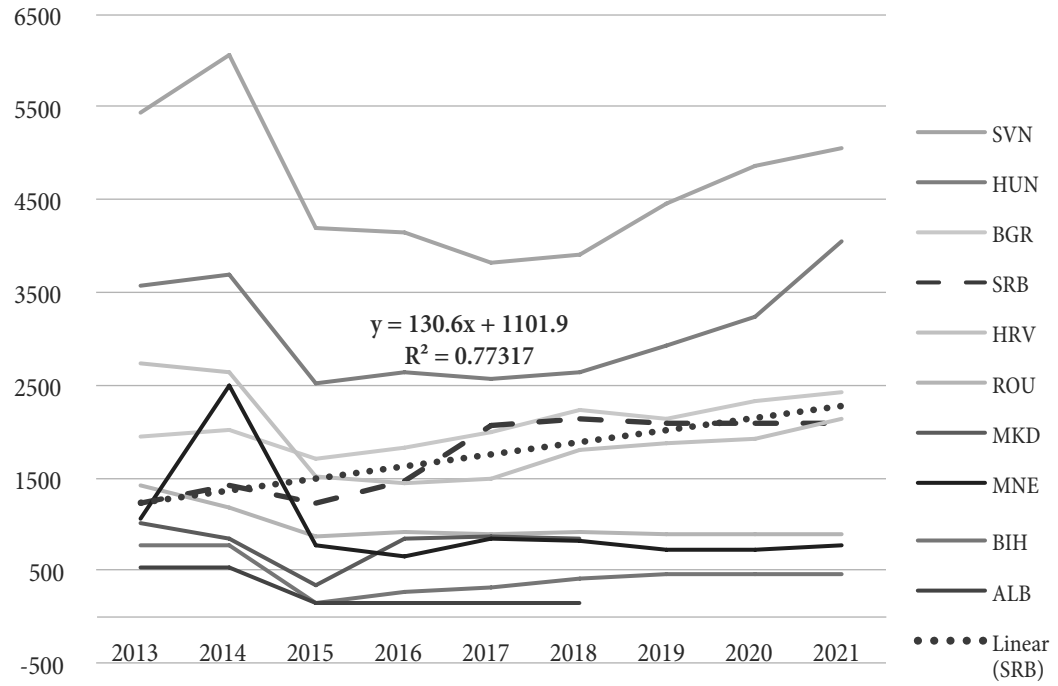


Source: GII database, author's calculations

Figure 10). As a result, consolidated GII output index followed a declining trend thereby confirming the GII 2021 conclusion that the overall national innovation system is faced with declining efficiency in converting a diverse vector of innovation inputs into innovation output (see Figure 11 and Figure 12).

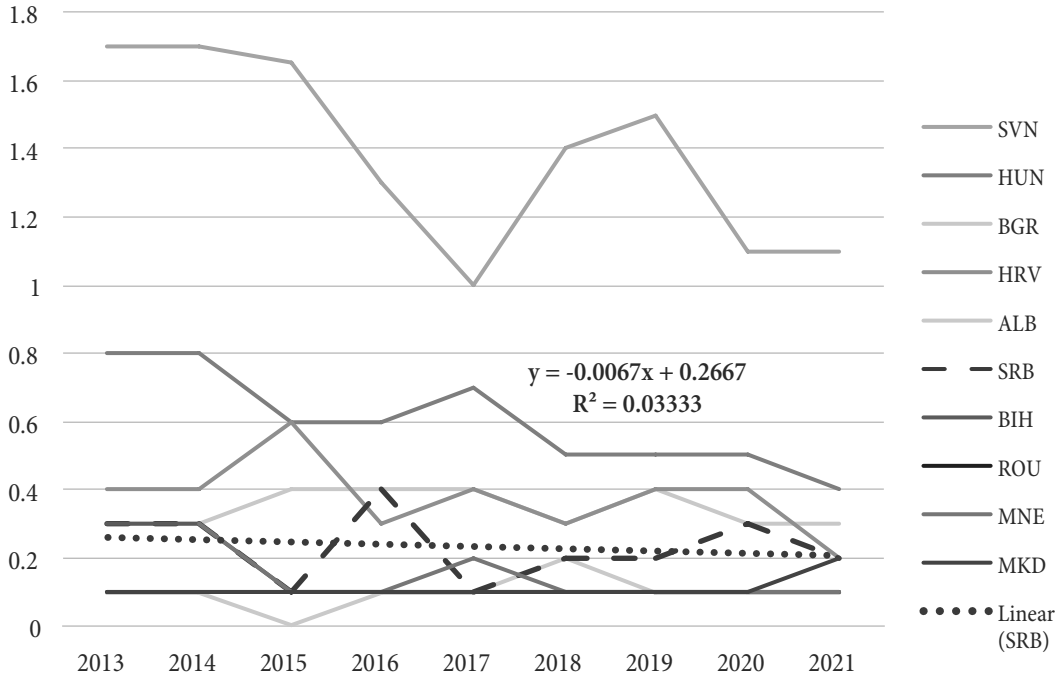
Two important caveats are in order: First, the anemic average performance of the overall national innovation system presented in the above trends does not apply to all innovation subsectors. Second, pouring in more resources without reforming the innovation system and identifying priorities is not likely to produce good overall

Figure 9: Number of researchers, 2013-2021



Source: GII database, author's calculations

Figure 10: Number of registered patents, 2013-2021



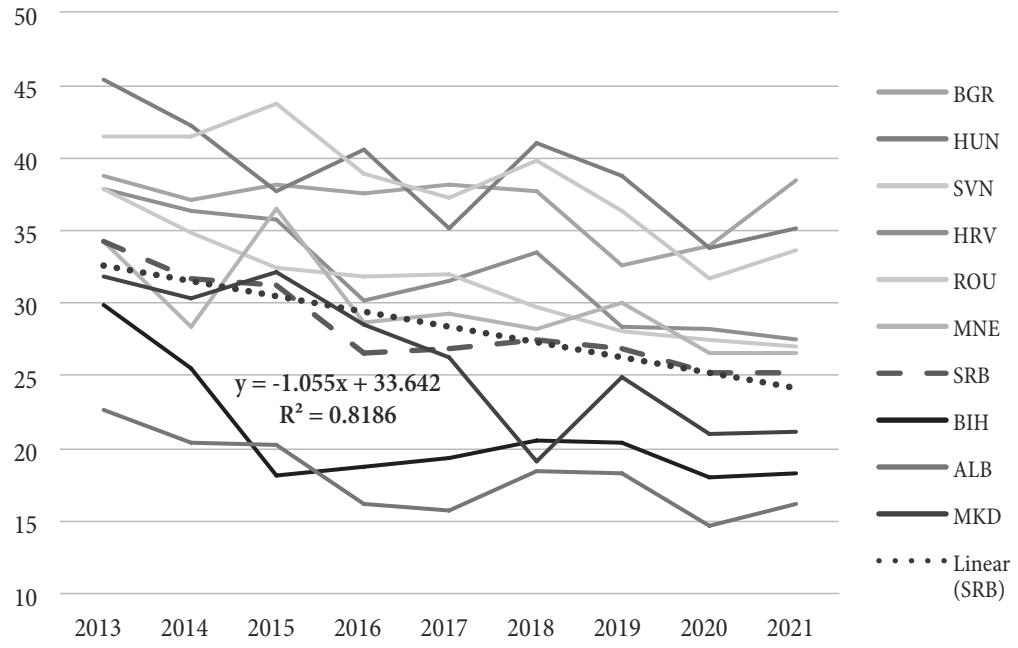
Source: GII database, author's calculations

results and, most importantly, the desired outcomes in increasing productivity and elevating long-term economic growth to the level needed to close the gap with regional leaders and the EU. This is the context in which the summary diagnostics and proposed reform and policy recommendations should be read.

Based on the GII evaluations and performance the following structural and functional weaknesses of Serbian national innovation system are apparent:

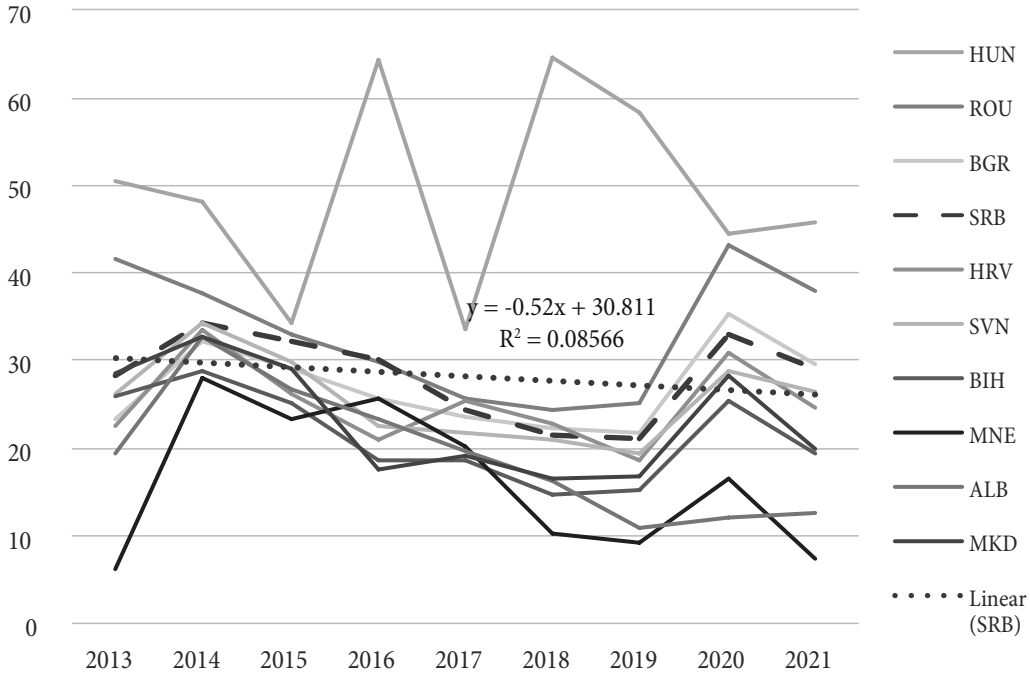
- Political support for "picking innovation winners" and lack of commitment for longer-term reform of the innovation system.

Figure 11: Innovation output GII methodology, 2013-2021



Source: GII database, author's calculations

Figure 12: Knowledge diffusion, 2013-2021



Source: GII database, author's calculations

- Weak linkages between innovation organizations and the economy due to:
  - Weak orientation of academia and R&D institutions towards business and technological innovations,
  - Low enterprise investment in R&D,
  - Lack of researchers in the enterprise sector.
- Weak SMEs role as innovation base due to their:
  - Short term commercial opportunistic orientation, and
  - Weak capacity (human capital) and financial base.
- Limited research potential in academia and R&D institutions due to prolonged transition, low investment in R&D, inadequate financial and career incentives, and brain drain.
- Outdated management systems and low quality of management in R&D institutions.
- Limited ability (flexibility and adaptability) and low motivation of R&D institutions to cooperate with the economy in general (and especially with SMEs) due to engagement in long-term projects (4-8 years) financed by the state budget.
- Lack of trust due to low transparency, betrayed expectations and lack of feedback on investment effects and results achieved.
- Slow progress of reforms due to inertia and resistance to change (i.e. the Innovation Law was passed in 2005 and has not been implemented in its important parts yet).
- Lack of reform and policy coordination and weak implementation of innovation strategies and policies.

NB One of the reasons for slow performance of the NIS is the excessive number of strategies (eight valid and three expired strategies), multiple policies and laws, poor policy coordination and the lack of dynamic prioritization - an imperative under tight budget constraints. This limitation is exacerbated by the large share of multi-year projects in scientific and research institutes at universities, or the small relative share of funds that the ministry can allocate or reallocate according to priorities using effective methods of motivating researchers, research teams and organizations.

Concluding remarks and recommendations

The first priority is to align the structure and size of the innovation supply (academic and R&D institutes) with the possibilities and needs of the country. A large number of fragmented entities engaged in science and applied R&D must be scaled down to realistic magnitudes based on academic and research capacity. The rules of accreditation could reduce the number of scientific and R&D entities to a reasonable level, without eroding scientific-research potential. A country with 7 million people and estimated GDP p/c of about USD $8,100 in 2021 cannot sustain 123 faculties or universities (albeit many of them private), 38 research institutes, and 35 R&D institutes.

Second, at the same time, it is necessary to significantly raise the quality of scientific research, R&D and innovation. To achieve this, it is necessary to raise the level of R&D funding from the budget from existing 0.9% of GDP in 2020 closer to 2% by 2025. Fiscal incentives should be used to adjust the structure of the supply of patents and innovations to the needs of companies, as well as to increase corporate investment in R&D from 0.4% of GDP in 2020 to 0.8% by 2025.

Third, in addition to raising the number and quality of production, organizational, technological and process innovations, it is necessary to significantly raise the level of innovation in society and the state. This includes:

- Advances in area of eGovernment at national and local level which will save time and increase productivity and quality of life of all citizens.
- Improved budget preparation process both regarding investment and current expenditures – especially in health, education and all sectors that significantly affect the quality of life of the population. This would largely coincide with already confirmed trends in the world, where the number and quality of innovations produced by research teams are growing rapidly, and valorization is done outside the market through population-state interactions or through social interactions.

Fourth, it is necessary to either adjust and empower the department within the MESTD dealing with basic

science, R&D and innovations or form a separate ministry for Science and R&D with a mandate to:

- Raise awareness of the need for innovation to achieve the desired higher growth rates;
- Establish innovation policies at the government level;
- Strengthen ongoing political support for innovation;
- Strengthen the efficiency of the implementation of the innovation policy strategy, accountability, continuity and coordination of policies and actors;
- Ensure more efficient spending on R&D;
- Incorporate innovation into sectoral policies (information technology, agriculture, energy, transport);
- Preserve and develop scientific and research potential as a precondition for innovation progress;
- Ensure the necessary degree of openness and involvement in international innovation flows;
- Strengthen the contribution of research to economic and social development;
- Equally evaluate the results of applied research and innovation with academic results measured by published scientific papers and participation in conferences;
- Evaluate not only the number but also the quality of scientific papers and innovations (impact);
- Enable researchers to engage outside the academic sphere;
- It is necessary to set clear rules for financing from domestic sources and structural EU funds;
- Propose topics for scientific and research projects on an equal footing (50:50 researchers and countries);
- Each research organization must have its own vision and research mission.

Special effort will be needed to implement a practical innovation support agenda by coordinating multiple innovation strategies and policies, mobilizing financial resources, identifying R&D and innovation priorities, and adopting a results based approach in evaluating performance of all stakeholders. Over time (3-4 years) key elements of performance based budgeting should be expanded from evaluating past budget achievements to guiding allocation of resources in future budgets.

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MODELLING THE TREND OF ENERGY PRODUCTIVITY IN THE SERBIAN ECONOMY

Modeliranje trenda energetske produktivnosti u privredi Srbije

Abstract

Energy productivity indicates the efficiency of energy use in production. Investment in energy efficient solutions, technologies and practices lead to increased energy productivity. It is often used as a suitable measure to compare the results of economic, energy and climate policies. In 2006, the Republic of Serbia became a member of the Energy Community, thus taking on the obligation to accept the energy acquis of the European Union. By this move, it also accepted the obligation to increase the use of renewables, its final energy consumption and energy services' efficiency. Energy productivity in Serbia has increased by 66.94%, in the period from 2000 to 2019. This growth was primarily driven by the national GDP high growth rate, but not by the reduction of energy consumption. Given the still extremely high Serbian energy intensity levels compared to the European and world average, the aim of this paper is to examine the expected future trends of this indicator. The inverse function econometric model best describes the energy productivity trend in Serbia. The paper concludes that its trend will most likely continue to move upwards, primarily because no significant changes in the Serbian economic and energy policy are expected and because, at least according to official statistics, the country's economy has not been largely affected by the global coronavirus pandemic COVID-19. Since the energy productivity improvement determines the competitiveness and performance of the economy, it is extremely important for Serbia to apply energy efficient technologies, and to implement its further structural changes.

Keywords: *energy productivity, energy efficiency, energy intensity, economic growth, renewable energy sources, energy policy, energy dependence, trend modelling.*

Sažetak

Energetska produktivnost meri efikasnost korišćenja energije u proizvodnji. Ulaganja u energetski efikasna rešenja, tehnologije i prakse dovode do povećanja energetske produktivnosti. Ovaj pokazatelj se često koristi i kao pogodna mera za poređenje rezultata sprovedenih ekonomskih, energetskih i klimatskih politika. Republika Srbija je 2006. godine postala članica Energetske zajednice, čime je preuzela na sebe obavezu prihvatanja energetskih pravnih tekovina Evropske unije. Ona je ovim potezom takođe prihvatila i obavezu da poveća korišćenje obnovljivih izvora energije, energetsku efikasnost svoje finalne potrošnje energije i sektora energetskih usluga. Energetska produktivnost u Srbiji je u periodu od 2000. do 2019. godine porasla za čak 66,94%. Ovoliki rast ovog pokazatelja je, pre svega, bio uslovljen visokom stopom rasta domaćeg BDP-a, a ne smanjenjem potrošnje energije. Cilj ovog rada je da, s obzirom na još uvek izuzetno visoke nivoe energetskog intenziteta Srbije u odnosu na evropski i svetski prosek, ispita očekivane trendove budućeg kretanja ovog pokazatelja. Trend kretanja energetske produktivnosti u Srbiji na početku ovog veka najbolje opisuje ekonometrijski model inverzne funkcije. U radu se zaključuje da će se trend kretanja ovog pokazatelja i dalje najverovatnije kretati uzlaznom putanjom, pre svega jer se ne očekuju značajnije promene u ekonomskoj i energetskoj politici Srbije i jer, barem prema zvaničnim statističkim podacima, privreda zemlje do sada nije bila u većoj meri pogođena globalnom pandemijom koronavirusa kovid-19. Pošto poboljšanje energetske produktivnosti opredeljuje rast konkurentnosti i performansi privrede, za privredu Srbije je od izuzetnog značaja da primenjuje energetski efikasne tehnologije, kao i da dalje sprovodi svoje strukturne promene.

Ključne reči: *energetska produktivnost, energetska efikasnost, energetski intenzitet, privredni rast, obnovljivi izvori energije, energetska politika, energetska zavisnost, modeliranje trenda.*

Introduction

In the most general sense, productivity is an aspect of production efficiency and is defined as the ratio between the value of output and a particular input. In other words, productivity measures the efficiency of the production factors' use such as labour, capital, land, electricity, natural resources, and other inputs consumed in the economy at a given production level, i.e., a given output or gross value added (GVA). In its broadest sense, productivity is the requirement to minimize input costs for a given production level, as well as to produce in an economically rational way. As such, productivity is one of the key determinants of economic growth and competitiveness and it often represents the basis for assessing and comparing the economic performance indicators of contemporary countries [19].

The Global Alliance for Energy Productivity defines energy productivity as a measure of the economic benefits derived from each unit of energy used. We can usually obtain this indicator by dividing total economic output (gross domestic product – GDP, national income or total gross value added) with the total energy consumption. Energy productivity also points to the economic results of energy efficient investments [2, p. 3]. By measuring this indicator, it is possible to determine the extent to which a given country more or less efficiently uses the energy it pays for. Investments in energy efficient solutions, technologies, and energy efficient practices lead to increased energy productivity. However, energy efficiency, as important as it is, is not an indicator of the economy's overall efficiency, but it is a measure of one of its aspects. Namely, it is possible to increase or decrease energy efficiency without concluding anything about the change in general efficiency, since other partial efficiency indicators may change in opposite direction in relation to general efficiency.

In addition to measures aimed at achieving energy efficiency, energy productivity, as a tendency to achieve greater results with the same or lower energy consumption, often includes the need for fuel substitution, energy storage, increased use of renewable energy resources, decarbonisation of the economy, etc. Increasing energy productivity directly contributes to reducing energy and electricity costs, protecting the environment, increasing the productivity of the economy, increasing the energy market competitiveness, and better managing energy demand [4]. This phenomenon also influences the reduction of greenhouse gas (GHG) emissions, improving economic performance and economic growth, increasing energy systems' reliability and security, introduction and development of technological innovations, etc. [2, p. 3]. Energy productivity is often used as a valuable and suitable measure to compare economic, energy and climate issues and policies' results internationally.

Energy intensity represents the ratio between the consumed energy and the total realized output and, as such, this indicator appears as a reciprocal value of energy productivity. Although the energy intensity indicator is more often used in practice, energy productivity gives better results and reasoning grounds, since it implies a better intuitive framework and has a positive connotation. In other words, while desirable improvements in energy productivity are represented by an increase in its value, improvements in energy intensity are reflected in a decrease in its value, which means that they are measured in less perceptive units of consumption [11, p. 6]. Recently, the popularity of energy productivity indicator has increased, considering that many contemporary countries and organizations, such as the American Climate Group EP100, have started to include it, as one of the strategic goals, in their agendas and development policies [5].

Changes in energy productivity at the level of an economy can occur, first, because of sectorial energy productivity that represents a consequence of technological improvements, changes in the energy mix of production, and changes of producers' and consumers' behaviour, but also changes of the economic activities' structure. For example, if structural change of economic activities is shifted to energy-productive sectors such as financial services, there will be an increase in aggregate energy productivity, even if the energy productivity of each sector would remain the same [3, p. 218]. We should add to the mentioned determinants the growth of energy efficiency, increase of GDP per capita, i.e., economic growth, growth of energy prices, national income and investments, growth

of service sector, increased rate of urbanization, etc., as factors that directly contribute to the energy productivity growth. In any case, the growth of energy efficiency leads to an increase in productivity, especially by reducing maintenance costs and increasing the yield per unit of energy input [10]. On the other hand, while a favourable industrial structure, openness of the economy, and per capita growth of available capital have a mostly positive influence, some authors are highlighting that the intensity of research and development (R&D) and government regulations can have a negative impact on the growth of energy productivity [14. pp. 1-9].

The state of the Serbian energy sector

In July 2006, the Republic of Serbia became a member of the Energy Community, thus accepting the obligation to adopt the European Union's (EU) acquis communautaire in the field of energy policy. This membership implies the country's obligation to encourage the use of energy from renewable sources, as well as biofuels and other renewable fuels for the needs of transport. By the decision of the Energy Community Ministerial Council in October 2012, the country undertook the commitment to increase the renewable energy sources' share in its gross final energy consumption from 21.2% to 27%, as well as to raise the share of renewable fuels in the transport sector to at least 10% in 2020 [25]. Serbia is at least declaratively committed to these goals, because in 2013 it adopted its first National Renewable Energy Action Plan. Membership in the Energy Community also obligates the country to increase energy efficiency of final consumption and energy services, to inform about and to label energy-important products, as well as to meet the criteria of energy performance for buildings. However, although it has fully transposed the Third EU Energy Package into its legislation, Serbia is clearly lagging behind in its implementation in many areas such as the splitting of activities of the national gas company Srbijagas and excessive air pollution from thermal power plants. In addition, Serbia is still far from achieving the defined target for 2020 of 27% share of renewable energy in its gross final energy consumption.

Primary energy consumption in Serbia in 2018 amounted to 15.4 million tons of oil equivalent (mtoe). Serbia is characterised by a high share of coal in its primary energy consumption, mainly low-calorie lignite (about 49%), which is mostly used for electricity production. Such high consumption of lignite compared to other states allows the country relatively high-energy independence in electricity production, with relatively lower and stable costs. On the other hand, such intensive use of lignite contributes to the GHG emissions' growth, and thus increases the adverse impact of the electricity sector on the environment. In 2018, Serbia's net import energy dependence was 34.8%, which is lower than in the vast majority of the EU countries in which the average value of this indicator is around 55%. Until 2013, import dependency of Serbia decreased due to increased domestic production of crude oil and natural gas, and after that, it started to grow again [1, p. 5]. In the last 12 years, the share or renewables in its final energy consumption has not changed significantly. Although the National Renewable Energy Action Plan defined a goal of achieving their share in gross final energy consumption of 27% until 2020 [16, p. 4], the value of this indicator in the observed period ranged only from 19.1% to 22.9% [7]. The most significant renewable energy sources in Serbia are in the form of biomass and hydropower, which in the past mostly participated in electricity production, but also in energy consumption. Further, renewable energy sources and renewable electricity accounted for about 21% of gross final energy consumption in the country [20]. During 2018, most windfarms (the share of 69.19%), small hydropower plants up to 10 MW of power (the share of 13.33%), and biogas power plants (the share of 12.03%) were built. The available data also show a very uneven distribution of production from various forms of renewable energy sources in the country [17, p. 6].

Energy productivity was quite stable at the beginning of the observed period from 2000 to 2019, and from 2003, when it reached its lowest value of € 1.42 per kilogram of oil equivalent (kgoe), it began to grow gradually. This indicator experienced its highest values twice, in 2014 (the value of € 2.42 per kgoe) and at the very end of the observed period, i.e., in 2019 when it amounted to € 2.45 per kgoe. In this period, the value of energy productivity

increased by as much as 66.94% compared to the initial year 2000. This growth of energy productivity was above all driven by even higher growth of national GDP by as much as 88.04%. In contrast to the desirable GDP trend, gross available energy increased in the observed period by 13.75%, which indicates an obvious increase in Serbian energy consumption. Besides, Serbia has one of the lowest levels of energy efficiency in Europe. According to some calculations, Serbia consumes 2.5 times more energy per unit of its GDP than the world average and four times more than the EU average [13]. Since the country's available energy sources are far lower than the world and European average, and since its consumption is huge, Serbia is also very dependent on energy imports. According to another study, in the period from 2000 to 2014, the country lagged behind the EU-28 in terms of energy intensity, measured by gross energy consumption per unit of GDP. Although both EU countries and Serbia recorded energy intensity declining trends in this period, energy efficiency in EU countries amounted to 122 kgoe per € 1,000 in 2014, while in Serbia this indicator was more than 3.5 times higher and amounted to 442 kgoe per € 1,000 [22, p. 11]. Finally, in 2018, the energy intensity of Serbia was at the level of the Western Balkan countries, but 1.79 times higher than the European average [15, p. 123]. Higher energy intensity occurs partly because of inevitable technical losses in the transformation of lignite into electricity, but also due to inefficient energy consumption in households and industry, low capacity utilization, and to outdated technology.

Methodological explanations: Analysis of the energy productivity trend in Serbia

A time series is a range of observations arranged in relation to time, usually at equal time intervals. The main goal of time series is to predict the future value and/or development of a phenomenon based on historical data [12, p. 6]. Time series trends are the basic development components in the study of some economic phenomena or processes dynamics. In that sense, the trends of development are the result of important and permanent factors, as well as reasons that determine the direction of a certain economic phenomenon trend. Research on development trends contributes to the analysis of the following aspects [23, p. 34]:

- From a descriptive analysis viewpoint, such research clearly shows the regularity of phenomenon development, and
- From a prognostic analysis aspect, it can help to predict future levels of some phenomenon, i.e., in this case the level of energy productivity in the country.

Generally, energy productivity is the relationship between some monetary output and energy consumption. At the level of economy, energy productivity is usually defined as the ratio between gross domestic product (GDP) and primary energy consumption (PEC). This indicator shows how many monetary units of GDP primary energy consumption can generate. Energy intensity is a reciprocal value of energy productivity and it indicates how many units of primary energy consumption are needed to create each monetary unit of GDP [11, p. 6]. Thus, energy productivity is often obtained based on the following formula:

$$Energy\ productivity = \frac{Gross\ domestic\ product\ (GDP)}{Primary\ energy\ consumption\ (PEC)}$$

The Eurostat, on whose methodology this paper relies, defines energy productivity as the ratio between GDP and gross available energy for the following year. The Eurostat bases its calculations on the following formula [9]:

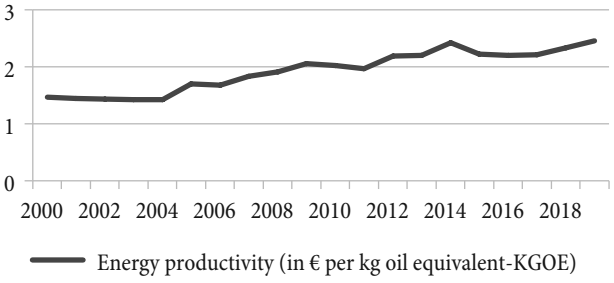
$$Energy\ productivity = \frac{Gross\ domestic\ product\ (GDP)}{Gross\ available\ energy\ (GAE)}$$

This indicator measures the productivity of energy consumption and gives a clear picture of the decoupling degree of energy consumption from GDP growth. To calculate energy productivity, the paper uses data on GDP in millions of euros in chain linked-volumes for the reference year 2010, at exchange rates from 2010. The paper traces the development of this phenomenon in the period from 2000 to 2019, while the data for its calculation are derived from the Eurostat database. The euro unit in chain-linked values makes it possible to observe the energy productivity trend over time in a country. Eurostat defines gross available energy as follows:

Gross available energy = Primary energy production +
Renewable and recycled products +
Energy imports – Energy exports + Stock changes

Gross available energy encompasses the overall energy supply for performing all activities on the territory of a certain country. This indicator also includes energy transformation, including generating electricity from combustible fuels, distribution losses, and use of fossil fuel products for non-energy purposes (for example in the chemical industry). It also covers fossil fuels' consumption in transport, including fuel purchased within the country that is used abroad (e.g., international aviation, international maritime bunkers, etc.). Energy productivity is expressed in euros per kilogram of oil equivalent, while its trend chart in Serbia in the period from 2000 to 2019 is presented in Figure 1.

Figure 1: Trend chart of energy productivity in Serbia, in the period from 2000 to 2019 (in euros per kgoe)



Source: Author's calculation based on the Eurostat data.

The diagram clearly shows that the development of energy productivity in Serbia in the period from 2000 to 2019 reveals a growing trend. There are numerous factors that determined this development path, including the growth of Serbia's GDP in the given period by 89.9%, the growth of gross available energy by 13.75%, but also better technological equipment of the national economy driven by foreign direct investment (FDI) inflows. These factors also include growth of energy efficient technologies' use in industry and households, restructuring of many large energy consumers, growth in the FDI volume, and growth in the share of services in the economy, etc. Thus, in this case, there was a relative separation of GDP from energy consumption because the economy grew much faster than energy consumption.

In addition to simple visual tracking of time series data, various statistical prediction methods such as hypothesis testing can be applied in the field of energy. In theory, various tests help to detect whether there is a development trend suitable for a given dynamic data order. A dynamic data order is an order of primary or secondary data, arranged in time in chronical order that reflects changes in a particular phenomenon over time. First-order autocorrelation coefficients are among the most commonly used tests in practice. Autocorrelation is the correlation between the values of a time series at different time points. First-order autocorrelation is the correlation between successive values of a statistical data order. Time series are considered autocorrelated when they contain a development trend, i.e., when each member of the order is correlated with and when it depends on the previous member and/or members of the same time series [23, pp. 35-36]. The first order correlation coefficient can be obtained based on the following formula [24, p. 7]:

$$r_1 = \frac{\sum_{i=2}^{N} Y_i Y_{i-1} - \frac{1}{N-1}\sum_{i=1}^{N-1} Y_i \sum_{i=2}^{N} Y_i}{\sqrt{\left[\sum_{i=1}^{N-1} Y_i^2 - \frac{1}{N-1}\left(\sum_{i=1}^{N-1} Y_i\right)^2\right]\left[\sum_{i=2}^{N} Y_i^2 - \frac{1}{N-1}\left(\sum_{i=2}^{N} Y_i\right)^2\right]}}$$

Where:

r_1 is autocorrelation coefficient of first order,

Y_i are the values of the observed dynamic row,

Y_{i-1} are the first order lagged values of the dynamic row, and

N is the length, i.e., the number of dynamic order members.

To perform this test, it is necessary to first define the null (H_0) and the alternative (H_1) hypotheses. In this analysis, a time series data on energy productivity of the Serbian economy in the period from 2000 to 2019 is observed. The calculation of autocorrelation coefficient is performed in the IBM SPSS statistical software. The initial and alternative hypotheses are as follows:

H_0: There is no autocorrelation in the dynamic row we examine, i.e., the autocorrelation coefficient is not statistically significant, which indicates that there is no development trend in the observed data series.

H_1: There is an autocorrelation in the observed dynamic row, i.e., the autocorrelation coefficient is statistically significant, which indicates that there is a development trend in the observed data series.

The significance level of the test, i.e., the risk of type I error is 5% ($\alpha = 0.05$). Table 1 indicates the results of calculating the autocorrelation coefficient, as well as the corresponding levels of their statistical significance. In this analysis, the first order autocorrelation coefficient amounts to r_1=0.838, while its significance level is *Sig.* = 0.000 which is less than 0.05. According to the methodology defined by Velichkova [24, pp. 71-74], this means that we can reject the null hypothesis H_0 and decline to reject the alternative hypothesis H_1 of the presence of autocorrelation in the dynamic data series we are examining. Thus, we can assume that there is a development trend in the observed data series on energy productivity in Serbia. In a specific case of this research, this further means that with a probability of 0.05 (5%), we can claim that energy productivity in Serbia in the first two decades of the 21st century was accompanied by a development trend.

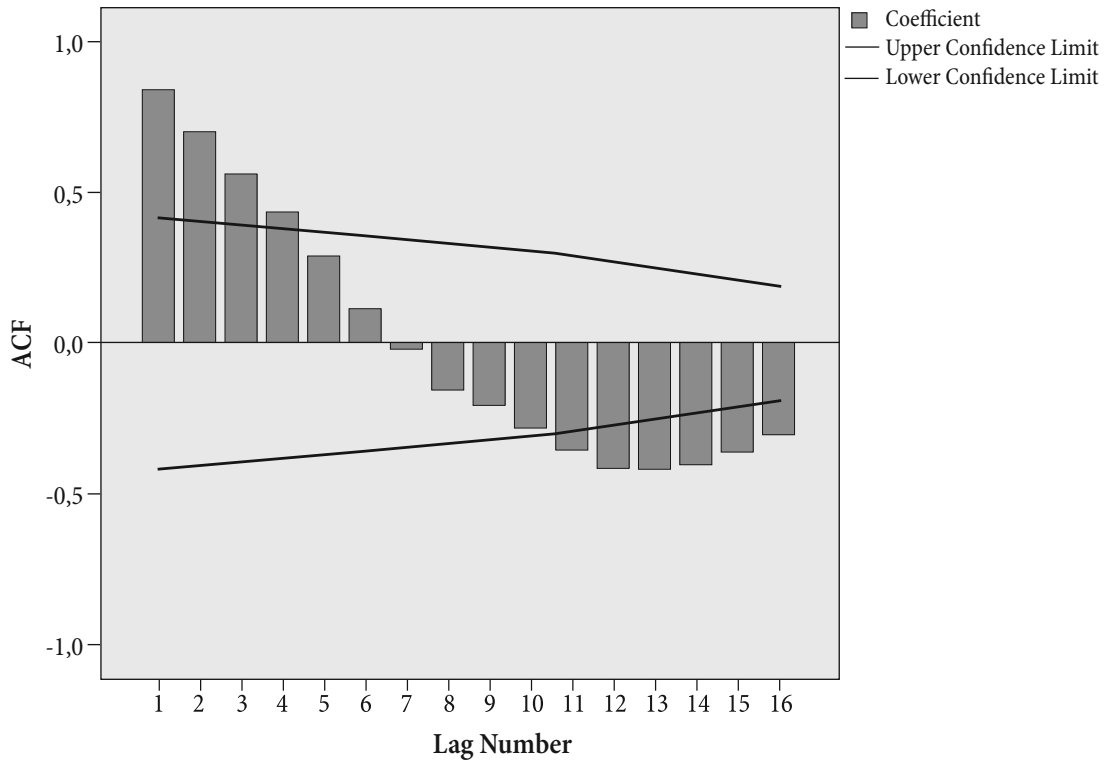
The presence of autocorrelation in the dynamic data series we are examining is also indicated by the autocorrelogram of energy productivity data (Figure 2). The autocorrelogram shows the correlation of a data series with itself. While the number of lags, i.e., orders of correlation is presented on the x-axis, the y-axis represents

Table 1: Autocorrelation coefficients of energy productivity in Serbia (for the first six orders, i.e., lags of correlation)

Lag	Autocorrelation coefficients	Standard errors	Ljung-Box test		
			Empirical values	Degrees of freedom	Significance
1	0.838	0.208	16.262	1	0.000
2	0.704	0.202	28.362	2	0.000
3	0.562	0.197	36.549	3	0.000
4	0.437	0.191	41.807	4	0.000
5	0.290	0.185	44.276	5	0.000
6	0.113	0.178	44.675	6	0.000

Source: Author's calculations.

Figure 2: Autocorrelogram graph of energy productivity in Serbia



the calculated autocorrelation coefficient (ACF). We can see from Table 1 and Figure 2 that at lag 1 the autocorrelation coefficient is 0.838, at lag 2 the autocorrelation coefficient amounts to 0.704 etc., which indicates that it decreases with the growth of lags, becoming negative at the seventh lag.

Trend modelling

Modelling of development trends generates a specific analytical type of functions, in which the studied phenomenon features depend on its development. In these functions, Y is the symbol used to represent the energy productivity of Serbia, t is an artificial variable that indicates time, while ε_t is a random component of the model. In order to determine the development trend of energy productivity in Serbia, the paper applies 11 different econometric linear and nonlinear models, within which the appropriate trend is determined by the model that has the highest coefficient of determination R^2, and thus the highest power of explanation. The coefficient of determination R^2 highlights the percentage of variation in the observed data sample that the given model explains. Table 2 shows the results of the energy productivity trend modelling with the aim of choosing the one that fits best.

The results of 11 tested competitive models indicate that with a probability of 95% we can assume that the **bolded** model of inverse function (3) is the best for describing the energy productivity trend in Serbia at the beginning of this century. Table 3 gives a brief description of the selected inverse function model basic statistical characteristics and estimated parameters.

The selected model of the inverse function is valid because it is statistically significant (*Sig.* = 0.000, which is lower than 0.05) and has a high coefficient of determination $R^2 = 0.911$. The chosen econometric model could be the most suitable because it explains 91.1% of the change in energy productivity in the country. Parameters' estimates of the chosen inverse function model indicate that the constant in this model is *Const.* = 117.473, while the curve slope is $b_1 = -232181.539$. Based on these data, it arises that the equation of this model is the following:

$$Y_t = 117.473 - \frac{232181.539}{t} + \varepsilon_t$$

Table 2: Results of 11 constructed econometric models

Models	Model characteristics				
	Coefficient of determination	F-statistic values	Degrees of freedom 1	Degrees of freedom 2	Level of significance
$Y_t = \beta_0 + \beta_1 t + \varepsilon_t$	0.910	182.424	1	18	0.000
$Y_t = \beta_0 + \beta_1 lnt + \varepsilon_t$	0.910	183.002	1	18	0.000
$Y_t = \beta_0 + \frac{\beta_1}{t} + \varepsilon_t$	0.911	183.575	1	18	0.000
$Y_t = \beta_0 + \beta_1 t + \beta_2 t^2 + \varepsilon_t$	0.910	182.424	1	18	0.000
$Y_t = \beta_0 + \beta_1 t + \beta_2 t^2 + \beta_3 t^3$	0.910	182.424	1	18	0.000
$Y_t = \beta_0 t^{\beta_1} + \varepsilon_t$	0.898	158.576	1	18	0.000
$Y_t = \beta_0 \beta_1^{\ t} + \varepsilon_t$	0.898	157.918	1	18	0.000
$Y_t = e^{\beta 0 + \frac{\beta 1}{t}}$	0.898	159.233	1	18	0.000
$Y_t = \frac{1}{\frac{1}{u} + \beta_0 \beta_1^{\ t}} + \varepsilon_t$	0.898	157.918	1	18	0.000
$Y_t = e^{\beta_0 + \beta_1 t}$	0.898	157.918	1	18	0.000
$Y_t = \beta_0 e^{\beta_1 t}$	0.898	157.918	1	18	0.000

Source: Author's calculations.

Table 3: Model summary and parameter estimates

Equation	Model summary					Parameter estimates	
	Coefficient of determination	F value	*df*1	*df*2	Sig.	Constant	b_1
Inverse	0.911	183.575	1	18	0.000	117.473	-232181.539

Source: Author's calculations.

After estimating its parameters, this model takes the form of the inverse function presented in Figure 3. As Figure 3 shows, the trend of energy productivity in Serbia in the period from 2000 to 2019, which is shown by a continuous straight line, is growing. In this case, it is specific that Serbia's energy productivity has been gradually growing, primarily due to rapid GDP growth (by 89.9%), so that in recent years the value of this indicator has approached the trend line amounting around € 2.5 per kgoe.

Forecasting the energy productivity trends in Serbia in the coming years

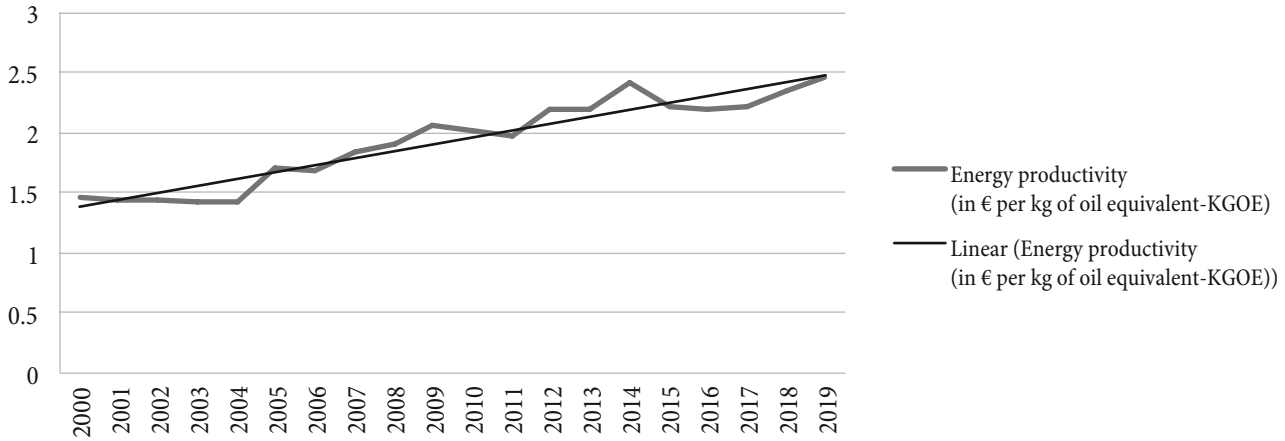
As already mentioned, modelling trends of energy productivity in Serbia could be used to describe its objective development laws, as well as to predict the further trends of this phenomenon in the forthcoming years. This analysis starts from the assumption that the energy productivity trend in Serbia until 2025 will follow the same patterns as in the analysed period (from 2000 to 2019). Table 4 and Figure 4 present the predicted values of this indicator in Serbia.

The dashed line in the middle refers to the observed and at the same time predicted trend of energy productivity in Serbia until 2025, while the upper and lower lines indicate the lowest and highest control limits of this phenomenon's development. As already mentioned, the starting point of this analysis is the assumption that energy productivity in Serbia will follow the same trend as in the previous period. In order to obtain a realistic and reliable statistical forecast, we need to consider the following key issues:

- The paper analyses 11 mutually competing econometric models, from which the modelled trend inverse function that gave the highest value of the coefficient of determination R^2 was selected.
- The calculated parameters can be accepted as stable ones, because we do not observe different trends of development in dynamic rows that have been examined for different time periods.

Figure 3: Dynamics of energy productivity in Serbia, in the period from 2000 to 2019

Energy productivity (in € per kg of oil equivalent)



Source: Author's calculation based on the Eurostat data.

Table 4: Estimated values of energy productivity of Serbia until 2025 (in € per kgoe)

Years	Estimated values of energy productivity	Lower limit	Upper limit
2020	2.531	2.278	2.785
2021	2.589	2.331	2.845
2022	2.645	2.385	2.905
2023	2.702	2.438	2.966
2024	2.759	2.490	3.027
2025	2.815	2.542	3.088

Source: Author's calculations.

- We can assume that in the coming years the trend of energy productivity in the country will remain relatively unchanged because no significant changes in the economic and energy policy of Serbia are expected. In addition, the COVID-19 coronavirus pandemic did not have a large impact on the country's GDP (a decrease of about 1% in 2020 compared to 2019), while no significant changes are expected in the level of gross available energy in 2021, nor in the next years.
- The modelled trends were extrapolated to 2025, providing a forecast for average expected values of energy productivity in the country.
- Prognostic confidence intervals were also calculated, showing the upper and lower limits within which energy productivity values can fluctuate in the coming years, with a probability of 95% ($p = 0.95$ and $\alpha = 0.05$).

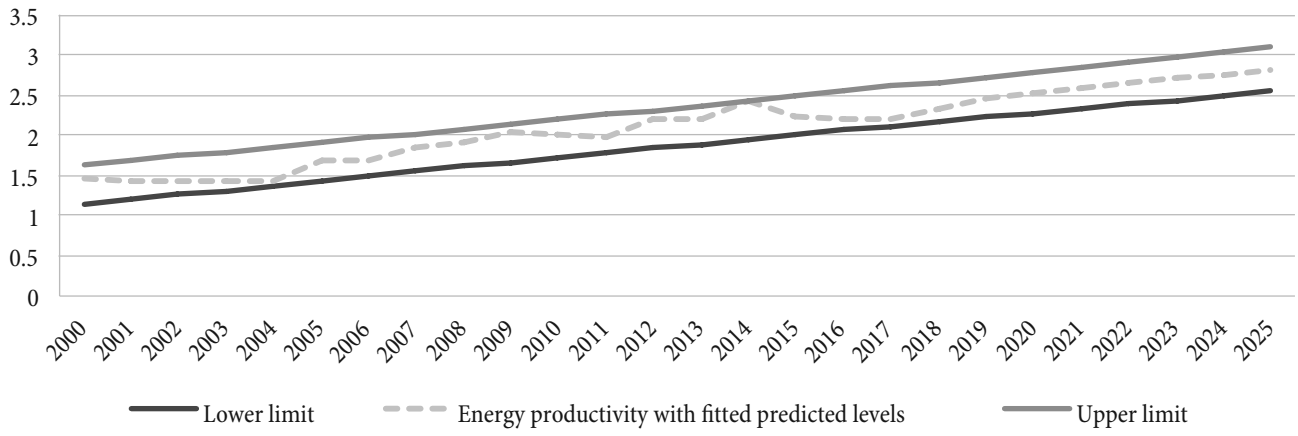
Based on this prognostic analysis, assuming that the trend of energy productivity in Serbia will remain unchanged in the coming years, it is very likely that in 2025 this indicator will not be less than € 2.542 per kilogram of oil equivalent and will not be more than € 3.088 per kgoe.

Despite the fact that the energy productivity of Serbia depends on various factors, the paper attempts to forecast its development trend in Serbia in the coming years, with the use of econometric models. Based on the conducted research, it can be assumed that if the observed energy productivity trends in Serbia from the first two decades of this century in the coming years remain the same, the expected value of energy productivity in 2025 could reach € 2.815 per kgoe. However, these results should still be taken with some caution given the adverse effects of the COVID-19 coronavirus pandemic on the country's economy. Despite all, it seems that the coronavirus global health crisis did not largely affect the Serbian economy until nowadays because, according to data from the Statistical Office of the Republic of Serbia, at the end of 2020 national GDP fell only by 1.1% compared to 2019. At the same time, this indicator in the fourth quarter of 2020 grew by 2.2% compared to the previous quarter [21, p. 1]. Finally, a massive wave of vaccination of the population is underway in the country, which is why we can expect that economic and social life of the country will slowly return to its regular course.

Conclusions from the statistical analysis

Studying and forecasting energy productivity trends is a complex and challenging process which, however, is crucial for the proper management of national energy policy, and also for the smooth functioning of all economic processes throughout the country. Such predictions are even more difficult to make in the context of a global or national economic crisis, as is the case with the current crisis caused by the COVID-19 coronavirus pandemic. This research followed the main trends in energy productivity in Serbia, as well as the expected trends of this indicator

Figure 4: Predicted values of energy productivity in Serbia until 2025 (in € per kgoe)



Source: Author's calculation based on the Eurostat data.

until 2025. Overall energy productivity in Serbia shows an upward trend in the last two decades, while it is expected that this trend will remain more or less unchanged. It is important to note that the country's energy productivity fluctuated in the observed period, as well as that in recent years (since 2016) we can observe its steady growth.

While in the era of the COVID-19 coronavirus pandemic, and thus great uncertainties, it seems unwise to make forecasts of trends in economic phenomena, the following facts can be pointed out in favour of the assumption of moderate increase of energy productivity in Serbia in the coming years (by expected 14.72%):

- Further expected encouraging inflow of foreign direct investments (FDI) in Serbia, which the development of the national economy is largely based on. Although in 2020 the inflow of FDI decreased by 20% compared to 2019, this trend still presents an extremely good result since FDI globally fell by 42%, in developed countries they fell by 69%, while in European countries they experienced a decline of as much as 71% [18]. In addition, in recent years, Serbia has established itself as an attractive location for attracting foreign investments at the regional level, primarily due to its generous policy of subsidizing foreign investors, which has great effects on attracting those investors that are favoured by these measures [18]. These predictions are supported by the already mentioned fact that according to the calculations of the Statistical Office of the Republic of Serbia in 2020 the country's GDP fell by only 1.1% compared to the previous year [21, p. 1].
- Expected activities of multinational companies (MNCs) in the South-East Europe region. It can also be expected that MNCs will reallocate their production activities intended for the European markets in this region, due to competitive low wages and other production costs. In addition, unlike domestic companies, actual foreign investors in Serbia are protected from bureaucratic procedures and other obstacles to successful conducting of business, which gives them a privileged position at the domestic market. All the mentioned trends directly reflect on the Serbian growth and attractiveness of its investment destination [18].
- Expected stable levels of gross available energy in Serbia. Gross available energy in the observed period from 2000 to 2019 recorded its modest growth of 13.75%, while in recent years (from 2016) this indicator has remained quite stable. Therefore, we can expect its stability in the coming period. If, on the other hand, a possible decline in the country's economic activities should occur, this fall could be reflected in a reduction in energy consumption, and thus in an increase in its energy productivity.
- Further growth of final energy consumption efficiency in the country. According to available data, in the observed period, the energy efficiency in Serbia, measured by the ratio between the output (GDP) and final energy consumption, increased moderately by 10.43% compared to the base year 2000 [8]. This indicates the fact that the application of more energy efficient technological solutions in industry and households is ongoing, and thus that there is a decline in energy consumption in the country. Due to the slight growth of this indicator in the last years of the analysis (from 2015 onwards), it is possible to expect its further moderate growth, and thus the growth of the country's energy productivity.
- The obtained results of trend modelling. Finally, the high explanatory power of the econometric analysis presented earlier, with very high coefficients of determination ($R^2 = 0.898$, $R^2 = 0.910$ and $R^2 = 0.911$), makes this predictions quite reliable.

Conclusions

Improving energy productivity is the simplest and most efficient way to reduce GHG emissions, solve the problem of rising energy costs, and improve energy security. Energy is the basic economic input, which is why there is a need for its more productive use. Improving energy productivity and efficiency increases the overall competitiveness and performance of the economy, while at the same time reduces energy costs for consumers and GHG emissions. Therefore, it is extremely important to continue to insist on the energy efficient technologies' application, the introduction of appropriate innovations, as well as further

structural changes in the economy. Measures such as the use of energy efficient lighting, efficient heating and cooling systems, automation of some industrial processes, improvement of energy data systems management, transport electrification, etc., belong to only some of the steps that can directly contribute to the energy productivity growth in the country. These measures should be coupled with energy losses reduction in transformation and distribution processes, transition to more renewable energy sources, the energy transition process, etc. That is why it is important for Serbia to focus especially on further improvements in its more efficient energy consumption. This aim could also be achieved by developing more serious plans to improve energy efficiency and energy productivity. These efforts could include defining ambitious national commitments and supporting sectorial targets, further development of its energy market, and mobilizing adequate resources. They would help Serbia in addressing all identified barriers such as the need for additional incentives and market distortions removal, lack of motivation, steady inertia in addressing these issues, as well as the lack of ability and appropriate knowledge on its path to transform into an energy conscious society.

Although Serbia is trying to improve its energy policy by implementing the recommended measures for energy efficiency improvement, it should strengthen its commitment and administrative capacity at the state level so that it could implement a substantial energy transition process in the whole country. In addition, today there are great demands for national energy companies themselves in the direction of their restructuring, which could also lead to operations that are more efficient, to cleaner and more technologically advanced energy, and higher energy productivity. Finally, with the aim of fostering and achieving more effective implementation of the energy transition process itself, it is necessary to popularize a new energy culture that requires the dissemination of knowledge, information and environmental culture, but also a higher level of general, both material and spiritual culture of society [6, p. 44]. Only in that way could a better and more consistent process of energy transition give rise to a sustainable Serbian energy future.

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THE IMPACT OF HIGH-TECH PRODUCTS EXPORTS ON ECONOMIC GROWTH: THE CASE OF SERBIA, BULGARIA, ROMANIA AND HUNGARY

Uticaj izvoza visokotehnoloških proizvoda na ekonomski rast – primer Srbije, Bugarske, Rumunije i Mađarske

Abstract

Innovative capacity represents the ability of long-term production and commercialization of the flow of innovative technologies and is an essential factor influencing competitiveness in modern economies. When it comes to innovation, research and development, gross domestic product (GDP) is often used as an indicator of investment opportunities at the national level to gain insight into the country's ability to improve innovation and competitiveness. Accordingly, this paper aims to determine whether the export of high-tech products, as one of the results of innovation in the economy, measured by GDP growth, has a positive effect on overall economic growth. For the analysis process to have a comparative character, four countries were included in the empirical research: Serbia, Bulgaria, Hungary and Romania. The international Eurostat database was used as the main source of data, and the period covered by this survey is from 2008 to 2018. A simple linear regression model was applied in the analysis to determine the relationship between the share of high-tech products in the country's total exports and GDP per capita. The research results in this paper show that it was not possible to confirm the positive relationship between exports of high-tech products and GDP growth in the case of Serbia, Hungary and Romania, while in the case of Bulgaria, the impact of growth in exports of high-tech products on GDP growth can be confirmed. According to the obtained results, it is most adequate that the issue of innovation, exports and economic growth is not observed exclusively through the development and application of innovations in high-tech industries. We need to look at the broader context in terms of how much innovation can improve exports and the overall business of medium and technologically inferior (less demanding) industries, what innovations these industries need, and how to develop and implement them.

Keywords: *high-tech product, export, innovation, economic growth, gross domestic product.*

Sažetak

Inovativni kapacitet predstavlja sposobnost dugoročne proizvodnje i komercijalizacije protoka inovativnih tehnologija i čini suštinski faktor koji utiče na konkurentnost u modernim ekonomijama. Kada su inovacije, istraživanja i razvoj u pitanju, bruto domaći proizvod (BDP) se veoma često koristi kao pokazatelj mogućnosti za ulaganja na nacionalnom nivou, a zarad sticanja uvida u mogućnosti unapređenja inovativnosti i konkurentnosti jedne zemlje. Shodno tome, cilj ovog rada je da se utvrdi da li izvoz visokotehnoloških proizvoda, kao jedan od rezultata primene inovacije u privredi, pozitivno utiče na ukupan privredni rast meren rastom BDP. Da bi sam proces analize imao komparativan karakter u empirijsko istraživanje su bile uključene četiri zemlje: Srbija, Bugarska, Mađarska i Rumunija. Kao glavni izvor podataka korišćena je međunarodna baza podataka Eurostat, a vremenski period obuhvaćen ovim istraživanjem je od 2008. do 2018. godine. Kako bi se utvrdila veza između udela visokotehnoloških proizvoda u ukupnom izvozu zemlje i BDP po glavi stanovnika, u analizi je primenjen model jednostavne linearne regresije. Rezultati istraživanja u ovom radu pokazuju da nije bilo moguće potvrditi pozitivan odnos izvoza visokotehnoloških proizvoda i rasta BDP u slučaju Srbije, Mađarske i Rumunije, dok je u slučaju Bugarske potvrđen uticaj rasta izvoza visokotehnoloških proizvoda na rasta BDP. Imajući u vidu ove dobijene rezultate, najadekvatnije je da se pitanje inovativnosti, izvoza i privrednog rasta ne treba posmatrati isključivo preko razvoja i primene inovacija u visokotehnološkim industrijama, već treba sagledati širi kontekst u smislu koliko inovacije mogu unaprediti ne samo izvoz, već i ukupno poslovanje srednjih i tehnološki nižih (manje zahtevnih) industrija, kakve inovacije su potrebne tim industrijama, kako ih razvijati i primenjivati.

Ključne reči: *visokotehnološki proizvod, izvoz, inovacije, privredni rast, bruto domaći proizvod.*

Introduction

Innovation policy is becoming a pre-eminent component of economic development management in most, especially in the world's leading economies. The concept of the national innovation system has a special place in the innovation policy of each country, and its constitution is in direct connection with the increase of innovation capacity at the national levA quality institutional environment is essential in situations where there is a need for direct state intervention in the economy. Competitiveness and economic growth are affected by the efficiency of institutions and the quality of institutional infrastructure [27]. Competition between companies, as well as national economies, is intensifying day by day. One of the ways to ensure growth and development, in changing and dynamic conditions, is undoubtedly the development of innovation skills, i.e. the ability to generate innovations.

Technological change and innovation are some of the main drivers of economic growth in most countries. The most commonly used indicator of economic growth is GDP. Economic growth mainly encourages overall social development and leads to numerous changes in society, from strengthening welfare, higher consumption, savings and investment, to the emergence of new products that are primarily the result of creating and applying new techniques and technologies.

Nowadays, it is possible to use various indicators to illustrate the environment of the national innovation system and consider its features and evaluate the results in practice. Therefore, research often pays attention to the effects of innovation activities by exporting high-tech products. On the one hand, it is possible to directly investigate the export of high-tech products within the analysis of national innovation systems. On the other hand, to indirectly analyze the results of knowledge and technology and innovative products and services.

Literature review

The impact of innovation on creating competitive advantage is based on companies' ability to apply innovation to meet current market needs through new ideas and knowledge stably and sustainably better than the competition by creating new value [11]. According to the evolutionary approach, companies invest in innovation to acquire new resources and explore the possibilities of their responses to the demands of the environment. Companies apply different strategies and react differently to changes in the environment, where economic activities include both the state of imbalance and dynamic change processes. At the same time, the results of the application of new technologies cannot be fully predicted [9].

In the modern era of the competitive market, globalization, and dramatic changes in industries, companies have begun searching for a unique strategy and innovative tactics that will provide them with a sustainable competitive advantage. One of the new models it offers is the business model of innovation, whose primary task is to act as the main driver for achieving competitiveness and top results [7], [2], [4]. Exports of high-tech products can contribute to greater competitiveness and improve the balance of payments of a country [8]. An economy needs to be as competitive as possible, which will significantly contribute to the growth of production and thus exports [12]. Innovation is a significant competitive advantage of any company, given its importance for economic growth, wealth creation, business expansion and technological progress [17], [22]. In addition, the link between innovation and competitive advantage is confirmed by the latest empirical research, which describes it as direct and positive, because the innovation capacity of companies can create, support and make sustainable competitiveness in both domestic and foreign markets [18], [3]. In their research, [13] analyzed the competitiveness of the Serbian economy and concluded that the share of exports in the formation of GDP was significantly reduced during the pandemic, which reflected on its competitiveness.

In a growing competitive environment, companies use their strategies to retain market share and increase profits. Only continuous learning ensures that companies adapt to changing market conditions and respond to competitive challenges in the most efficient way [29]. Companies make decisions about investing in technology based on expected profits, where profit is important not only for the evolution of technology, but also for economic

growth. In modern business conditions it can be generated through entrepreneurial initiative and innovation [35].

Comparing the results of national innovation systems is a very complex process [1], [31]. Indicators, such as the amount of allocation or the percentage of gross domestic product intended for research and development, as well as indicators of the results of innovation activities, such as patents, the share of high-tech products in exports and the share of new products in total production, are used for this purpose. Market demands and competition force companies to innovate and develop knowledge in a globalized IT world, change their behavior and innovation processes [20]. Higher exports of high-tech products (HTP) would increase the competitiveness of countries in the world market, and thus achieve higher economic growth and a higher standard of living. Adopting new technological knowledge and applying new technologies increase the company's profit. From a macroeconomic point of view, this means that technology and innovation increase gross domestic product and encourage innovation [30]. From the perspective of the national innovation system, as an approach to the study of innovation, the ability to achieve technological and economic progress depends on the power of countries to organize innovation activities in the broadest economic scope at the national level.

Many studies have observed innovation and correlation of innovation in the manufacturing industry from several aspects, such as factors of influence, transformation and improvement of the manufacturing industry, national innovation system, and innovation's impact on economic development [26]. For the success of the desired innovative products, only the mass production of HTP enables profit in fierce competition. For the production of HTP, it is necessary to have quality technology, employees and resources. Based on the conducted research [28], concluded that there is a significant impact of GDP on the export of high-tech products.

Research methodology

The main goal - the hypothesis in this paper, is to determine whether the export of high-tech products, as one of the results of applying innovations in the economy, affects economic growth measured by GDP growth. The quantitative research design was applied in the study, as it examines the relationships between variables, measured on an interval or measurement scale, using statistical methods, techniques and tests in data analysis, based on measurements, causal relationships and attempts to come to general conclusions [6], [33]. The features of the quantitative design of the research corresponded to the empirical research in this paper, because the intention was to accurately measure the researched phenomena and discover the connections between them. The studied phenomena and their connections within the quantitative design are analyzed in detail. At the same time, the comparative approach was chosen because it emphasizes that social and economic phenomena can be better understood only if we compare them in several different cases. Therefore, in addition to Serbia, the empirical research includes three neighboring EU member states - Romania, Hungary and Bulgaria.

The period covered by this research was from 2008 to 2018. The internationally recognized Eurostat database was used as the main secondary data source. The reason for choosing this database is the availability of data to be used in the research, the quality and representativeness of the data, and the comparability of data for several different countries. The variables listed in Table 1 were extracted from Eurostat international statistical databases, by the hypothesis for empirical research.

Table 1: Variables included in the research, their types and sources

Independent variable	Dependent variable	Source
Share of exports of high-tech products in total exports of the country	Economic growth measured by GDP per capita	Eurostat

A simple linear regression was used to statistically test the relationship between the share of high-tech products in the country's total resources and GDP per capita. This statistical technique was chosen because it is suitable for detailed research, modeling, describing and evaluating the relationship between two variables [10]. Before performing a simple linear regression, it is necessary to check the fulfillment of several assumptions on which this

statistical technique is based. These assumptions refer to: (1) the existence of two variables that have a continuous nature and are measured on an interval or ratio scale; (2) the existence of a linear relationship between variables; (3) absence of atypical points; (4) the existence of independence observations; (5) the absence of heteroskedasticity, i.e., the variance of random errors should not differ by observations; and (6) the normal distribution of residual errors [37], [23]. The first assumption about the nature of variables was tested by insight into the measurement scales on which they were measured. To test the assumption of a linear relationship between variables and the absence of atypical points, the construction of a distribution diagram was used [37]. The fulfillment of the fourth assumption regarding the independence of observations was checked by calculating the Durbin-Watson statistics according to the formula:

$$d = \frac{\sum_{i=2}^{n} x(e_i - e_{i-1})^2}{\sum_{i=2}^{n} x\, e_i^2} \quad (1)$$

where:

$e_i = yi - \hat{y}_i$ residuals

n = number of elements in the set.

The values of the Durbin-Watson statistic indicator d between 1.5 and 2.5 indicate that the assumption of the independence of the observations is fulfilled [15]. The fifth and sixth assumptions of simple linear regression, the absence of heteroskedasticity, and the normal distribution of residual errors were verified by constructing histograms and Normal P-P Plot [21]. Data on the magnitude of the obtained correlation and determination coefficients in the regression model were evaluated according to Cohen's criteria [14].

Research results

The main task in this paper was to check the existence of a positive impact of the growth of exports of high-tech products on economic growth. Exports of high-tech products were expressed as a percentage, as the share of exports of high-tech products in total exports of the country. At the same time, economic growth was measured by gross domestic product (GDP) per capita and was expressed in euros. Data on the share of exports of high-tech products and GDP per capita in the cases of Serbia, Bulgaria, Hungary and Romania are shown in Table 2.

1. *The ratio of the share of exports of high-tech products in total exports and GDP per capita in the case of Serbia*

Before conducting a simple linear regression analysis in the case of Serbia, the assumptions on which it is based were tested. The results of this check are shown in Table 3.

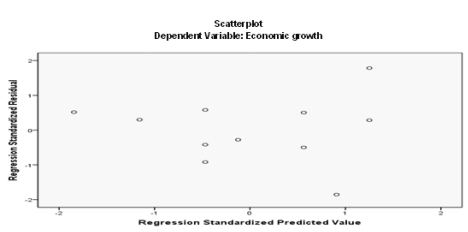
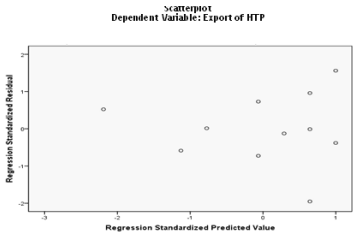
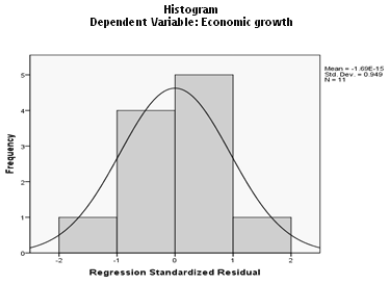
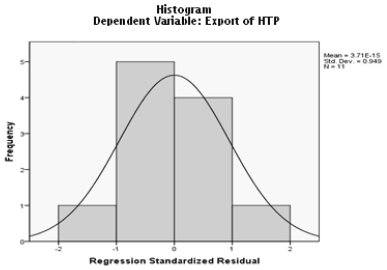
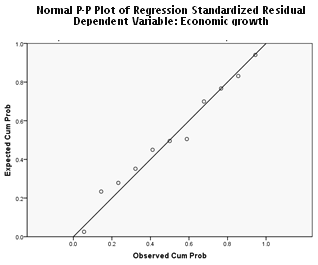
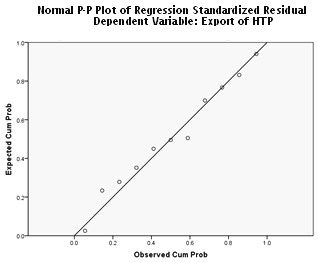
The first assumption, which referred to the continuous nature of variables, was fulfilled. The independent variable share of high-tech products in total exports and the dependent variable GDP per capita were metric variables measured on a ratio scale. The second and third assumptions, which referred to a linear correlation between variables and the absence of atypical points, were not met.

Table 2: Data on the share of exports of high-tech products and GDP per capita in the cases of Serbia, Bulgaria, Hungary and Romania

Country	Serbia		Bulgaria		Hungary		Romania	
Year/data	% HTP exports	GDP	% HTP exports	GDP	% HTP exports	GDP	% HTP exports	GDP
2008.	2,4	4.400	3,6	5.100	20,2	10.500	5,4	6.730
2009.	2,8	4.300	4,4	5.000	22,2	9.810	8,2	6.410
2010.	2,4	4.300	4,1	5.100	21,8	9.900	9,8	6.190
2011.	2,0	4.400	3,7	5.300	20,9	10.110	8,8	6.350
2012.	2,6	4.400	3,8	5.300	17,3	10.010	6,3	6.510
2013.	2,1	4.600	4,0	5.400	16,3	10.230	5,6	6.760
2014.	2,3	4.500	3,9	5.500	14,5	10.690	6,4	7.020
2015.	2,4	4.600	4,4	5.700	15,4	11.130	7,3	7.330
2016.	2,1	4.800	5,1	6.000	15,9	11.410	8,3	7.720
2017.	1,9	4.900	5,4	6.300	16,0	11.930	7,9	8.320
2018.	1,9	5.200	5,9	6.500	15,6	12.560	8,4	8.700

Source: Eurostat (2019), available at: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=htec_si_exp4&lang=en and https://ec.europa.eu/eurostat/web/products-datasets/-/sdg_08_10

Table 3: The results of testing the assumptions of simple linear regression in the case of Serbia

Variable / assumption	Share of exports of high-tech products in total exports (n = 11)	GDP per capita (n = 11)
The nature of the variable	Metrics	Metrics
Distribution diagram		
The value of the Durbin-Watson statistic indicator	d = 1,353	d = 2,579
Histogram		
P-P diagram of normality		

Source: author's research

The fourth assumption related to the independence of observations was not fulfilled, considering the obtained values of the Durbin-Watson coefficient of d = 1.077 and d = 2.536. The fifth and sixth assumptions about the absence of heteroskedasticity and the normal distribution of residual errors were, like histograms and Normal P-P Plot show, only partially fulfilled. Due to the violation of the assumptions of simple linear regression, data transformation was started. Data on the results of simple linear regression in the case of Serbia, conducted with logarithm-transformed variables, are shown in Table 4.

A correlation coefficient between the export of high-tech products and GDP per capita of R = 0.760 was determined, which can be considered large according to Cohen's criteria. The calculated coefficient of determination was R2 = 0.578, and the corrected coefficient of determination was Adj. R2 = 0.531. They showed that a total of 57.8%, or 53.1% of changes in the dependent variable GDP per capita, can be explained by changes in the independent variable - the share of high-tech products in total exports.

As the data related to ANOVA showed, the given regression model was statistically significant at the level of p <0.050, since the results of this test were F (1.9) = 12.304, p = 0.007. This result provides additional information on the ratio of independent and dependent variables included in the regression model. It suggests that exports of high-tech products give a statistically significant explanation for changes in GDP per capita.

By reviewing the regression coefficients, more details describing the relationship of the analyzed variables were obtained. The ordinary regression coefficient B was statistically significant at the level of p <0.050 and amounted to B = 3.786 (SE B = 0.036), so the following regression equation can derive based on it:

GDP per capita = 3,786 - 0,3358 *
(% export of HTP, Serbia) (2)

Table 4: The results of simple linear regression in the case of Serbia

Model Summary[b]				
R	R Square	Adjusted R Square	SE of the Estimate	
0,760[a]	0,578	0,531	0,01785	
a. Predictors: (Constant), Izvoz_Trans b. Dependent Variable: BDP_Trans				
ANOVA[b]				
	Sum of Squares	df	Mean Square	F	p
Regression	0,004	1	0,004	12,304	0,007[a]
Residual	0,003	9	0,000		
Total	0,007	10			
a. Predictors: (Constant), Izvoz_Trans b. Dependent Variable: BDP_Trans					
Coefficients[a]					
	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	Std. Error	Beta		
(Constant)	3,786	0,036		104,362	0,000
Izvoz_Trans	-0,358	0,102	-0,760	-3,508	0,007
a. Dependent Variable: BDP_Trans					

Source: author's research

This means that with each unit of increase in the share of high-tech products in the total exports of Serbia, GDP per capita changes according to the formula 3,786 - 0,3358 * exports of high-tech products. In addition, the standardized beta regression coefficient in this case is β = -0.760, and can be qualified as significant. The obtained negative value of the standardized regression coefficient β should be interpreted as a rule that each unit of increase of the predictor results in a decrease of the value of the dependent variable by the value of the calculated standardized regression coefficient β [34]. In this particular case, this means that with each unit of increasing the share of high-tech products in the total exports of Serbia, GDP per capita decreases by -0.760. However, since the share of high-tech products in the total exports of Serbia decreased during the observed period, this means that each unit of this decrease was accompanied by GDP growth per capita of 0.760.

2. *The ratio of the share of exports of high-tech products in total exports and GDP per capita in the case of Bulgaria*

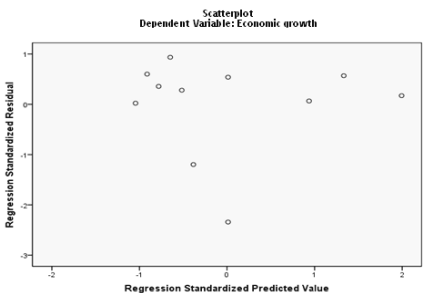
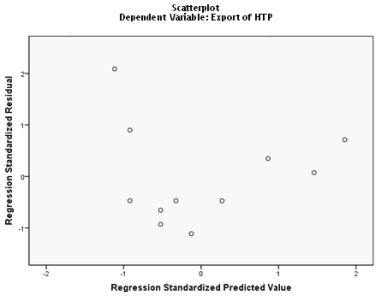
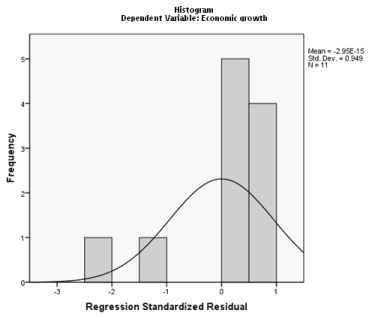
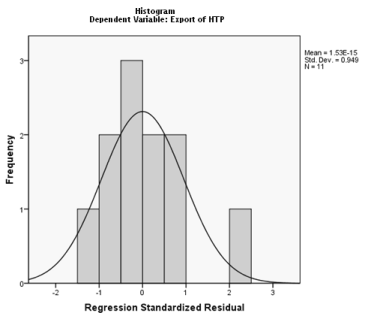
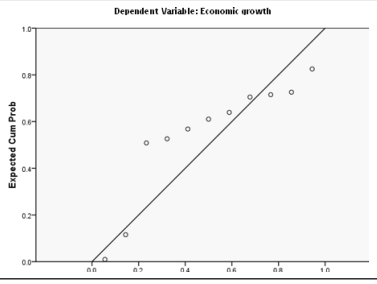
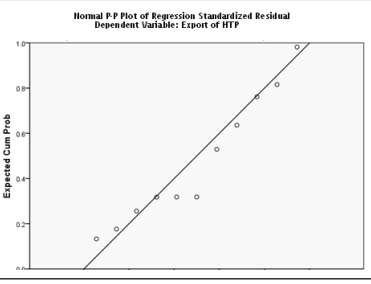
Before conducting a simple linear regression analysis in the case of Bulgaria, the assumptions on which it is based were tested. The results of this check are shown in Table 5.

The first assumption, which referred to the continuous nature of variables, was fulfilled. The independent variable share of high-tech products in total exports and the dependent variable GDP per capita were metric variables measured on a ratio scale. The second and third assumptions, which referred to a linear correlation between variables and the absence of atypical points, were not met. The fourth assumption related to the independence of observations was not fulfilled, considering the obtained values of the Durbin-Watson coefficient of d = 1.267 and d = 1.448. The fifth and sixth assumptions about the absence of heteroskedasticity and the normal distribution of residual errors were not met. Due to the violation of the assumptions of simple linear regression, data transformation was started. Data on the results of simple linear regression in the case of Bulgaria, conducted with logarithm-transformed variables, are shown in Table 6.

A correlation coefficient between the export of high-tech products and GDP per capita of R = 0.685 was determined, which can be considered large according to Cohen's criteria. The calculated coefficient of determination was R2 = 0.747, and the corrected coefficient of determination was Adj. R2 = 0.719. They showed that a total of 74.7%, or 71.9% of changes in the dependent variable GDP per capita, can be explained by changes in the independent variable - the share of high-tech products in total exports.

As the data related to ANOVA showed, the given regression model was statistically significant at the level of p <0.050, since the results of this test were F (1.9) = 26.629, p = 0.001. This result provides additional information on

Table 5: The results of testing the assumptions of simple linear regression in the case of Bulgaria

Variable / assumption	Share of exports of high-tech products in total exports (n = 11)	GDP per capita (n = 11)
The nature of the variable	Metrics	Metrics
Distribution diagram		
The value of the Durbin-Watson statistic indicator	d = 1,267	d = 1,448
Histogram		
P-P diagram of normality		

Source: author's research

Table 6: The results of simple linear regression in the case of Bulgaria

Model Summary[b]			
R	R Square	Adjusted R Square	SE of the Estimate
0,865[a]	0,747	0,719	0,02033
a. Predictors: (Constant), Izvoz_Trans b. Dependent Variable: BDP_Trans			

ANOVA[b]					
	Sum of Squares	df	Mean Square	F	p
Regression	0,011	1	0,011	26,629	0,001[a]
Residual	0,004	9	0,000		
Total	0,015	10			
a. Predictors: (Constant), Izvoz_Trans b. Dependent Variable: BDP_Trans					

Coefficients[a]					
	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	Std. Error	Beta		
(Constant)	3,446	0,058		59,470	0,000
Izvoz_Trans	0,467	0,090	0,865	5,160	0,001
a. Dependent Variable: BDP_Trans					

Source: author's research

the ratio of independent and dependent variables included in the regression model. It suggests that exports of high-tech products provide a statistically significant explanation for changes in GDP per capita.

By reviewing the regression coefficients, more details describing the relationship of the analyzed variables were obtained. The ordinary regression coefficient B was statistically significant at the level of p <0.050 and amounted to B = 3.446 (SE B = 0.058), so the following regression equation can derive based on it:

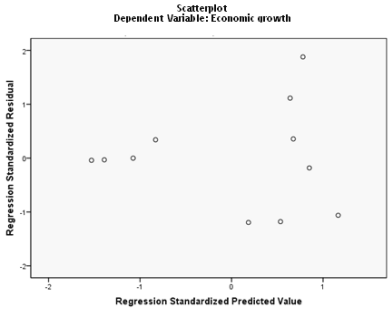
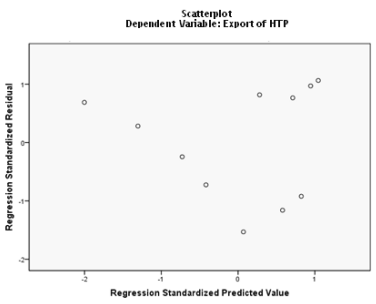
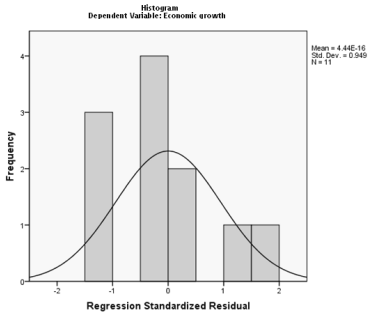
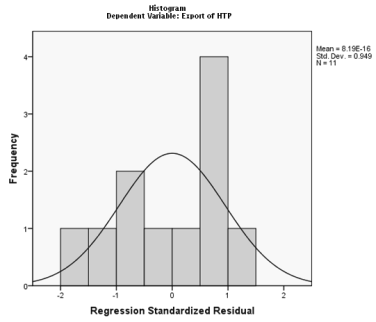
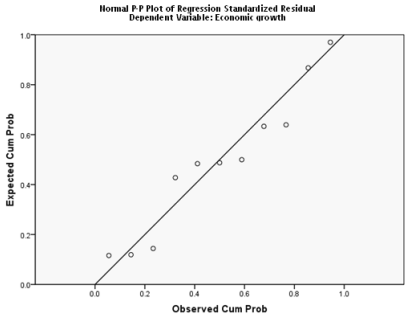
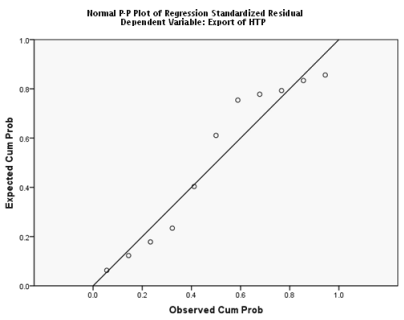
GDP per capita = 3,446 + 0,467 *
(% export of HTP, Bulgaria) (3)

This means that with each unit of increase in the share of high-tech products in the total exports of Bulgaria, GDP per capita changes according to the formula 33.446 + 0.467 * exports of high-tech products. In addition, the standardized beta regression coefficient in this case is β = 0.865, and can be qualified as large. Its positive sign indicates that in the case of Bulgaria, there was an increase in the share of high-tech exports in total exports during the observed period. An increase followed her in GDP per capita.

3. *The ratio of the share of exports of high-tech products in total exports and GDP per capita in the case of Hungary*

Before conducting a simple linear regression analysis in the case of Hungary, the assumptions on which it is based were tested. The results of this check are shown in Table 7.

Table 7: The results of testing the assumptions of simple linear regression in the case of Hungary

Variable / assumption	Share of exports of high-tech products in total exports (n = 11)	GDP per capita (n = 11)
The nature of the variable	Metrics	Metrics
Distribution diagram		
The value of the Durbin-Watson statistic indicator	d = 0,423	d = 0,497
Histogram		
P-P diagram of normality		

Source: author's research

The first assumption, which referred to the continuous nature of variables, was fulfilled. The independent variable share of high-tech products in total exports and the dependent variable GDP per capita were metric variables measured on a ratio scale. The second and third assumptions, which referred to a linear correlation between variables and the absence of atypical points, were not met. The fourth assumption related to the independence of observations was not fulfilled, considering the obtained values of the Durbin-Watson coefficient of d = 0.423 and d = 0.497. The fifth and sixth assumptions about the absence of heteroskedasticity and the normal distribution of residual errors were partly met. Due to the violation of the assumptions of simple linear regression, data transformation was started. Data on the results of simple linear regression in the case of Hungary, conducted with logarithm-transformed variables, are shown in Table 8.

A correlation coefficient between the export of high-tech products and GDP per capita of R = 0.673 was determined, which can be considered large according to Cohen's criteria. The calculated coefficient of determination was R2 = 0.453, and the corrected coefficient of determination was Adj. R2 = 0.392. They showed that a total of 45.3%, or 39.2% of changes in the dependent variable GDP per capita, can be explained by changes in the independent variable - the share of high-tech products in total exports.

As the data related to ANOVA showed, the given regression model was statistically significant at the level of p <0.050, since the results of this test were F (1.9) = 7.461, p = 0.023. This result provides additional information on the ratio of independent and dependent variables included in the regression model. It suggests that exports of high-tech products provide a statistically significant explanation for changes in GDP per capita.

By reviewing the regression coefficients, more details describing the relationship of the analyzed variables were obtained. The ordinary regression coefficient B was statistically significant at the level of p <0.050 and amounted to B = 3.446 (SE B = 0.058), so the following regression equation can derive based on it:

GDP per capita = 4,469 - 0,352 *
(% export of HTP, Hungary) (4)

This means that with each unit of increase in the share of high-tech products in the total exports of Hungary, GDP per capita changes according to the formula 4.469 - 0.352 * exports of high-tech products. In addition, the standardized beta regression coefficient in this case is β = -0.673, and can be qualified as large. As in the previous case of Serbia, its negative sign indicates that in the case of Hungary, the share of exports of high-tech products in total exports decreased, and this decrease was accompanied by an increase in GDP per capita, during the observed period.

Table 8: The results of simple linear regression in the case of Hungary

Model Summary[b]

R	R Square	Adjusted R Square	SE of the Estimate
0,673a	0,453	0,392	0,026766

a. Predictors: (Constant), Izvoz_Trans
b. Dependent Variable: BDP_Trans

ANOVA[b]

	Sum of Squares	df	Mean Square	F	p
Regression	0,006	1	0,006	7,461	0,023 a
Residual	0,007	9	0,001		
Total	0,013	10			

a. Predictors: (Constant), Izvoz_Trans
b. Dependent Variable: BDP_Trans

Coefficients[a]

	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	Std. Error	Beta		
(Constant)	4,469	0,161		27,758	0,000
Izvoz_Trans	-0,352	0,129	-0,673	-2,731	0,023

a. Dependent Variable: BDP_Trans

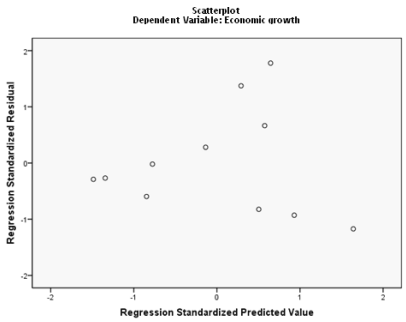
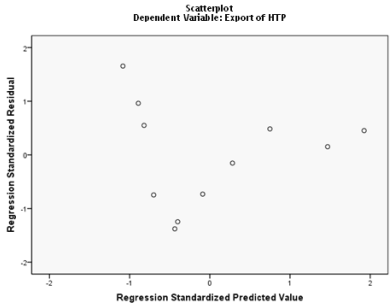
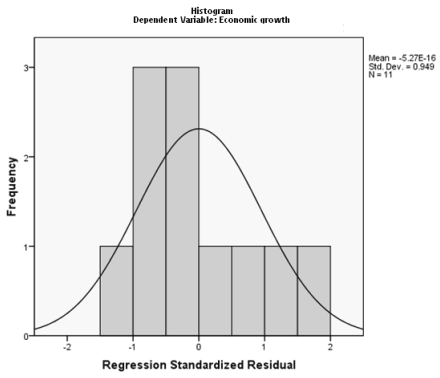
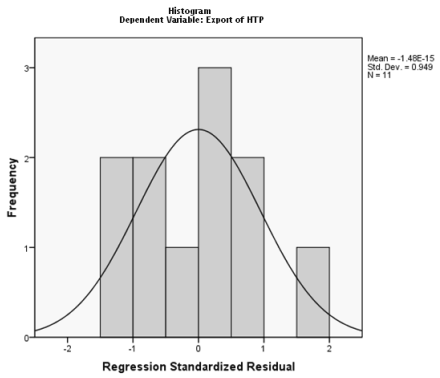
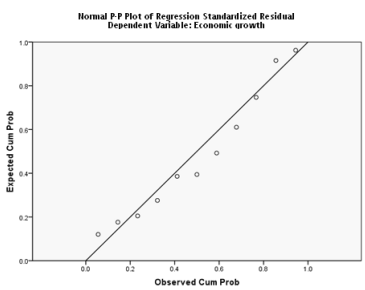
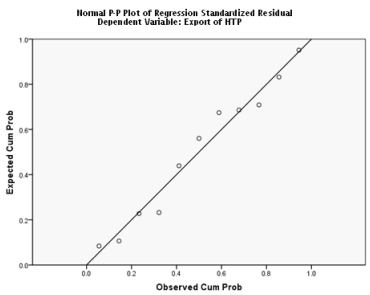
Source: author's research

4. *The ratio of the share of exports of high-tech products in total exports and GDP per capita in the case of Romania*

Before conducting a simple linear regression analysis in the case of Romania, the assumptions on which it is based were tested. The results of this check are shown in Table 9.

The first assumption, which referred to the continuous nature of variables, was fulfilled. The independent variable share of high-tech products in total exports and the dependent variable GDP per capita were metric variables measured on a ratio scale. The second and third assumptions, which referred to a linear correlation between variables and the absence of atypical points, were not met. The fourth assumption related to the independence of observations was not fulfilled, considering the obtained values of the Durbin-Watson coefficient of d = 0.183 and d = 1.089. The fifth and sixth assumptions about the absence of heteroskedasticity and the normal distribution of residual errors were partly met. Due to the violation of the assumptions of simple linear regression, data transformation was started. Data on the results of simple linear regression in the case of Romania, conducted with logarithm-transformed variables, are shown in Table 10.

Table 9: The results of testing the assumptions of simple linear regression in the case of Romania

Variable / assumption	Share of exports of high-tech products in total exports (n = 11)	GDP per capita (n = 11)
The nature of the variable	Metrics	Metrics
Distribution diagram		
The value of the Durbin-Watson statistic indicator	d = 0,183	d = 1,089
Histogram		
P-P diagram of normality		

Source: author's research

A correlation coefficient between the export of high-tech products and GDP per capita of R = 0.103 was determined, which can be considered small according to Cohen's criteria. The calculated coefficient of determination was R2 = 0.011, and the corrected coefficient of determination was Adj. R2 = -0.099. The obtained negative value of the corrected coefficient of determination requires additional explanation. According to statistical theory, a negative value of the corrected coefficient of determination occurs when the value of the sum of the residual squares is close to the total sum of squares. Then the explanatory power of the regression model is very small or impossible to determine [19]. A correlation coefficient between the export of high-tech products and GDP per capita of R = 0.103 was determined, which can be considered small according to Cohen's criteria. The calculated coefficient of determination was R2 = 0.011, and the corrected coefficient of determination was Adj. R2 = -0.099. The obtained negative value of the corrected coefficient of determination requires additional explanation. According to statistical theory, a negative value of the corrected coefficient of determination occurs when the value of the sum of the residual squares is close to the total sum of squares. Then the explanatory power of the regression model is very small or impossible to determine (Fogarty, 2019). With this in mind, even with a very low value of the obtained coefficient of determination of 1.1% (according to which a total of 1.1% of changes in the dependent variable GDP per capita can be explained by changes in the independent variable), the share of high-tech in total exports one should take with reserve, and thus evaluate the entire explanatory power of the regression model as insignificant. According to Cohen's criteria, the reason for this situation can be found in the small size of the calculated coefficient of determination, the existence of only one predictor, or the inclusion of only one independent variable in the model, and the small sample size which in this case was n = 11.

As the data related to ANOVA showed, the given regression model was not statistically significant at the level of p <0.050 since the results of this test were F (1.9) = 0.097, p = 0.762.

By reviewing the regression coefficients, more details were obtained that describe the correlation of the analyzed variables. The usual regression coefficient was not statistically significant at p <0.050 and was B = 3.796 (SE B = 0.169). The standardized regression coefficient beta in this case is β = 0.103, and can be qualified as small. The small values of the correlation and determination coefficients and the absence of statistical significance of the regression model suggest that in the case of Romania, there is no link between the share of exports of high-tech products in total exports per GDP per capita.

Table 10: The results of simple linear regression in the case of Romania

Model Summary[b]

R	R Square	Adjusted R Square	SE of the Estimate
0,103[a]	0,011	-0,099	0,05164

a. Predictors: (Constant), Izvoz_Trans
b. Dependent Variable: BDP_Trans

ANOVA[b]

	Sum of Squares	df	Mean Square	F	p
Regression	0,000	1	0,000	0,097	0,762[a]
Residual	0,024	9	0,003		
Total	0,024	10			

a. Predictors: (Constant), Izvoz_Trans
b. Dependent Variable: BDP_Trans

Coefficients[a]

	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	Std. Error	Beta		
(Constant)	3,796	0,169		22,501	0,000
Izvoz_Trans	0,060	0,194	0,103	0,312	0,762

a. Dependent Variable: BDP_Trans

Source: author's research

A comparative overview of the obtained results in all four countries and summaries of the hypothesis test are presented in Table 11.

Based on the presented data and previous analyzes in the cases of Serbia, Bulgaria, Hungary and Romania, it was concluded that the hypothesis regarding the existence of a positive impact of the share of high-tech products in total exports on economic growth, measured GDP per capita, was not disproved only in the case of Bulgaria. The following findings of the conducted analysis led to this conclusion:

1. in the case of Bulgaria, evaluated according to Cohen's criteria, there is a strong relationship between these two variables ($r = 0.865$, $r > 0.500$), the regression model is statistically significant $F(1.9) = 26.629$, $p = 0.001$, and the obtained regression coefficient has a positive value $\beta = 0.865$;
2. in the case of Serbia, evaluated according to Cohen's criteria, there is a strong relationship between these two variables ($r = 0.760$, $r > 0.500$), the regression model is statistically significant $F(1.9) = 12.304$, $p = 0.007$, but the resulting regression coefficient has a negative value $\beta = -0.760$;
3. in the case of Hungary, evaluated according to Cohen's criteria, there is a strong relationship between these two variables ($r = 0.673$, $r > 0.500$), the regression model is statistically significant, $F(1.9) = 7.461$, $p = 0.023$, but the resulting regression coefficient has negative value $\beta = -0.673$;
4. in the case of Romania, evaluated according to Cohen's criteria, there is a weak relationship between these two variables ($r = 0.103$, $r < 0.300$), and the regression model was not statistically significant $F(1.9) = 0.097$, $p = 0.762$

Discussion

After the analysis, the hypothesis about the impact of exports of high-tech products on GDP growth was withdrawn in the cases of Serbia, Hungary and Romania. At the same time, this was not the case with Bulgaria. At the same time, the ratio of these two variables in the case of Bulgaria can be described as strong and positive, in the case of Serbia and Hungary as weak and negative, and in the case of Romania the applied statistical analysis did not determine any correlation between exports of high-tech products and GDP growth. Such heterogeneous results require further explanation using both the data included in the analysis and relevant data from other theoretical studies and empirical studies that have addressed the correlation between these two variables.

The case of positive correlation of exports of high-tech products to GDP growth in the case of Bulgaria has its theoretical explanation in economics in the well-known export-led growth hypothesis. This hypothesis states that at the level of the national economy there is a positive interdependence between export growth, productivity and economic growth [32]. In addition, if in the period analyzed, variables related to the export of high-tech products and GDP growth are observed in parallel, in the case of Bulgaria, it is noticed that since 2014, the growth of exports of high-tech products has been constantly accompanied by Bulgarian GDP growth. In other words, in the period from 2014 to 2018, the percentage of growth in the share of high-tech products in total Bulgarian exports increased from 3.9% to 5.9%. It was accompanied by parallel GDP growth from 5,500 to 6,500 euros per capita. At the same time, in the cases of Serbia and Hungary, the share of exports of high-tech products in total exports from 2008 to 2018 decreased from 2.4% to 1.9% in the case of

Table 11: Hypothesis test summary

	Serbia	Bulgaria	Hungary	Romania
Hypothesis test result	Not confirmed	Confirmed	Not confirmed	Not confirmed
Calculated values of the correlation coefficient	0,760	0,865	0,673	0,103
Calculated values of the coefficient of determination	0,578	0,719	0,453	0,011
The obtained regression equation	GDP = 3,786 - 0,3358 * % export of HTP	GDP = 3,446 + 0,467 * % export of HTP	GDP = 4,469 - 0,352 * % export of HTP	-
Statistical significance of the regression model	Exists	Exists	Exists	No exist
Relation of variables in the regression equation	Negative	Positive	Negative	-

Source: author's research

Serbia, and from 20.2% to 15.6% in the case of Hungary. Results similar to those obtained in the case of Bulgaria can be found in a number of similar studies examining the impact of high-tech exports on economic and GDP growth [5], [16], [38], [24].

The results obtained for Serbia and Hungary have been explained in previous studies. Thus, some authors [36] conclude that the export of high-tech products is not crucial for economic and GDP growth in some countries. They are dominated by exports of products from medium and lower technology industries. Keep in mind that such industries are mainly based on labor-intensive work and that their exports are usually based on large imports. In the case of Romania, no correlation has been found between exports of high-tech products and GDP growth, and such a result is confirmed in previous research [25].

Conclusions

Innovation is one of the key factors of competitiveness in the global market. High technologies are generally known for innovation and exports, contributing to economic development. Therefore, the state needs to create conditions for raising the export capacities of companies operating in high technologies to increase the economy's competitiveness on a global level. Activities should be aimed at creating conditions that will enable the greatest possible performance in the field of innovation, which will automatically be reflected in the country's ranking on the list of the Global Competitiveness Index. The country can expect accelerated technological development if it creates a favorable environment for knowledge transfer, development of new technologies, commercialization of products, and networking and stimulating the growth of the knowledge-based economy.

In the previous decade, there was an increase in exports of high and medium technological complexity products in Serbia. This is especially true for high-tech products whose export value has increased almost 15 times. In addition, there is a high degree of production concentration in the exports of the hi-tech group. In contrast, the concentration in the export of products of medium technological complexity is close to the average of the countries in the region. In this regard, one of the goals set by the Hungarian government was to take a leading role in applying new, innovative technologies at the regional and European level, all to become a leader when it comes to technological research. According to the IMF analysis from 2019, Hungary and Germany are ranked first in the share of high-tech products. Romania has a small number of companies and a low average of R&D spending and a lower share of employment in high- and medium-tech industries. The situation can be explained by low technology in the economy and the limited number of multinational companies establishing R&D centers in Romania, but also by the weak interest of companies in R&D reporting. Bulgaria's innovation system operates below its potential, whether measured by system inputs (based on R&D spending), output (by number of patents), or economic growth (measured by high-tech exports).

Accordingly, this paper aimed to investigate the share of exports of high-tech products, as one of the results of the application of innovations in the economy, in total economic growth measured by GDP growth. The main task was to check the positive impact of the growth of exports of high-tech products on the economic growth of four countries (Serbia, Bulgaria, Hungary and Romania). The analysis results showed that the positive relationship between exports of high-tech products and GDP growth could not be confirmed in the case of Serbia, Hungary and Romania. In contrast to these countries, in the case of Bulgaria, the impact of growth in exports of high-tech products on GDP growth has been confirmed. The pronounced negative correlation between the share of exports of high-tech products in total exports of Serbia and GDP per capita shows that the percentage of exports of high-tech products in total exports decreased during the study period, while GDP per capita grew. This tells us that Serbia did not base its economic development in the previous period on strengthening the export of high-tech products. Regarding the share of high-tech products in total exports, in the last ten years there has been a decline from 2.8% in 2009 to 1.9% in 2018.

After a detailed analysis, the main conclusions of this research were adopted, which indicate that (a) a decrease in the share of high-tech products in total

exports is accompanied by an increase in GDP per capita (Serbia), (b) a decrease in the share of exports of high-tech products is accompanied by an increase in GDP per capita (Hungary), (c) the increase in the share of exports of high-tech products is accompanied by an increase in GDP per capita (Bulgaria) and (d) there is no correlation between the share of exports of high-tech products and GDP per capita (Romania). The obtained results have significant and concrete implications for decision-makers. Although the cases of Serbia and Hungary show that economic growth is possible without increasing the share of exports of high-tech products in total exports, the question of sustainability of such development remains open and the application of innovations in medium-tech low-tech industries. On the one hand, the highest profit rates and the highest growth rates are provided by the products of high-tech sectors and compatible technological innovations. Still, other industries also need the improvement of technologies and innovations for their better results.

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MUNICIPAL GREEN BOND YIELD BEHAVIOUR

Karakteristike prinosa zelenih obveznica lokalnih samouprava

Abstract

The aim of this paper is to study municipal green bonds as fixed-income instruments used for environmentally friendly projects. This research was motivated by the absence of an effective global CO2 pricing scheme, making green bonds one of the most important instruments to tackle climate change. After an overview of the U.S. municipal green bond market, yields of municipal green bonds vs. ordinary municipal bonds were analysed. S&P U.S. Municipal Green Bond Index and S&P U.S. Municipal Bond Index were used in the study. The methodological framework includes a review of relevant literature, descriptive statistics with correlation analysis and hypotheses testing. As initially expected, significant positive correlation between green bond and ordinary bond yields was found, where green municipal bonds generate slightly lower yields than otherwise similar ordinary bonds. The existence of a statistically significant yield discount, i.e., a green premium, has not been confirmed.

Keywords: *green bonds, climate change, environmentally friendly projects, sustainable finance, municipal bonds, bond yields, green bond labelling.*

Sažetak

Cilj ovog rada jeste proučavanje zelenih obveznica kao instrumenata sa fiksnim prinosom koji se koriste za finansiranje ekološki prihvatljivih projekata. Motivacija za ovo istraživanje rezultat je odsustva efektivnog globalnog mehanizma taksi na emisiju CO2, što zelene obveznice čini jednim od najvažnijih instrumenata za borbu protiv klimatskih promena. Nakon pregleda tržišta zelenih obveznica lokalnih samouprava u SAD, analiziran je prinos zelenih obveznica u odnosu na prinos konvencionalnih obveznica lokalnih samouprava. U istraživanju su korišćeni S&P U.S. indeksi zelenih i konvencionalnih obveznica lokalnih samouprava. Metodološki okvir obuhvata pregled relevantne literature, deskriptivne statistike sa korelacionom analizom i testiranje hipoteza. Kao što je inicijalno očekivano, pronađena je značajna pozitivna korelacija prinosa zelenih i klasičnih municipalnih obveznica, kao i to da zelene municipalne obveznice u proseku generišu nešto niži prinos u odnosu na slične klasične obveznice. Nije potvrđeno postojanje statistički značajnog prinosnog diskonta, odnosno cenovne premije kod zelenih obveznica.

Ključne reči: *zelene obveznice, klimatske promene, ekološki prihvatljivi projekti, održivo finansiranje, obveznice lokalnih samouprava, prinos obveznica, sertifikacija zelenih obveznica.*

Introduction

The cost of green bond financing is the focus of this paper's analysis. The lack of a global carbon pricing scheme makes bond markets one of the most important vehicles to tackle climate change.

As climate changes accelerate, financing of environmentally friendly projects (renewable energy, CO_2 reduction, nature remediation, etc.) is becoming a global priority. Since 1880, the six warmest years have been recorded after 2010 [14]. The consequences of climate change are seen in rapid temperature increases, water acidity, sea level increases, ice glaciers shrinking, and so forth. As additional hazards, droughts and floods are becoming more frequent in recent years [2].

Enormous financial resources are required to decelerate the climate change. According to the most recent energy outlook scenarios, keeping global temperature rise below 2°C, the Paris Agreement's global warming threshold that lowers the probability of disastrous outcomes, will cost USD 12 trillion over the next two and a half decades, by 2050 [20].

Green bonds appeared as a promising financial vehicle to tackle climate change. They are fixed-income instruments created as viable tools for financing environmentally friendly investments, such as sustainable agriculture and forestry, renewable energy, clean transportation, energy efficiency, and biodiversity conservation [20].

In 2007, the first green bond was created by the European Investment Bank (EIB). Since then, various green bonds have emerged, including corporate, sovereign, municipal, and so forth. Supranational institutions followed EIB's lead as the International Finance Corporation issued the first USD 1 billion green bond in 2013 [2].

Globally accepted standardisation of green bonds has yet to be established, as there is no globally recognised system for determining the green status. There are essentially two types of green bond labels. The first one states that the issuer can claim green bond status without third-party confirmation, while the second assumes the third-party certification according to a set of standards. The lack of unified global standards creates a barrier to significant developments of the global green bond market.

The analysis in this paper is focused on the costs of green bond financing. We provide valuable insight into a yield differential between green and ordinary municipal bonds in the U.S. municipal bond market. The findings are in line with one stand of relevant research and literature in this area of study that indicate the absence of a statistically significant green premium for municipal green bonds.

The paper is organised as follows – following the introduction, the second chapter presents the current conditions in the green bond market segment. The third chapter summarises the findings of the relevant literature review. Chapter four consists of the central research hypothesis, methodological framework, and data sources used in the analysis. We present the findings of the empirical analysis and a discussion of the results in chapter five, followed by the paper's conclusion.

The green bond market landscape

In December 2020, the Climate Bonds Green Bond Database captured the representative value of the green bond market to be USD 1 trillion. The green bond market increased by USD 290 billion in 2020, which is an increase of 9% compared to the previous year. The number of issuers increased by 14% to a total of 634. The total number of green bond instruments issued was 1696, with an average size of the instrument being USD 171 million. There were 55 countries involved in the issuance of green bonds, with 34 currencies in which these securities were denominated. The denomination in the three dominant currencies – EUR (48%), USD (28%), and CNY (6%) – increased to 82%. More than 62% of the 2020 green bond volume had a maturity of less than ten years, while almost 40% had a maturity of between 5 and 10 years [20].

Hereunder are the analysed green bond issuances by region, issuer, and investment sector (Figure 1, Figure 2, and Figure 3, respectively).

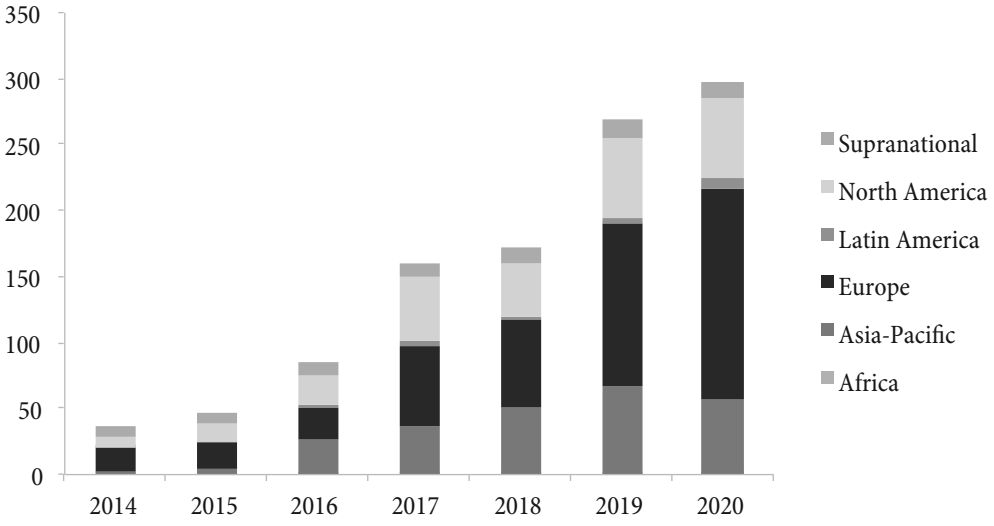
According to data from the Climate Bonds Initiative (Figure 1), issuers of the dominant share of the overall green bonds originated from developed countries (more than 80% in 2020). Emerging markets accounted for 16% in 2020, while the portion of supranational entities was 4%. The most considerable amount of green bonds

was issued in Europe (USD 156 billion, 48%), followed by North America (USD 61.5 billion) and Asia. The USA remained the largest issuer of green debt, reaching USD 52.1 bn (18%) in 2020. Municipal issuers, such as local governments and government-backed issuers, are the most common issuers in the U.S. market [5].

FGreen bond issuers include corporations, governments, municipalities, and supranational organisations. The surge in public sector issuances (France, China and the United States) was typical of the expansion in overall green bond issuances in 2020, while private sector volumes remained stable or diminished. This pattern can be explained by the COVID-19 pandemic crises affecting private sectors more than the public ones. On the other hand, the local government issuers increased by 50%, reaching the level of USD 18.5 bn, where 72 U.S. municipal green bonds worth USD 9.5 billion accounted for more than half of the total number [5].

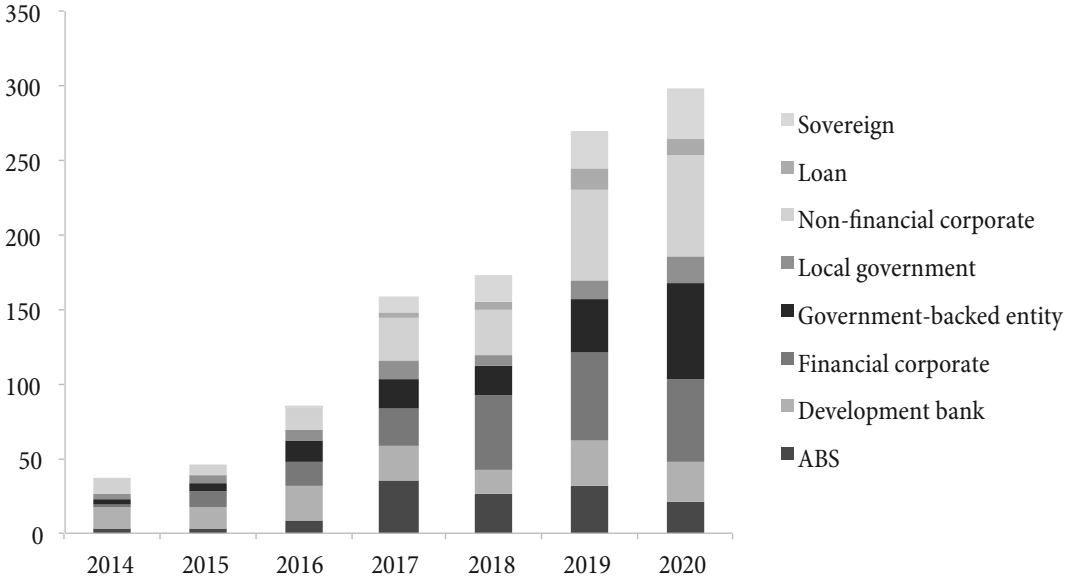
Energy, Buildings, and Transportation were the most common sectors to issue green bonds to finance their activities in 2020, accounting for 85% of the total, followed by Water and Land use.

Figure 1: Green bond issuances by region, in US$ bn, 2014-2020



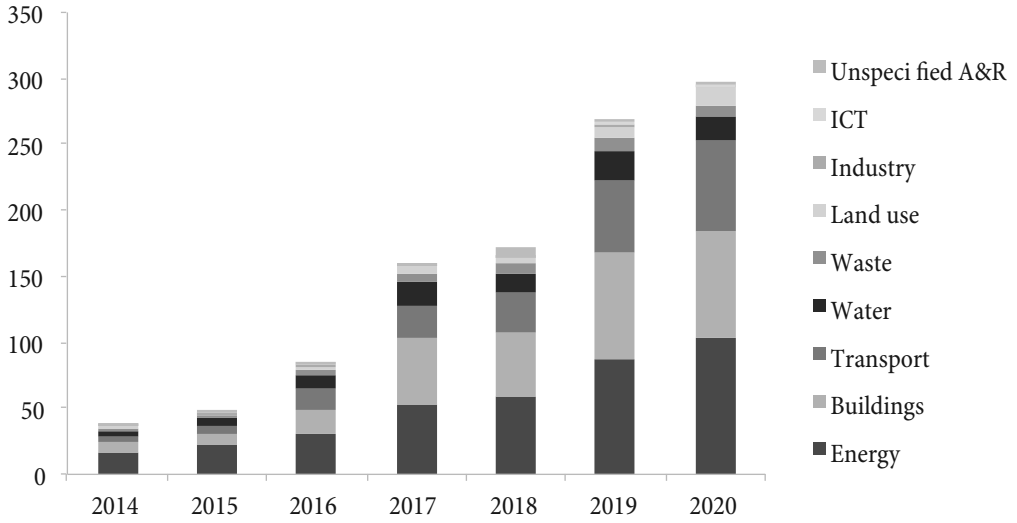
Source: [4].

Figure 2: Green bonds by the issuer, in US$ bn, 2014-2020



Source: [4].

Figure 3: Green bonds by sector, in US$ bn, 2014-2020



Source: [4].

Green bonds reviewed by external reviews made up for 89% of green debt instruments in 2020. Investors actively encourage greater market transparency through information disclosure and are looking for independent confirmation of the legitimacy of green financial instruments [5].

Literature review

Various studies of green bonds emerged in the recent years. The analysis of the relevant literature signals that many papers found the yield on green bonds to be lower than the yield of the similar non-green bonds (known as yield discount or green bond price premium, i.e., greenium). However, the results of different analyses vary depending on, among other factors, the green bond issuer, type of green bond certification, whether the primary or secondary market is surveyed, sample selection, timing, and the methodology used.

Sharfman and Fernando (2008) and Ghoul, Guedhami, Kwok and Mishra (2011) found that an established environmental risk management results in a lower cost of capital and reorientation from equity towards debt financing, accompanied by higher tax benefits. Modestly lower costs of financing for green bonds were identified by Hachenberg and Schiereck (2018), who found limited pricing differential for green and plain vanilla bonds in the secondary market.

Many research papers showed various degrees of green premium – greenium.

Gianfranco and Peri (2019) identified a statistically significant average green premium for the issued green bonds of approximately 18 basis points. Zerbib (2019) found a low green premium of two basis points.

Bachelet, Becchetti and Manfredonia (2019) found that institutional green bonds had a negative yield premium, while corporate bonds had a positive premium compared to non-green bonds unless the corporation certified the green bond. By analysing a sample of 89 bond pairs (green and ordinary bonds), they discovered that green bonds had higher yields and liquidity while being less volatile than their closest non-green bond counterparts. Similarly, Hyun, Park and Tian (2019) found that green bonds that were externally certified had a green premium of around six basis points. Furthermore, the Climate-Bonds Initiative-(CBI)-certified green bonds had a yield discount of roughly 15 basis points.

Baker, Bergstresser, Serafeim and Wurgler (2018) found that green bond after-tax yields at issuance were approximately six basis points below the equivalent ordinary bond yields. The yield discount was increasing after external certification and registration in CBI.

By analysing panel data, Fatica, Panzica and Rancan (2021) discovered a green premium for supranational issuers' green bonds and corporate green bonds. Bour (2019) found evidence of yield discount for green bonds.

The price premium varied depending on the ratings, currency denomination and sector of the issuers.

However, other researchers did not find valid proof of green bond yield discount (green premium).

Partridge and Medda (2020) did not find a strong argument for the existence of green premium in the primary market. Furthermore, Östlund (2015) found no proof of a green premium nor of the fact that green bonds had been traded at a discount compared to their non-green counterparts. Tang and Zhang (2020) found a favourable reaction of stock prices to the issuances of green bonds. Nevertheless, they did not identify a consistently significant green premium, concluding that stock returns behaviour after the green bond announcement is not entirely driven by the lower debt costs.

When comparing municipal green bonds to equivalent ordinary municipal bonds, Larcker and Watts (2020) discovered a very small yield discount, without proof to support a premium on municipal green bonds. Thus, they concluded that the green premium was practically zero. On a wide sample of U.S. municipalities, Karpf and Mandel (2018) investigated U.S. municipal green bonds and found price discounts in the secondary market. In the recent years, however, they stressed out that the quality of municipal green bonds had risen and that premium for some of them became positive.

Different sampling processes, investigated time periods and applied methodologies, securities' credit ratings, issuers' business sector, bond currency denomination, and other characteristics of the issuance and green bonds could all potentially contribute to the stated mixed results found in various studies.

Methodology, data sources and research hypothesis

Research hypothesis

The main research hypothesis in this paper states that:

- Municipal green bonds generate lower average yields compared to ordinary municipal bonds.

There are theoretical reasons to support this assumption.

Firstly, environmentally concerned investors are willing to invest in bonds with lower yields for environmental benefits [18], [15]. In the German market, Kaenzig, Heinzle and Wüstenhagen (2013) showed that consumers are willing to accept a lower yield and pay a price premium of around 16% over the current average for a more environmentally oriented default electricity mix.

According to research by Rommel, Sagebiel and Müller (2016), investors are willing to accept significantly lower yields for financing green renewable energy offered by cooperatives or municipal electricity utilities. Karpf and Mandel (2018) investigated U.S. municipal green bonds and concluded that the credit quality of municipal green bonds was increasing over time, finally resulting in a positive green premium.

Methodology

To obtain objective results of the analysis, the following methods were employed:

- Intensive literature research;
- Descriptive statistic and correlation analysis;
- Hypothesis testing (F-test: for the equality of variances of two samples; T-test: for the equality of means of two samples assuming unequal variances);
- Consultations with experts on climate change and finance.

Data sources

Secondary data sources were employed:

- Data from Climate Bonds Initiative for the 2014-2020 period.
- S&P U.S. Municipal Green Bond Index [23] daily data from 2nd September, 2014 to 31st December, 2020.
- S&P U.S. Municipal Bond Index [22] daily data from 2nd September, 2014 to 31st December, 2020.

Results and discussion

In the analysed period, the S&P U.S. Municipal Green Bond Index and S&P U.S. Municipal Bond Index yields have demonstrated a significant positive co-movement,

where in certain subperiods green bond yields were below (2014, 2015, 2016, 2019, Jan-Feb 2020), while in others they were above the level of their non-green counterpart yields (2017, the first half of 2018, March-Dec 2020).

The behaviour of the green and conventional counterpart bond yields is statistically quite similar, as seen in Table 1 and Figure 4.

Table 1: Summary statistics for S&P U.S. Municipal Green Bond Index and S&P U.S. Municipal Bond Index yields to maturity, 2nd September, 2014–31st December, 2020

	S&P U.S. Municipal Green Bond Index	S&P U.S. Municipal Bond Index
Mean	0.0302395	0.0302476
St. error	0.0000720	0.0000750
Median	0.0306351	0.0308994
St. deviation	0.0028655	0.0029856
Sample variance	0.0000082	0.0000089
Kurtosis	-0.6672738	0.1621299
Skewness	-0.3548610	-0.8120451
Range	0.0164415	0.0178338
Min.	0.0225163	0.0222470
Max.	0.0389579	0.0400808
Sum.	47.8691406	47.8820064
Count.	1583	1583

Source: Authors' calculations.

The municipal green bond index had a mean yield of 3.02395% over the analysed period, compared to 3.02476% for the municipal bond index, with similar levels of dispersion indicators.

As expected, the correlation between the green and ordinary municipal bond yields was high with a positive sample Pearson correlation coefficient of +88.04%.

Next, we tested the relevant hypotheses.

First, the F-test based on two samples was employed to test the null hypothesis of whether the variances of two bond yield populations are equal:

$$H_0: \sigma_{non\text{-}green}^{\ 2} = \sigma_{green}^{\ 2}$$
$$H_1: \sigma_{non\text{-}green}^{\ 2} \neq \sigma_{green}^{\ 2}$$

Since F-stat was found to be higher than the F-critical one-tail (5% significance level), 1.0873 > 1.0862, we have rejected the null hypothesis. The variances of the two bond populations were found to be unequal.

Then, we continued with the T-test based on two yield samples assuming unequal variances. The T-test was used to test the null hypothesis that the mean yields of two bond populations are equal.

Figure 4: S&P U.S. Municipal Green Bond Index and S&P U.S. Municipal Bond Index yields to maturity, 2nd September, 2014–31st December, 2020

Source: Authors' presentation based on S&P data [22], [23].

$$H_0: \mu_{non\text{-}green} - \mu_{green} = 0$$
$$H_1: \mu_{non\text{-}green} - \mu_{green} \neq 0$$

If t-stat < -t-critical two-tail or t-stat > t-critical two-tail, we could reject the null hypothesis (5% significance level). This was not the case, since -1.9607 < 0.0673 < 1.9607. Therefore, we did not reject the null hypothesis. The observed difference between the sample means (average $yield_{non\text{-}green}$ - average $yield_{green}$ = 0.000098) was not persuasive enough to state that the average yield of plain vanilla municipal bonds and green municipal bonds differed significantly in the investigated period.

Thus, the research hypothesis was not statistically confirmed, even though the municipal green bonds accounted for a lower average yield in the analysed period compared to the ordinary municipal bonds. The difference, or the yield discount, was found to be very narrow, accounting for less than one basis point (-0.98 bp).

As previously noted, many studies of green bond yield spreads have discovered significant differences in green bond premiums depending on the issuer of the bonds. The most prominent greeniums were found for green bonds of corporations and supranational institutions, while a significant price advantage for green bonds was not found for financial institutions [6]. According to our results, this finding can be extended to municipal green bonds where "greening" seems not to be providing a significant difference in the cost of financing. Our findings are consistent with those of other researchers who found no clear evidence of the existence of a yield discount (green price premium) for green bonds (Larcker & Watts (2020), Partridge & Medda (2020), and others).

Given that the obtained results are potentially reliant on the studied period, the selected samples, and the methodology used, further economic interpretation of the obtained results is needed. The fact that non-financial institutions, such as corporations, usually issue green bonds to finance specific projects offering more transparency to potential investors, while financial institutions and municipalities often use green bonds to fund a pool of projects, which is a process accompanied by less transparency, as a result, may have a higher required rate of return on green bond investments.

Conclusion

Rapid climate change is posing an imminent threat. The need for financial solutions for environmentally friendly projects becomes a necessity. Over time, green bonds emerged as a promising vehicle for addressing the financial needs of green investments.

In this paper, we have analysed green bonds and, in particular, the U.S. municipal green bond market. By comparing yield performances of green vs. non-green municipal bonds, we found no statistically significant advantage in green premium for municipalities issuing green bonds, as the average yield in the investigated period was just slightly lower than plain vanilla municipal bonds' average yield.

The influence of COVID-19 led to global economic and social disruptions. However, the bond market has proven to be a resilient and flexible funding platform, assisting with immediate and longer-term recovery strategies. Over 110 countries are making an effort to become carbon neutral by 2050. Thus, governments must respond to this challenge by implementing large-scale green infrastructure plans as part of the after-COVID-19 recuperation. Green bonds, among others, will be critical to financing these plans.

As green bonds are relatively new fixed-income instruments, future research related to boosting transparency, unifying labelling, and adopting global green standards, among other topics, would be of high investigative and broader public interest.

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INVESTIGATING THE RELATIONSHIP BETWEEN QUALITY, LOYALTY, AND PERSONAL RELATIONSHIP IN THE BANKING SECTOR: AN ANALYSIS OF MICRO, SMALL AND MEDIUM-SIZED ENTERPRISES IN SERBIA

Istraživanje odnosa između kvaliteta, lojalnosti i personalnih odnosa u bankarskom sektoru – analiza mikro, malih i preduzeća srednje veličine u Srbiji

Abstract

The aim of this paper is to examine specific aspects of banking services, from the founding of the company and the first steps of entrepreneurs, through its growth from micro, small to medium-sized enterprises. The quality of the bank's service is directly related to the positive experience of service users, i.e. it depends on the extent to which the bank manages to solve the problem of the entrepreneur. Furthermore, this quality leads to a deeper connection between the bank and the business client, a personal relationship, based on two-way communication and trust, which contributes to building a loyal two-way relationship. In the Serbian market, we examined the experience of 99 entrepreneurs with the services offered by 26 banks. The products are similar; what makes the difference is the marketing of banking services and the positioning of the bank's brand in the consciousness of the entrepreneur as a bank that cares about the client and is ready to further invest in building trust and loyalty. Our findings indicate that the owners of micro-size firms and entrepreneurs located in Belgrade, have comparatively more concerns about the quality of rendered services.

Keywords: *banking services, quality, brand loyalty, personal relationship, entrepreneurs, SMEs, Serbia*

Sažetak

Cilj rada je istraživanje specifičnih aspekata bankarskih usluga, od osnivanja preduzeća i prvih koraka preduzetnika, tokom rasta firme od mikro, malog, pa sve do preduzeća srednje veličine. Kvalitet bankarskih usluga je direktno povezan sa pozitivnim iskustvom korisnika usluga, tj. zavisi od mere u kojoj banka uspeva da reši probleme preduzetnika. Osim toga, pomenuti kvalitet usluga vodi ka dubljoj vezi između banke i poslovnog klijenta i ličnom odnosu koji se bazira na dvosmernoj komunikaciji i poverenju, što doprinosi izgradnji uzajamne lojalnosti. Na srpskom tržištu, istražili smo iskustva 99 preduzetnika kojima su ponuđene usluge od strane 26 različitih banaka. Proizvodi su slični: ono što predstavlja razliku je marketing bankarskih usluga i pozicioniranje brenda banke u svesti preduzetnika, za banku koja brine o klijentu i spremna je da dalje ulaže u izgradnju poverenja i lojalnost. Rezultati istraživanja ukazuju da vlasnici mikro preduzeća i preduzetnici u Beogradu imaju komparativno veću zabrinutost u povodu kvaliteta ukazanih bankarskih usluga.

Ključne reči: *bankarske usluge, kvalitet, lojalnost brendu, personalni odnos, preduzetnici, mala i srednja preduzeća, Srbija*

Introduction

It is a long way from the time of Adam Smith, who believed that intangible activities could not create value [59, p. 9], until the end of the last century, wherein Great Britain every fifth worker and in the USA every sixth worker are in manufacturing [36, p. 11], while all others work in service activities. This is precisely the reason why services are one of the most studied categories. The perception of the service user is studied first of all, because its quality depends on the user experience when using the service, which is the topic of this manuscript. Undoubtedly, the large share of the financial sector in the entire service sector, and thus in a country's economy, is very important. According to Thomas Pillippon, the US financial sector has doubled in just over two decades, from 4.9% of GDP in 1980 to 8.3% of GDP in 2006 [60].

In Serbia, the financial sector, especially the banking sector, has undergone tectonic changes in the last 20 years. Since 2002, when there were 50 banks, through consolidation and privatisation [52], that number has been reduced to 33 banks in one decade, while in 2018 there were 28 banks [86]. Now, according to the data of the National Bank of Serbia, 26 banks are operating on the Serbian market, of which four are domestic, and 22 are foreign banks. In the market competition on the territory of Serbia, 26 banks aim to satisfy the needs and provide adequate service to clients, including entrepreneurs.

According to available data, banks operate in 1,398 branches and 1,755 ATMs in 150 cities in Serbia [39]. We can say that this is not enough, because if we compare with Croatia in the region, we see that in the neighbouring country of 4 million inhabitants there are 1,171 branches and 4,443 ATMs, according to Croatia's Association of Banks in 2016 [50, pp. 24-25]. However, users of banking services, i.e. natural and legal persons in Serbia, have the opportunity to choose. The topic of our paper is precisely that aspect that refers to the satisfaction of users and their commitment to cooperation with the selected bank.

According to data from 2017, a total of 100,488 legal entities operated in Serbia, of which 86.6% were 87,012 micro enterprises (0-9 employees), followed by 10.5% or 10,583 small enterprises (10-49 employees), 2,372 medium-sized companies (50-249 employees), or as the percentage of 2.4%, and 521 large companies (over 250 employees) or 0.5% of the total number of companies [62, p. 14]. According to the last official census from 2011, the number of inhabitants in Serbia is 7,186,862 [54].

The service in the general sense is intangible, invisible, without colour, smell and taste; it cannot be stored, and it is not divisible. The quality of service is measured by the perception of the service user about its quality, where the perceived quality means a specific judgment or attitude of the service user that is related to the use of the service [85].

The Law on Protection of Users of Financial Services [83] defines banking services as services that a bank provides to its users of services based on a mutually concluded loan or deposit contract, then the agreement on issuance and use of credit card, agreements on overdraft and other services that the Bank provided in accordance with the law.

International banking includes the provision of banking services to service users in many countries. It covers many services that are of interest to the business of all participants, especially entrepreneurs who are import and export-oriented. Of particular importance to them is a wide range of banking services such as transactions with foreigners and domestic residents, from the aspect of foreign exchange risk protection [43].

As a country in transition, through the privatisation of the banking sector, Serbia has started the process of integration with the international banking sector. This has significantly contributed to the unification and standardisation of banking services offered to individuals and entrepreneurs. According to the data available by the Association of Serbian Banks observed by sector structure at the end of 2017, loans to entrepreneurs recorded a nominal growth of 3%, while loans to households at the end of 2017 were nominally higher by 10% compared to the previous year, which contributed to a significant decline in interest rates on foreign currency indexed loans. The total value of entrepreneurial loans at the end of 2016 amounted to 313 million euros, while in 2017 this value rose to 336 million euros. Retail bank loans in 2016 amounted to EUR 5.7 billion, while this amount also increased in 2017 and amounted to EUR 6.6 billion [77]. All this points to a positive trend

of economic development of Serbia, which has led to an increase in the need for banking and financial services, primarily for credit.

Entrepreneurs as clients are especially interested in banking services, primarily because the development of their business is inconceivable without lending by banks, but also without all other services. Therefore, their views on the quality of banking services are extremely important, and according to Green Erling [31], play a key role in the development of the entire economy. Entrepreneurs' assessments can be hampered by a lack of adequate terminology and a complete view of entrepreneurship as a segment of economic development. The intuition of entrepreneurs should not be ruled out when making the final decision on the evaluation of banking services, which would further lead to the correct business decisions in the credit market.

In the academic sphere and at various government levels, there is an increasing interest in the field of entrepreneurship [35], even in Serbia. Entrepreneurs have become active participants in public life, and their media coverage has become important. Therefore, banks are striving to improve relations with clients from the ranks of entrepreneurs. They try to recruit and retain them as permanent users of banking services. Customer satisfaction has a direct impact on their loyalty [37]. The higher the degree of satisfaction with banking services, the greater their loyalty.

Since men and women demonstrate different goals and intentions in their companies due to self-schemas and identities [49], we examine differences between male and female entrepreneurs when dealing with selected banks. Viewing all respondents from the gender-blind perspective could be discriminatory [72]. The size of the firms is another feature that could affect the level of satisfaction with banking services. Following improvements in information and communication technologies, it is to be expected that banking services would reach the farthest and most disadvantaged customers in a country [55]. Finally, our sample is dominated by entrepreneurs located in the capital city of Belgrade, which implies that market conditions in the place where a firm is headquartered could be dominant in determining its current and future opportunities [48].

To the best of our knowledge this is the first comprehensive attempt to examine the quality, loyalty and relationship with selected banks across specific respondents' characteristics, such as gender, firm size and the location of a firm's headquarters in the Republic of Serbia.

In the subsequent chapter, we provide the literature review, which will be followed by the discussion on methodology and descriptive statistics. In Chapter IV, we provide analysis and finalise the study with concluding remarks.

Literature review

Quality

Rapid economic growth and the development of global markets have caused financial institutions to make maximum efforts to gain a competitive advantage in the provision of their services. The constant struggle for survival in turbulent times has refocused banks on creating long-term and efficient relationships with clients, all in order to meet their needs and satisfaction. It is the quality of services that is the key to all the comparative advantages that a bank can have [7]. From the aforementioned reasons, and in preserving the continued survival and promotion in the financial sector, the bank continuously monitors and measures the quality of its services, which is reflected primarily through loyalty.

The conceptualisation of quality can be more complex in itself due to the fact that it is evaluated depending on the context, and it is often subjective. This complexity, especially in the field of services, comes from the specific nature of the same because the services are heterogeneous and intangible, unlike products, and have the so-called multidimensional, often abstract quality measurement scale [61]. Quality is the dominant characteristic with which the company wants to achieve its competitive advantage, because the modern banking system is faced with increasingly frequent and growing demands by its customers, expanding banking operations, but also the widespread use of online banking, which raises the implementation of service quality to a very high level. When examining gender differences, it is claimed that women

pay specific attention to the quality of banking products and services in addition to the friendly service rendered in banking institutions. Apparently, women, as opposed to men, believe that bank staff members are thorough in providing information relevant to banking services and products [13].

Research relating to the quality of banking services is unified regarding that claim that the confidence in the bank, accountability and speed of implementation of services and effectiveness in providing the services have a positive impact on the customer satisfaction with banking services [44], [7]. In order to satisfy the users of its services, the bank must focus on the quality of its products and services. Complex models of banking services, depending on whether they address individuals or legal entities, are primarily based on their quality. Only in this way, bank managers can be committed to improving the performance of the financial institutions they manage [27].

Some research on the quality of banking services and loyalty [16] is based on the fact that customers are analysed as 'permanent' users of all banking transactions with one main (permanent) bank, where the assumption is that in addition to depositing their money for savings, they also perform other necessary banking transactions, which again emphasises the quality of services. On the other hand, banks especially care about having 'quality' clients (users who will materially bring more deposits to the bank, i.e. enable higher financial inflows to the bank on various private and business grounds).

The latest research of the banking sector in the field of measuring the quality of its services is based on hierarchical and multidimensional constructions [81]. Namely, the perception of service users is measured when it comes to the quality of the same at several different levels. The first level is at the so-called individual scale, where the quality of the direct relationship with the banking service provider is measured. The next level aims to measure the interaction at the next dimensional level, while the last level is the overall perceived quality of service from the beginning to the end of a particular banking transaction [20].

Perceived quality is traditionally defined as the basic determinant of banking service user satisfaction, which only finally confirms the excellent relationship that the bank has established with its client [84], which precedes the formation of the loyalty of banking transaction users [11]. If an entity is perceived as a risky one by the bank, the scale and scope of products and services may be limited [55]. Since Serbia is a transitional country, it is an imperative to examine whether banks have managed to narrow the differences between micro, small and medium-sized companies.

Firms located in major metropolitan areas have frequent interactions with various information providers. Entrepreneurs in smaller towns and remote areas could have fewer interactions with market agents and request information from institutional providers [69]. This may imply that due to lower expectation and less intensive competition, entrepreneurs located outside major metropolitan areas are more satisfied with banking services and products.

Loyalty

The already established brand of a given banking institution can be the dominant reason for attracting loyal service users who are willing to pay a premium price for the provided financial services [21]. The loyalty of users of banking services significantly affects the profitability of the bank, but there are also so-called non-financial benefits such as a positive verbal recommendation [80], which grow into a positive image of the banking institution and accordingly create customer loyalty [1]. It is the image of the bank that is key to creating the loyalty of users of banking services in communication that becomes closer in time due to mutual interaction [47]. The brand defines and creates special relationships with consumers/users in the manner described above, by building self-confidence, loyalty and trust. Famous brands in the banking sector build strong relationships with their customers through connections, loyalty and continuous interaction. Customer satisfaction affects the value of the brand, and through perceived quality service and built loyalty [65], [41] in their study show how the consumer satisfaction intensifies the relationship between the following factors: quality of service, perceived prices,

benefits of banking services for clients and loyalty of banking service users.

This means more precisely that the recipients of banking services interpret the first (basic) information about the bank and banking services exclusively in the social context [22], and in accordance with the personal interpretation of each of them form a positive or negative opinion about the bank. Of course, it is to be expected that the cooperation with the bank will continue only in the situation of forming a positive opinion. Belas et al. [13] claim that on average women are more satisfied than men with services provided by bank staff members, which ultimately leads to stronger loyalty.

A strong and well-built image of the bank is a prerequisite for building solid and long-term loyalty relationships with service users [28]. Moreover, empirical research conducted on the topic of loyalty in banks only confirms the thesis mentioned above [38], [42]. The greater the connection of the brand of a certain banking institution with the service user of a given bank, and the more the service user identifies with it, the greater his loyalty will be. Wahyuni and Fitriani [78] also confirm that identification with a banking brand leads users of banking services to secure loyalty to the same bank. Another study on the loyalty of users to a particular bank and banking services [53] showed that service users who understand the activities of the bank positively and thus perceive its image completely, are ultimately more loyal to the bank, repeat the use of banking services and spread positive recommendations in their surroundings. Through a well-created marketing image, a bank can behave like a certain person who is given specific characteristics of a living being, and by providing its services to be in some way 'alive and experiential' [87]. Loyalty is very much related to the bank's image. If in any way there is abuse or negative publicity when it comes to a particular bank, in parallel with the negative image of the bank, the loyalty of the users of the banking service to the same will decrease [70].

It is interesting to compare the loyalty of users of traditional banking services with those who are mainly involved in electronic and mobile banking. Traditional banking recognises the formation of emotions in recipients of banking services as a key creation for loyalty to the bank [19]. Namely, the introduction of electronic and mobile banking has introduced significant innovations in the field of customer connections versus the quality of banking services [14], [68]. Functional customer service is dominant here because there is no direct (face-to-face) relationship with the banking service provider.

In essence, the attitudes of service users are based on their belief system [6], which should be distinguished from the functional and symbolic meanings of these same services. Functional associations/attitudes refer to all performance date services (how and in what way a certain service is performed), while symbolic associations/attitudes have a direct connection with the psychographic meaning of a given service (what that specific service means to the user sociologically, psychologically or culturally). Thus, in the field of traditional banking, Candi and Kahn [18] singled out the feeling of happy enjoyment of using the service as a basic emotional component when it comes to overall quality, while another group of authors claimed that excitement due to functional features of the service and emotional attitude towards the overall service are the basis according to which attitudes are formed, and the quality of a bank is glorified [57]. Finally, both emotional and rational factors in the bank's service users are considered to be important for forming attitudes towards the bank, and to influence loyalty [3].

Personal relationship/recommendation

Financial institutions, where banks dominate as industry leaders, have a focus on innovative services that are highly aligned with the latest technologies, but above all in a skillfully designed almost personal relationship with each client. Between sellers and buyers of services in the banking sector, it is believed that certain indicators are key to the analysis of the personal relationship with the client: the length of cooperation between the bank and users of banking services and trust that emerges and builds between banking intermediaries (officers or advisors) and recipients of banking services [23]. The personal relationship between providers and recipients of services in the banking sector is visible through solving problems

in the field of banking services, less waiting time for users of these same services, fast and efficient service [40].

Theoretically, bank employees are constantly striving to achieve a successful relationship with customers [29]. Some researchers have even dealt with the topic of creativity of bank employees and their impact on the satisfaction of users of banking services. Thus, market focus in banking services is an important determinant of the efficient performance of banking officials when it comes to service delivery [79]. Male and female clients respond differently to changes in banking services, which is an essential input for management when determining the prospective strategy to be implemented by bank staff members. For instance, an improvement in environmental awareness is particularly attractive for male customers [73].

Creative innovations of bank employees inevitably affect the satisfaction of banking service users. This is evidenced by another study that investigated how customer-oriented employees in banks are directly engaged in creating special service value and thus credited with developing relationships with their clients [74]. Some previous studies support this claim with the result that the orientation towards bank clients is a positive direction for bank employees because it is closely related to the intentions of clients to perform services in the same banking institution [32].

The creativity of bank employees who work with clients is believed to be the most important factor that subsequently determines the competitive advantage and among the banks themselves [63]. Service user orientation is a mechanism that encourages creativity in the provision of banking services. This is especially present today when banks face major competition [76]. It is believed that monotonous and extremely uninteresting products and services can significantly demotivate consumers/users, and for this reason, researchers claim that they can evaluate the quality of a given service based on the experience of creation [58]. This is a sufficient reason for the users of banking services to remain with those banking service providers who provide them with a unique, creative and interesting service, which indirectly achieves their satisfaction.

The customer orientation policy is the result of the openness of bank employees to help their customers solve certain financial problems through a range of services that meet their needs. The positive outcomes are the satisfaction of banking service users, but also their loyalty [82]. They will be loyal and satisfied only when some of their previous financial inquiries have already been successfully resolved [24]. In this way, customer-oriented sales of banking services fully justify the good relationship between buyer and seller in banking institutions. Also, the value of banking services will be measured by the quality of mutual interactions between users of banking services and their providers [61]. Banking clients in large metropolitan areas have close relationships with all stakeholders, while entrepreneurs in remote or less developed areas could have acquired lower educational levels, and their businesses could be predominantly in the primary sector and plagued by high communication costs [64]. Thus, trustworthy and long-term relations may be an important strategic advantage for banks outside major metropolitan areas.

The long-term and good relationship between the users of banking services and the bank is the result of the satisfaction of the first users who can provide a positive recommendation to some future users. The literature review emphasises the importance of efficient communication and social interaction in the provision of banking services. Creativity in placing a banking service is just an additional incentive for complete customer satisfaction.

The link between quality, loyalty, personal relationships and examined variables

Studies indicates that women, as the users of online financial applications, show greater interest in the quality of banking services compared to male users [46]. Research on quality and personal relationships in the field of tourism services also showed a significant difference in gender response - women showed more interest in the increase of the mentioned variables than male respondents [45]. The quality of the service as well as the location have a significant impact on loyalty, and then on the satisfaction of service users [66]. A group of researchers found that firms located in rural areas have cost disadvantage in credit markets, but on the other hand form a closer personal relationship with the bank and change the bank less frequently [5]. Personal

relationship is extremely important for companies based in less urbanized areas, because contacts between business owners and bank employees are more frequent, more intimate and fruitful [34].

Research methodology

The research, which included monitoring the relationship between quality, loyalty and recommendation in the banking sector in micro, small and medium enterprises in Serbia, lasted from 20th April until 30th June 2020. It was conducted through an online questionnaire that generated 99 responses from legal entities (respondents - owners of micro, small and medium-sized enterprises), of which 77 were female, and 22 male respondents, respectively. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is 0.892, which supports the validity of our sample, since it is larger than 0.8.

In our study, the following goals will be investigated, related to all three observed factors in the analysis (quality, loyalty and recommendation.

One study in the field of research on the quality of educational services showed that female students pay more attention to the quality of services than male students and that they are more demanding in terms of the quality of services than their colleagues [30]. The results of another study showed that women entrepreneurs are more creditworthy and pay less interest [12]. Research in the field of quality of Greek banks based on customer perceptions (including 1,260 users of banking services) found that gender differences significantly affect quality performance, which is later reflected in the bank's approach, pricing, service portfolio, trust and assurance [71]. The study, which was based on examining the quality of online financial services, showed that the gender of users does not significantly affect the formation of service quality, e-satisfaction, e-trust, e-loyalty and e-personal relationship. Therefore, we claim that:

1) There is no difference between the sexes in assessing the quality, loyalty and recommendation of banking services

Most analyses deal exclusively with micro or small firms [2], but there are generally no studies in terms of the firm's influence on decisions related to selection and cooperation with banking institutions, which is surprising given that certain researchers have dealt with the topic of the influence of the size of the company and what economic effects it has on the choice of external associates [9]. This was one of the reasons why we dared to examine in our research study the extent to which the size of the company not only influences the choice of the desired bank, but also determines satisfaction with the quality of banking services, customer loyalty and personal relationship with the bank. Also, there is a lack of literature and at the same time it is necessary to conduct research in Serbia, which is presented in this paper, as a contribution to a better understanding of the issue and a clearer picture at the global level. We propose that:

2) There is no difference between companies grouped by size, when assessing the quality, loyalty and recommendation of banking services

The location of companies plays an important role both in their survival and relationship they form with the entities they correspond with in the market [10]. It is important for banks to arrange their branches so that they are available to as many clients as possible, both natural persons and legal entities, ie corporate clients [51]. Research in South Africa related to the territory of the headquarters of bank branches showed that the four main banks group their branches in the same areas, which indicates the possibility of oligopolistic agreements between those banks [56]. In Canada as a developed country, it is characteristic that there are a large number of branches. Only one of the top three banks each has more than 1,000 branches, and the next two by bank size, each with more than 750 branches. All banks are located in all provinces. Research [25] has shown that the availability of bank buildings has a direct impact on the loyalty of banking users and in that way if they want to change the bank, customers can do so very easily and quickly because their competition is very close. Research conducted in Ethiopia shows that in addition to the quality and accessibility of services, the quality and availability of physical and human resources are the main factors influencing the users of banking services when choosing a bank [75]. Research conducted in Spain has led to results

indicating that financial involvement of the population is extremely important, which means that the availability of banks is important, and that it is the responsibility of local associations in charge of rural development policy to identify problems due to such a lack and to suggest alternative services [17]. The result of the regression also shows that the above-mentioned factors not only affect the choice of the client's bank, but also the level of their loyalty. The great world crisis in 2008 significantly affected the banking sector. After a period of intensive expansion, there was a period of closing, re-grouping, merging branches and entire banks. Changing the bank's registered office and absence from certain locations can negatively affect certain social groups [4]. In many developed countries, the number of branches was reduced after the recession. A study was conducted in Italy, which showed, among other things, that banks close their branches where the branches and sub-branches of competitors are closer [26]. For researchers, the geographical position of banks is an interesting topic. In Slovakia, it was found that the number of branches in the districts is largely determined by factors related to the degree of economic development, the number of inhabitants and the characteristics of the population, as well as the concentration of certain economic branches. Spatial positioning of bank branches is not random but is planned [15]. Site selection is as important for banks as it is for industrial and commercial enterprises and companies [8]. Based on everything, it can be seen that the spatial, ie geographical position of banks has been identified as an important category for bank operations. The financial literature has modestly studied the way corporate options versus the offers of different banking institutions from the point of view of their locations - whether they are in urban or rural areas, as well as how far they are from larger cities [5]. Accordingly,

3) There is no difference between companies observed by the city of the registry, in assessing the quality, loyalty and recommendation of banking services

Results - descriptive statistics

Of the total number of respondents, the largest number of them, as many as 88%, are aged between 36 and 65 years. Table 1 shows the ratio of male and female owners of micro, small and medium-sized firms, and it shows that more than half of the surveyed owners of both sexes are the representatives of micro firms in Serbia, 57%.

Table 1: Firm size and gender

		Firm Size				
		Micro	Small	Medium	Large	Total
Gender	Male	14	6	1	1	22
	Female	42	25	10	0	77
Total		56	31	11	1	99

Source: the authors

Regarding the level of education, the largest share of respondents of both sexes is university educated, which is 71%. The most frequent use of banking services by respondents of both sexes - owners of micro, small and medium-sized companies (large companies have been excluded from the study due to the lack of sample observations) in Serbia is with Intesa Bank (29%), Komercijalna Bank (16%), Raiffeisen Bank (14%), and Unicredit Bank (11%). In all other banks, such as OTP, Erste Bank, Halk Bank, Addiko, Sberbank, Credit Agricole, NLB, AIK and Direktna Banka, less than 10% of respondents per bank have reported possessing accounts. When it comes to the length of cooperation between banks and clients (owners of companies in Serbia), the largest share, 56% are those who have their accounts from 6-15 years in one of the reported banks. It is interesting to note that among the respondents as many as 68% are founders of micro, small and medium-sized companies from Belgrade, 19% of them with the company's headquarters in central Serbia (Serbia without autonomous regions), and 13% with the city of company registry in Vojvodina.

In Table 2, we provide item descriptions along with relevant indicators. Each of the three examined variables comprises three items. The results of the Principal Component Analysis confirm that only one component could be extracted. In the case of quality, 77.7% of the total variance is explained by the initial factor extracted. In the case of loyalty and personal relationship, these values are 72.4% and 82.1%, respectively. Cronbach's alphas are all about 0.7, the benchmark generally requested in social research, which implies a high internal consistency. Average variance extracted (AVE) values are above 0.5 [33], which means that the variables explain more than 50% of the

indicator's variance, while composite reliabilities (CR) are in excess of 0.7 [33], thereby complying with requirements imposed in similar studies.

Discussion

Quality

When examining the first research goal out, our online research shows *there is a difference between the sexes* - among the founders of micro, small and medium-sized companies in Serbia, which are analysed when assessing the quality of banking services. For example, for the claim that the chosen bank is responsible, safe and consistent in providing its services, 21% of self-employed women partially or completely declared that they do not agree with it, while 14% of male entrepreneurs voted that way. Interestingly, the question of whether the chosen bank provides superior service 28% of male entrepreneurs stated that this is not the case, and this was confirmed by 21% of women, which may support the claim by Teeroovengadum [73] that male and female customers respond varyingly to changes in quality. However, our results are not supported by the t-test analysis.

From the point of view of the size of the company, which is related to our second research goal, the owners of micro companies in terms of the quality of banking services differ more in their attitudes with the owners of small and medium-sized enterprises in Serbia. This is especially true of the claim that the selected bank provides a superior service, where 27% of micro-business owners denied this claim, as opposed to small-business owners who voted negatively with 19%. Interestingly, the owners of medium-sized companies did not have any objections to this claim. These findings may indicate that Serbian banks fail to fully profit from advancements in information and communication technologies to serve all customers effectively [55], and are supported at the 5% significance level by the ANOVA analysis.

Finally, our third claim related to responsibility, security and consistency when it comes to providing banking services, owners of micro, small and medium-sized companies from Belgrade lead in denying them with 24% compared to 10% represented by owners of companies from the interior of Serbia and 0% of owners from Vojvodina. When it comes to the claim that the quality provided by the bank is excellent, 25% of entrepreneurs from Belgrade think the opposite, compared to entrepreneurs from Serbia without autonomous regions (16%) and entrepreneurs from Vojvodina (8%). This confirms the *difference in claims depending on where micro, small and medium-sized enterprises in Serbia are registered*. The former claim about consistency is weakly supported by the ANOVA analysis at 10%, but the latter one is supported at 1% significance level.

It is interesting to point out that with the length of years of cooperation with the chosen bank, clients become more satisfied with the service of a given bank (especially after ten years of cooperation), where the owners of small and medium-sized companies are understandably in the

Table 2: Properties of the selected variables

Variable	Items	Std. Factor Loading	Cronbach's Alpha	AVE	CR
Quality	The selected bank is responsible, secure and consistent in providing its services.	0.869	0.856	0.777	0.913
	The chosen bank provides me with superior service.	0.856			
	The overall quality provided to me by the chosen bank is excellent.	0.919			
Loyalty	I think it is a wise decision to have a bank account with the chosen bank, although I am aware that not all banks have the same terms of cooperation.	0.812	0.809	0.724	0.887
	I will always recommend my chosen bank.	0.869			
	When selecting banks, I will always give priority to the selected bank.	0.870			
Personal Relationship	The chosen bank always offers me products and services that best suit my needs.	0.931	0.889	0.821	0.932
	I have certain benefits when using the services of the chosen bank, which many users do not get.	0.883			
	In a problematic situation, the chosen bank always shows sincere interest and helps to find a solution.	0.904			

Source: the authors

lead. It is important to underline that the owners or micro firms have comparatively shorter-term relationships with selected banks (see Figure 1).

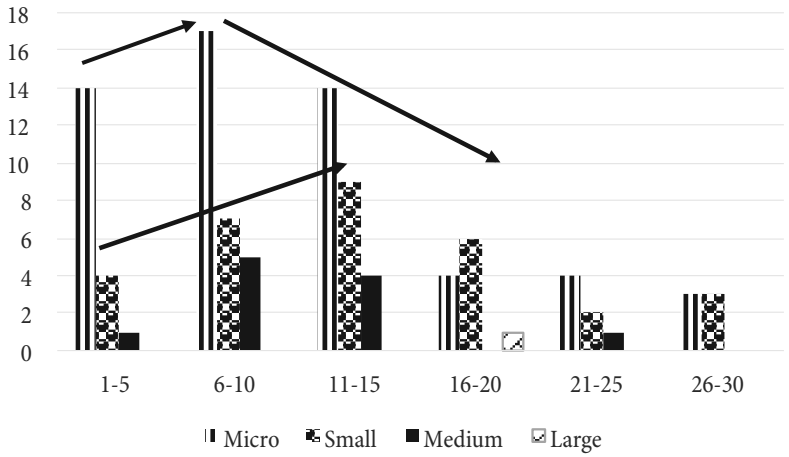
Loyalty

Our dealing with the initial research goal indicates that there is a difference between sexes - owners of micro, small and medium-sized companies in Serbia when it comes to loyalty to selected banks. For example, in the statement "I will always recommend my chosen bank", as many as 32% of respondents partially or completely refuted this statement, in contrast to female respondents who make up a group of 19%. The surveyed male owners of companies are also less loyal when compared to female owners when asked the following question "When selecting banks, I will always give priority to the selected bank", where 23% of male entrepreneurs and 18% of female company founders did not agree. The higher loyalty demonstrated by female respondents complies with findings purported by Belas et al. [13]. However, none of loyalty claims related to gender is supported by the t-test analysis.

From the standpoint of the size of the company, with the growth in size augments loyalty to the selected bank. Namely, the claim that "I think it is a wise decision to have a bank account with the chosen bank, although I am aware that not all banks have the same terms of cooperation", partial and full disapproval is provided by the 21% owners of micro firms, 16% of owners of small companies, and only 9% are owners of medium-sized companies. This is supported by the following statement "When selecting banks, I will always give priority to the selected bank", which was partially and completely refuted by 25% of micro-firm owners, only 16% of small-firm owners, and 0% of medium-firm owners. However, only the latter claim is strongly supported by the ANOVA analysis.

When examining the third research goal, i.e. *from the point of view of the company's headquarters and loyalty to the selected bank*, an obvious difference is noticed between the attitudes of the owners of micro, small and medium-sized companies located in Belgrade, the interior of Serbia and Vojvodina. Thus, for example, in the statement "I will always recommend my chosen bank", the 20% of company owners based in Belgrade denied it, compared to only 1% of owners in the interior of Serbia and 1% of entrepreneurs in Vojvodina. In the statement "When selecting banks, I will always give priority to the selected bank", 18% of respondents from Belgrade did not agree with the same, while only 1% of company owners from the interior of Serbia did not agree with this statement. It is interesting that the owners of companies based in Vojvodina only declared themselves positively on this issue. The high level of satisfaction expressed by clients located outside Belgrade supports the claim that owners of companies located in more competitive markets, i.e. in metropolitan areas, are more demanding, better informed and involved across a wider spectrum of industrial activities [64], which causes bank services and products to be less favourably evaluated vis-a-vis in other

Figure 1: Years with a selected bank compared with the size of the firm



Source: the authors

parts of the country. All claims are strongly supported by the ANOVA analysis at 1% confidence level.

And as far as loyalty is concerned, with years of cooperation with the chosen bank, the owners of small and medium-sized companies are more satisfied, compared to the owners of micro companies.

Personal relationship/recommendation

When it comes to the personal relationship between the surveyed owners of micro, small and medium-sized companies and selected banks in Serbia there is a difference in the responses of the sexes (research goal No. 1 in a statement, "I have certain benefits when using the services of the chosen banks, which many users do not get" as many as 50% of respondents denied it, while 44% responded positively. A more transparent example is the statement "In a problematic situation, the chosen bank always shows sincere interest and helps to find a solution", where 41% of respondents did not agree with the statement, while significantly fewer, 23% of respondents, denied it. This finding is supported by the Belas et al. [13] claim that women are more convinced that banks staff members have a genuine interest in resolving problems caused by financial constraints. Unfortunately, gender-related claims are not supported by the t-test analysis.

In analysing our second research goal, 20% of survey representatives of micro enterprises in Serbia stated that the chosen bank does not always offer them the best products and services, while the same answer was given by 9% of representatives of small enterprises and only 2% of medium-sized enterprises. An even more drastic relationship can be seen in the statement "I have certain benefits when using the services of the chosen bank, which many users do not get" which was refuted by 32% of representatives of micro firms, compared to 10% of representatives of small firms and only 3% of medium-sized firms. The latter claim is strongly supported by the ANOVA analysis.

Finally, when it comes to examining the personal relationship between the surveyed owners of companies in Serbia and selected banks, as many as 33% of representatives of Belgrade companies believe that in a problematic situation, the selected bank does not always show sincere interest and does not help find a solution, unlike owners of companies in the interior of Serbia whose share is 26%. Interestingly, the owners of micro, small and medium-sized companies in Vojvodina did not have negative comments on this issue in our research. Since bank clients in major metropolitan areas collect information from various stakeholders [69], it is not surprising that other respondents provide less unfavourable views regarding their banks. All statements related to the personal relationship category have been strongly supported by the ANOVA analysis.

Conclusion

Banking is a rapidly growing economic sector that operates in a highly competitive environment. In such a competitive environment, it is of utmost importance to gain a competitive advantage, which is first achieved through continuous improvements in the quality of services for bank customers.

Recognising the importance of relational marketing and its influence in the banking sector, we see a direct connection between the satisfaction of users of banking services with loyalty, which consistently occurs if the service was of good quality [67]. Our findings support this claim across various dimensions of our respondents. The owners of micro-size firms and entrepreneurs located in Belgrade, have comparatively more qualms about the quality of rendered services, which may affect loyalty. Increasing customer satisfaction with the banking service will undoubtedly result in loyalty to the bank. Accordingly, recipients of banking services will continue to use banking products and services as long as the bank invests in continuous monitoring and fulfilment of customer satisfaction.

The results show how investments in the elements of the banking brand affect the bank's reputation, regardless of whether they are direct users of the banking service or future users. Strategies for eliminating the outflow of banking service users are based on banking performance indicators, which find their basis in the loyalty of service users. The starting points can also be used to understand better the choice of the range of banking products and services among users, which is considered valuable for the

bank's development strategy. Our study also showed how the elements of loyalty among users of banking services lead to repeated services in a particular bank.

In a turbulent market environment and constant pressures from the competition, the importance of personal relationships in the provision of banking services must not be ignored. Banking service providers are constantly encouraged to work on preserving and improving the quality of the service provided, which is to approach the solution of financial problems of their customers creatively and uniquely. This has the positive consequence of constant mediation of the relationship between the provider and the recipient of banking services, which is based on user orientation and the ultimate satisfaction of the recipient of the service. Our study implies that banks should create more products suitable for the owners of micro-sized firms and follow the latest trends in the banking industry to satisfy the growing needs of busy customers located in the capital city.

The preponderance of Belgrade entrepreneurs among respondents is one of the major limitations of our study. In future studies, we may have to include more relevant variables and distribute questionnaire in specific geographic areas to avoid potential biases.

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IMPACT OF ISO STANDARD APPLICATION ON FINANCIAL PERFORMANCE OF PRIVATE HOSPITALS

Uticaj primene ISO standarda na finansijske performanse privatnih bolnica

Abstract

Health care is a set of measures implemented with the aim of preventing the occurrence of diseases in the population, timely diagnosis, treatment and rehabilitation. Hospital health care is a part of a secondary level of health care. The paper examines the impact of the application of the International Organization for Standardization (ISO standards) on financial performance in private hospitals. The case study was made on the basis of a sample of the private hospitals in the city of Belgrade (the Republic of Serbia).

Keywords: *quality management system, ISO standards, private hospitals, the quality of health services, economic benefits, financial performance.*

Sažetak

Zdravstvena zaštita predstavlja skup mera koje se sprovode sa ciljem prevencije nastanka bolesti kod stanovništva, blagovremene dijagnoze, lečenja i njihove rehabilitacije. Bolnička zdravstvena delatnost predstavlja deo sekundarnog nivoa zdravstvene zaštite. U radu je istražen uticaj primene standarda Međunarodne organizacije za standardizaciju (engl. "International Organization for Standardization") - ISO standarda na finansijske performanse privatnih bolnica. Studija slučaja je urađena na osnovu uzorka privatnih bolnica na teritoriji grada Beograda (Republika Srbija).

Ključne reči: *sistem menadžmenta kvalitetom, ISO standardi, privatne bolnice, kvalitet zdravstvenih usluga, ekonomske koristi, finansijske performanse.*

Introduction

Health care is an organized activity aimed at preserving and improving the health of the population. It can be realized as a primary, secondary, and tertiary health activity. An important segment of a secondary level is a hospital health activity. As for an ownership criteria, hospitals can be public or private. The standards of the International Organization for Standardization (ISO standards) are applied in order to provide the conditions for adequate healthcare provision along with the economic sustainability of the functioning of hospitals. The subject of the paper is the analysis of the impact of the application of ISO standards on the financial performance of private hospitals. The aim of the paper is to outline the basic role of ISO standards and the degree of their impact on the financial performance of the aforementioned health care institutions based on the analysis. The paper consists of five parts. In the first part of the paper, there is a brief literature review which includes individual segments that are the subject of analysis in the paper. The second part of the paper presents an explanation of the research methodology. The features of ISO standards and their application in private hospitals are presented in the third part of the paper. Special attention, within the fourth

part of the paper, is paid to the basic financial effects of the application of ISO standards in private hospitals. The discussion of empirical results (case study), obtained on the basis of a sample of 44 private hospitals in Belgrade in the Republic of Serbia, is presented in the fifth part of the paper.

Literature review

For the purposes of our paper, the analysis of the impact of the application of ISO standards on financial performance in private hospitals, we selected the following papers. Johannesen et al. [8] pointed out the reasons for the application of ISO standards in hospitals (such as Norway). Chaw et al. [3] identify key differences in quality management between accredited hospitals, i.e. certified, and those which are not. In the paper Heuel et al. [7] it is described how The Red Cross Hospital in Beverwijk, The Netherlands implemented ISO 9000 in the entire hospital and received ISO 9002:1994 and then ISO 9001:2000 certification. One of the goals in the paper of Stoimenova et al. [19] is an analysis of the application of ISO 9001 standard in European hospitals. Busse et al. [2] indicate the impact of the standards, inter alia, on clinical practice. In the paper of Dombradi et al. [5], the characteristics of the application of ISO 9001 standard on the quality of the work of the hospitals in Hungary are analysed and a comparative utility analysis is conducted together with applying other ISO standards. Mohamadi et al. [11] conducted a study that aimed to investigate the effect of ISO 9001 standards on improving hospital performance. The economic effects of the application of ISO standards are discussed in the study International Organizational for Standardization [6]; the economic viability of the implementation of ISO 9001 standard in the health sector in the paper of Petkovska et al. [13]; the impact of ISO 9001 standard on the overall quality of hospital performance with a special emphasis on the contribution of hospitals in the performance is presented in the paper of Noviantoro et al. [12]; the possibility of measuring the benefits of applying ISO standards in hospitals in the paper of Shaw [16], etc., all of them provide a solid basis for concrete analysis in our paper. According to our information, having researched the papers available on the Internet, no concrete analysis of the impact of ISO standards on the financial performance of private hospitals, in the case of the Republic of Serbia, has been conducted so far, which indicates that this analysis is the first attempt to do so.

Research methodology

In order to achieve the goal of the paper, it is first necessary to describe the general characteristics of ISO standards based on a description method and analyse the basis of their application in private hospitals. Based on a comparative analysis of different approaches in the selected papers, it is necessary to highlight the basic effects of ISO standards on the performance of private hospitals. Determining the relationship and their strength between the application of ISO standards and the operation of private hospitals implied planned collection, selection and the preparation of adequate data on the number of private hospitals that (do not) apply ISO standards as well as the preparation of comparable data on their functioning and business operation. The basis is the analysis of the impact of the application of ISO standards on the income of 44 private hospitals in the city of Belgrade (the Republic of Serbia) and a regression analysis.

Characteristics of ISO standards and their application in private hospitals

As already stated in the Introduction, at a secondary level, healthcare includes specialist consulting and hospital health activities [23, Article 61, 68]. Hospital management aims to achieve the maximum level of health service quality, optimization, and efficient management of key processes [17, pp. 445-451]. In order to achieve all of that, the application of ISO standards is the best solution [3]. ISO management system standards are most often applied in the institutions that provide medical and healthcare services [27].

International standards for management systems, quality (ISO 9001), environmental protection (ISO 14001), occupational health and safety (ISO 45001),

information security (ISO 27001), food safety (ISO 22000) and others, contain the requirements for organizations of all sizes and all business activities. The standards are of a general nature and they are applied voluntarily. They do not impose a uniform structure of management systems as technical standards do. Organizations can apply several management system standards and integrate them into Integrated Management System (IMS) through joint documentation. The basic requirements of all management system standards are identical, some of their sub-requirements differ, so the joint documentation includes the same requirements and sub-requirements, and it is supplemented by a specific documentation for each of these standards. The system certification is performed according to the requirements of each standard individually and it is valid for three years. There are also standards that contain instructions and according to them the management system is not certified, such as ISO 26000 standard – the guidance on social responsibility, ISO 9004 - Quality Management, the guidance to achieving sustainable success, etc. The application of these standards contributes to the further improvement of the overall business system of an organization [21. pp. 594-614].

The series of standards for quality management system ISO 9000 consists of three standards: ISO 9000, ISO 9001, and ISO 9004. ISO 9000 standard provides terms and definitions and specifies the key features of quality management: customer focus, leadership, engaging people, process approach, improvement, evidence-based decision making, and relationship management [18, pp. 12-22]. By applying the principle of customer focus, organizations can understand much better the needs and expectations of customers and define their goals accordingly [15, p. 80]. Customer satisfaction is continuously monitored so as to take appropriate corrective measures in a timely manner. Prompt and flexible response of an organisation to changes regarding customer requirements ensures customers' greater loyalty along with increased income. To achieve sustainable business success, organizations need to achieve a balance between customer satisfaction and other stakeholders (owners, employees, suppliers, a local community, and a society as a whole). To balance the requirements of all stakeholders, organizations can be helped by the application of the already mentioned ISO 26000 standard as well as the Balanced Scorecard method – BCS [9, p. 9]. The leadership principle implies that leaders should establish the unity of goals and organisational leadership by creating an internal environment in which employees give their optimal contribution to business operations. The effects of applying the principle of engaging people also depend on successful leadership [21, p. 34]. It is essential for employees to be actively involved in business processes in order to increase their motivation [21, p. 11], responsibility, innovation, and creativity [4, pp. 411, 412]. A process approach implies that the entire quality system of an organization is viewed as a set of interconnected processes. By applying the approach, necessary activities are defined precisely so that the desired results can be achieved and responsibilities established for each activity [21, p. 85]. The processes are regularly monitored, enabling timely identification of errors and their causes followed by taking appropriate measures. ISO 9001 standard emphasizes the need for risk management which is more efficiently implemented by applying a process approach. The principle of improving the overall performance of organizations should be ongoing [15, p. 83]. Organizations need to develop the ability to respond promptly to opportunities and dangers to survive in an ever-changing market. Evidence-based decision making implies that decisions are based on the analysis of data and information. It is vital to keep appropriate documentation on all activities [13]. Key process indicators are monitored and measured, as well as customer satisfaction [21, p. 37]. The top management is obliged to regularly, at least annually, reassesses the quality management system of the entire organization. Relationship management is the establishment of the cooperation between an organization and its suppliers as well as other business partners [21, p. 38]. This increases the flexibility and speed of the joint response to market changes. An organization needs to optimize the number of its suppliers in order to build long-term partnership with them.

ISO 9001:2015 standard, Requirements for Quality Management System, is based on the continuous

application of the PDCA approach (Plan - Do - Check - Act) and contains the following basic requirements for a quality management system: subject and scope of the application, normative references, terms and definitions, the context of an organization, leadership, planning, support, realization of operational activities, performance evaluation, and improvement. Through the abovementioned requirements of ISO 9001 standard and its sub-requirements, the previously explained basic principles of quality management are applied. The requirement to determine the context of an organization refers to the identification of external and internal issues relevant to the purpose of an organization and its ability to achieve the intended outcome. An organization has to define its stakeholders and their requirements, consider the features of its products and services and determine the process-oriented quality management system [18, pp. 18-22]. Leadership is the requirement that emphasizes the leading role of the top management in establishing, maintaining and continuous improvement of quality management system [12]. The management adopts a quality policy, determines organizational roles, responsibilities and authorities and plans the necessary changes in the quality system [18, pp. 22-24]. The requirement for planning a quality system implies that an organization considers risks and opportunities and sets appropriate quality objectives accordingly. The objectives should be in line with the defined quality policy. They are adopted at different levels: at an organizational level, organizational parts, processes, products, and individuals [18, pp. 24-28]. Support is a requirement related to: resource management, competence and awareness of employees, communication in an organization and documentation (i.e. documented information) of a quality management system [18, pp. 28-34]. The realisation of operational activities includes several sub-requirements: planning and managing the realisation of operational activities; requirements for products and services; design and development of products and services; management of externally provided processes, products and services; production and providing services; the release of products and services; the management of nonconforming outputs [18, pp. 34-48]. Performance evaluation contains the following sub-requirements: monitoring, measuring, analysis and evaluation, internal audit, and reviewing by the management [18, pp. 48-54]. Within this requirement, the following things are evaluated: products and services, customer satisfaction, quality management system, the measures relating to risks and opportunities, external suppliers, improvement of quality management system, etc. The request for improvement refers to: non-compliances, corrective measures, and continuous improvement [18, p. 54]. In the event of certain non-compliance with the specifications, it is necessary to take appropriate corrective measures to eliminate the consequences and causes of the non-compliance. Furthermore, an organization needs to select the opportunities for improvement and implement the measures needed to meet customer requirements.

As previously mentioned, ISO 9000 standards are successfully applied in healthcare systems [10, pp. 314-340]. The world's best-known quality management standard is ISO 9001 [7]. This standard refers to, as stated, a management system (organizational structure, the responsibility of participants in an organization, the processes and resources necessary for a system management) whose application leads to the realization of defined goals regarding business quality and providing service [25]. ISO 9001 had its versions from 1987, 1994, 2000, 2008, and 2015. In the latest version of ISO 9001 standard, from 2015, the ultimate responsibility of the top management for a quality management system is highlighted and more requirements for risk assessment and management are established compared to the previous versions of the standard. The requirements for the existence of a procedure for corrective measures are retained, while preventive measures are no longer regulated by a special procedure, but by risk management procedures. Some terms, names of documents are altered. [27, 25].

By adhering to the standard, health institutions improve the efficiency of a management system and thus strengthen the trust that their patients have in their system [24]. By certifying the management system, health institutions can show their readiness to consistently comply with all the requirements of the standard aiming to constantly improve patient satisfaction which is reflected in improving their health by providing quality health care [8]. Health is a basic human right and one of the most

important prerequisites for economic development and quality life of inhabitants of a country [14, p. 168]. The application of ISO 9001 standard does not interfere, but only supports and improves the effects of compliance with relevant legislation in the field of health care. It affects better patient care [19]. The focus is on the efficiency of clinical, business and support processes to ensure quality care [11]. The standard promotes the adoption of a process approach, continuous improvement of processes and services through objective measurements, etc. [7, pp. 361-369]. The application of best business practices contributes to the improvement of a quality system and increases the satisfaction of patients and other stakeholders [28].

Financial effects of using ISO standards in private hospitals

Healthcare providers, hospitals, recognize the importance of the value system that combines the fulfilment of all criteria for quality management [2], which includes managing a system of interrelated processes and adherence to the established procedures [13, p. 912]. The proper application of ISO standards should provide a number of economic benefits for hospitals (increased income, reduced costs, saving time when proving health services, etc.). It is extremely difficult to measure the direct impact of ISO standards on financial performance of companies. However, the possibilities of determining the connection between the indirect impact of ISO standards and the business performance of private hospitals are much greater. One possibility is to apply the ISO methodology, based on a four-phase value chain, to assess these effects of ISO standards on enterprises, which could be applied to hospitals with some modifications. The first phase is understanding a value chain (identifying key business processes and activities that add value), and the second phase is identifying the impact of standards (determining business functions and activities in a value chain within which standards play an important role). The third phase refers to the analysis of value drivers (key organizational skills that affect competitive advantage) and the determination of operational indicators (time, price, the number of services provided, etc.), and the fourth phase is the assessment and calculation of results [6, pp. 4-65]. To put it differently, it is possible to single out key activities in hospitals (diagnostics, treatment, surgical interventions, rehabilitation) and especially emphasize those activities on which ISO standards have a significant impact (e.g. surgical interventions). Afterwards, it is possible to identify value drivers in order to prepare and realise fast and quality services (prompt laboratory analyses, check-ups, preparation for surgeries, surgeries), determine operational indicators (saving time, reducing costs, etc.), and determine results (impact on income etc.). It is important to compare the results with the results from the previous period in which there was no application of ISO standards and to make a comparison with the competition.

By applying the requirements of ISO 9001 standard, numerous benefits are achieved for an organization. Some of them are the following: good organization and implementation of work processes [13], achieving optimal employee results, continuous process improvement, cooperation with business partners, flexible response to changing market demands and the like, which should result in high customer satisfaction and increased customer loyalty. Simultaneously, there is an increase in the satisfaction of other stakeholders, and overall improvement in the financial indicators of business success [16].

A great contribution to the implementation of ISO 9001 standard is reflected in the continuous improvement of processes, especially the key ones. The processes are constantly monitored and appropriate process performance indicators are measured, so that pre-identified risks could be managed appropriately [1, p. 9]. If errors occur, the goal is to detect them as soon as possible, preferably at the time and place of their occurrence. In this way, the consequences of those errors are promptly eliminated at the lowest cost with appropriate corrective measures. By analysing the causes of those errors, adequate preventive measures are taken in order to minimize the risks of similar types of errors in the future.

Given that hospitals provide health services, the application of ISO 9001 standard has its own features [5]. A service is a product that is entirely or partially created in direct contact with a user, therefore, errors are much more noticeable here and are directly reflected

on customer satisfaction [20, pp. 62-64]. The demand for hospital services is inelastic, it cannot increase in accordance with the attitudes of users, as it is the case with, for example, consumer products (clothing, footwear, going to the cinema, restaurants, travel, etc.). People are treated when they are ill, and in those moments they choose the hospital that is the most affordable for them in terms of quality of service and price.

The quality of hospital service is greatly influenced by competent and motivated employees - the expertise of doctors in establishing a diagnosis, recommending a therapy and performing surgical interventions, expertise and kindness of hospital staff, level of hygiene, etc. Proper definition of procedures for performing a process, development of appropriate instructions for the activities within a process, defining quality goals at the level of each employee are the documents required by ISO 9001 standard, and which significantly determine how well employees perform their activities, how easily newly employed get involved in the activities, how to reduce errors in case of incomplete communication between employees, etc. Proper sterilization of medical instruments, disinfection of all surfaces and materials where there is a risk of transmitting infections is immensely important. In order to properly perform these and other activities, it is vital to conduct appropriate education and training of employees.

If other management system standards are applied along with ISO 9001 (ISO 14001, ISO 45001, ISO 27001, etc.), the possibilities for continuous business improvement and achieving sustainable success of an organization are further increased. Some of significant benefits for hospitals are: good medical waste management and environmental protection, employee health protection and reduction of workplace injuries, maintaining the availability and integrity of information, and especially maintaining the confidentiality of personal data and patient diagnoses.

Organizations that have certified occupational health and safety management systems in compliance with the requirements of ISO 45001:2018 standard can integrate into their system the guidance from ISO/PAS 45005:2020 specification. ISO/PAS 45005:2020 specification is a document adopted in response to the COVID-19 pandemic and increased risk to human health in all work environments. By applying the guidelines from this specification, organizations can apply a systematic approach to risk management concerning COVID-19, take effective measures to protect workers and other stakeholders, and adapt effectively and timely to changing situations.

Since most of the requirements of the standard represent the minimum criteria that organizations need to meet, business excellence models are being developed to further improve business performance. According to the criteria of these models, quality awards are given. In the Republic of Serbia, the national award for business excellence "Oscar of Quality" is awarded according to the FQCE model of business excellence created by the Fund for Quality Culture and Excellence. The model has been revised several times, and its current version partially deviates from the version of the European Foundation for Quality Management (EFQM) excellence model. Actually, the model had to be adapted to the specifics of the business environment in the Republic of Serbia. The FQCE model consists of 9 criteria that altogether have 1000 points: leadership, strategy, the potentials of an organization, processes and technologies, market and users, business results, employee satisfaction, customer satisfaction, and social responsibility. The first five criteria show the capabilities of an organization (the mechanisms for achieving results), and the next four criteria relate to results. The ratio of the points of the criteria related to the mechanisms according to the result criteria is 600:400. In this paper, we are not going to deal in more detail with the analysis of the model, we want to emphasize the contribution of voluntary application of the model to business improvement. Hospitals and health centres are among the winners of the national quality award.

Due to, in general, standards, and, in particular, ISO 9001, it is possible to more clearly (precisely) define health services and application processes which should lead to the simplification of internal processes in hospitals, reducing healthcare supply costs, and saving unnecessary, excessive investments [13]. In other words, the inputs are of better quality and there are no redundant health services. The funds saved in the aforementioned way can be directed to the improvement and development of hospitals by innovating health services, implementing new, more

efficient ways of performing surgical interventions, etc. The roles of participants in the system of work processes and their responsibility regarding activities, procedures and results are clearly defined. The processes are documented and thus controlled.

As mentioned above, procedures are prescribed, so health services are provided faster which increases the productivity and better organization improves efficiency. It enables new patients an easier and better access to hospital services. Therefore, the application of ISO standards is of crucial importance, i.e. the number of patients increases which results in higher income. Competitive advantage is gained in this way. Supervision is of better quality which also leads to better control of the procurement of health material. Generally speaking, the application of ISO standards should affect the rationalization of internal processes which reduces costs, encourages innovation, and increases the number of health services and the number of insured persons, etc. [6, pp. 4-65]. One of the ways to determine the impact of ISO standards on the economic performance of hospitals is to determine the differences in operating income of private hospitals that have ISO certification and private hospitals that do not have this certification.

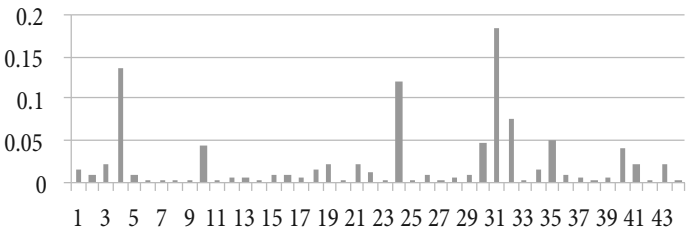
Empirical results (case study)

For the purpose of our research, we analysed 44 private health institutions, hospitals in the city of Belgrade (the Republic of Serbia). Among these institutions, 15 of them belong to the category of micro enterprises, 25 belong to the category of small enterprises, 3 belong to the category of medium, and only 1 is a large enterprise. Base on the available financial reports, we analysed the performance of these institutions. Operating income in 2020 was one of the variables we analysed. Figure 1 shows the market share of the analysed hospitals.

The average income in 2020 of all analysed market participants[1] was 236058.2 thousand dinars. The average income of private hospitals that used ISO 9001 standard was 679810.9 thousand dinars, while the average income of private hospitals that did not use ISO 9001 was 152105 thousand dinars. Private hospitals that used ISO 9001 generated significantly higher income than the others which did not use the ISO standard. The difference in income is presented in Figure 2.

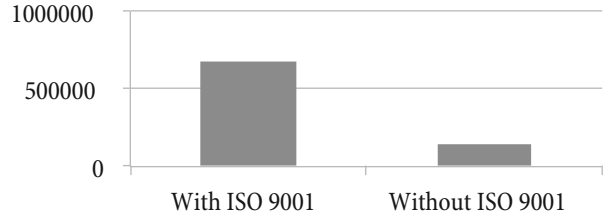
1 1. General Hospital "MCB" medical system Belgrade, 2. General Hospital "Una", 3. Gynaecological Hospital "Teofanović", 4. General Hospital "Acibadem BEL MEDIC", 5. "ST Medica" General Hospital, 6. Special Hospital for Special Surgery "Hirurgija dr Đoković", 7. Special Hospital for Plastic and Reconstructive Surgery "AVACENA PRIMAL", 8. Hospital for Special Surgery "M.C. Aesculap", 9. DIONA Special Hospital for Plastic, Reconstructive and Aesthetic Surgery, 10. Miloš Clinic special ophthalmology hospital, 11. Special Hospital for Eye Microsurgery "Zenit", 12. Hospital for General Surgery "Surgery dr Drašković", 13. MEDIGROUP Slavija - Special Hospital for Neurology, 14. "MEDIC ONE" Special Hospital for Plastic and Reconstructive Surgery, 15. Psychiatric Hospital "Dr. Vorobjev VIP", 16. General Hospital "Analife", 17. Hospital for Neurology "DC Zemun", 18. Special Hospital for Ophthalmology "Professional - Dr. Suvajac ", 19. Special Hospital for Internal Medicine "Im Clinic", 20. Special Hospital for Internal Medicine "Eliksir Medical", 21. Special Hospital for Treating Addictive Disorders "Dr Vorobjev", 22. "MEDICON" Special Hospital for Haemodialysis, 23. Special Hospital for Internal Medicine "Puls - Cardiology Centre", 24. General Hospital "EUROMEDIK 2", 25. Special Gynaecological Hospital for the Treatment of Infertility "Beograd", 26. Special Hospital for Ophthalmology "OCULUS", 27. Special Hospital for the Treatment of Infertility "INTERMEDICUS BIS", 28. Special Hospital for Ear, Throat and Nose "dr Žutić", 29. Special Hospital for Plastic and Reconstructive Surgery "Klinika Varis", 30. General Hospital "EUROMEDIK 3", 31. General Hospital "MEDIGROUP", 32. Special Hospital for Haemodialysis "Fresenius Medical Care", 33. General Hospital "Impuls", 34. "SIRIUS MEDICAL" Special Hospital for Internal Medicine, 35. "ATLAS" General Hospital, 36. "Beogradski oftalmološki centar" Special Eye Hospital BOC, 37. "MEDICAL CENTER" General Hospital, 38. "OREA BG" Special Hospital for Plastic, Reconstructive and Aesthetic Surgery, 39. "ADONIS" Special Hospital for Plastic, Reconstructive and Aesthetic Surgery, 40. Special Hospital for Gynaecology "Jevremova" with a maternity hospital, 41. "SVETI VID" Special Hospital, 42. "MENS SANA" Special Hospital for Plastic Reconstructive and Aesthetic Surgery, 43. "ONCOMED SYSTEM" Special Hospital for Internal Diseases, 44. "ETERNA Hospital" Special Hospital for Reconstructive Surgery.

Figure 1. Graphical presentation of the market share of the analysed health care institutions



Source: https://www.apr.gov.rs

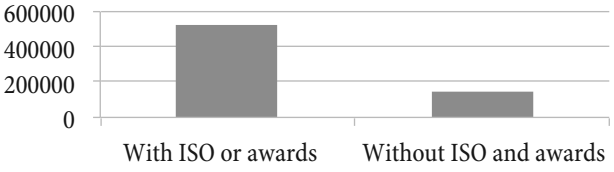
Figure 2. Graphical presentation of the income of private hospitals that used ISO 9001 and the ones that did not use the ISO standard



Source: https://www.apr.gov.rs

The average income of private hospitals that used ISO 9001 or some other ISO standard (ISO 14001, ISO 45001, etc.) or received the quality award amounted to 530301.2 thousand dinars, while the average income of private hospitals that did not use any standards nor received any quality awards was 149516.1 thousand dinars. The difference in income is presented in Figure 3.

Figure 3. Graphical presentation of the income of private hospitals that used some of the standards or received the quality award and those that did not use any standards nor received any quality awards



Source: https://www.apr.gov.rs

For the purposes of our research, we are going to analyse the following linear regression model:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \varepsilon_i$$
$$i = 1,2,\ldots,$$

where:

Y– dependent variable (operating income in 2020 in thousands of dinars),

X_1– the first explanatory variable related to the application of ISO 9001 standard and takes values 0 or 1,

X_2– another explanatory variable related to the application of other ISO standards and takes values 0 or 1,

X_3– the third explanatory variable related to whether a company has received the quality award or not and takes values 0 or 1,

X_4– fourth explanatory variable representing the number of employees,

X_5– fifth explanatory variable representing the amount of intangible costs in dinars,

ε_i –random error,

$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ – regression coefficients (model parameters).

Business income depends on a number of variables; however, only few of them are listed here. Regression coefficients obtained by the OLS method are presented in Table 1. Based on Table 1, we can conclude that at the significance level of 0.10, all estimators are statistically significant, i.e. all explanatory variables affect operating income.

Table 1. Regression coefficients obtained by the OLS method

Variable	Coefficient	Standard Error	t-statistic	Prob.
Const	-37561.96	10503.37	-3.576183	0.0010
X_1	54926.17	27358.80	2.007624	0.0518
X_2	137657.0	55288.82	2.489779	0.0173
X_3	-99444.25	31196.62	-3.187661	0.0029
X_4	-1.357560	0.588775	-2.305739	0.0267
X_5	6937.062	232.6288	29.82031	0.0000

Source: Output from R

One of the indicators of the quality of the model is Adjusted R-Squared. It equals 0.9835, meaning that 98.35% of the variations in operating income is explained by the model. However, in the model with these types of variables, there is usually a heteroskedasticity problem. We have conducted heteroskedasticity testing by using the Breusch-Pagan test in which the null hypothesis states that the error terms are homoskedastic. When testing the null hypothesis, the realized value of the test statistic has been 2.6071 and p-value 0.763. The p-value obtained in this way suggests that at the significance level of 0.10 we do not reject H_0. Therefore, we will not make a correction of the standard errors in the model. The testing has been conducted by using the code in the programming language *R*.

Looking at Table 1, we can conclude that variable X_1 affects operating income. The null hypothesis states that the variable describing the application of ISO 9001 does not affect; whereas, the alternative one states that it affects operating income. The p-value is 0.0518 and, therefore, the null hypothesis can be rejected at the significance level of 0.10. Observing the estimated value of the coefficient β_1,

we can conclude that in our sample the private hospitals that use ISO 9001 standard have an average of 54926.172 thousand dinars higher income than the private hospitals that do not use ISO 9001 standard (provided that they have the same value of other variables). The same situation is with the variable X_2. It affects business income as well. The null hypothesis states that the variable describing the application of other ISO standards does not affect, and the alternative one states that the variable affects the operating income. The p-value amounts to 0.0173, therefore, the null hypothesis can be rejected. Furthermore, observing the estimated value of the coefficient β_2, we can conclude that the private hospitals applying other ISO standards have an average of 137656.969 thousand dinars higher income than the private hospitals that do not apply other ISO standards (provided that they have the same value of other variables). Thus, we can conclude that the private hospitals that apply ISO 9001 or other ISO standards on average have more income compared to the private hospitals that do not apply them. This result should be taken with limitation. Only one set of explanatory variables has been analysed here, there are other variables that can affect income. Nevertheless, the obtained result is a motivation for the application of ISO standards.

Conclusion

Health institutions, hospitals, are a part of a secondary healthcare activity that have a significant role in the process of treatment and rehabilitation of patients. In order to improve the quality of health services and good business practices in hospitals, ISO management system standards are applied: for quality (ISO 9001), environmental protection (ISO 14001), occupational health and safety (ISO 45001), information security (ISO 27001), and other standards. The application of the aforementioned standards is expected to have a positive impact on the business operation of private hospitals. It is difficult to determine the direct economic impact of ISO standards on private hospitals. There is a greater possibility of determining the indirect impact of ISO standards on the financial performance of private hospitals. Based on the analysis of a sample of 44 private hospitals in the city of Belgrade (the Republic of Serbia), it was determined that there is a correlation between the application of ISO 9001 and other ISO standards and the average income of the analysed private hospitals. Based on a regression analysis, it was concluded that the private hospitals that apply ISO 9001 or other ISO standards have on average higher operating income compared to the private hospitals that do not apply ISO 9001 nor any other ISO standards. The interpretation of these results is limited by a sample size. The subject of further research can be the inclusion of a larger number of private hospitals in the analysis, as well as measuring the impact of ISO 9001 and other ISO standards on other economic results of private hospitals.

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EMPIRICAL MODELING OF HOTEL OCCUPANCY RATE WITH DYNAMIC PANEL DATA

Empirijsko modelovanje stope popunjenosti kapaciteta hotela dinamičkim panel podacima

Abstract

The previous research studies used mainly the occupancy rate as one of the key indicators of hotel performance. As the hotel occupancy rate varies both throughout the year and for different types of hotels, the use of panel data is more appropriate and more comprehensive compared to the cross-sectional data or time series, which have so far been most commonly used in similar research. Also, the previous research did not take into account the great heterogeneity among the analyzed hotels, nor the correlation of the occupancy rate in relation to its past values. By using the generalized method of moments within the dynamic panel data model, it is possible to take both properties into account. The analyzed data pertain to the hotel industry of Spain. Specifically, the given panel data include a sample of 49 hotels observed over a period of 12 years. The application of dynamic panel analysis shows that the values of hotel occupancy rate are influenced by the values of hotel occupancy rate with a lag one, as well as the values of total marketing expenses with a lag one. It was further determined that the values of incentive management fees, as well as the average daily rate and the consumer price index also have an impact on the observed variable. We are convinced that the presented analysis results will be of significant benefit to hotel managers.

Keywords: *hotel industry, occupancy rate, dynamic panel data, panel generalized method of moments, Sargan test, Arellano-Bond serial correlation test.*

Sažetak

U dosadašnjim istraživanjima, kao jedan od glavnih pokazatelja uspešnosti poslovanja hotela, uglavnom se uzimala stopa popunjenosti kapaciteta. Kako stopa popunjenosti kapaciteta u jednom hotelu varira tokom godine, ali isto tako varira i za različite tipove hotela, za njenu analizu prikladnija je i sveobuhvatnija upotreba forme panela podataka u odnosu na podatke preseka ili vremenske serije, koji su se do sada najčešće primenjivali u sličnim istraživanjima. Takođe, dosadašnja istraživanja nisu istovremeno uzimala veliku heterogenost među analiziranim hotelima, kao ni povezanost stope popunjenosti kapaciteta sa njenim istorijskim vrednostima. Upotrebom generalizovane metode momenata u okviru modela dinamičkih panel podataka, moguće je da se oba svojstva uzmu u obzir. Analizirani podaci pripadaju hotelskoj industriji Španije. Tačnije, dati panel podaci obuhvataju uzorak od 49 hotela posmatranih u periodu od 12 godina. Primenom dinamičke panel analize pokazano je da na vrednosti stope popunjenosti kapaciteta utiču vrednosti stope popunjenosti kapaciteta sa docnjom jedan, kao i vrednosti ukupnih troškova marketinga sa docnjom jedan. Daljom analizom utvrđeno je da na posmatranu varijablu utiču i vrednosti podsticajnih nagrada za menadžere, kao i prosečna dnevna cena sobe, kao i potrošački indeks cena. Uvereni smo da će menadžerima hotela prikazani rezultati analize biti od značajne koristi.

Ključne reči: *hotelska industrija, stopa popunjenosti kapaciteta, dinamički panel podaci, panel generalizovani metod momenata, Sarganov test, Arelano-Bond test serijske korelacije.*

Introduction

Financial performance ratios are commonly used as an indicator of business success, but also as the bottom line target, given that companies expect to generate an appropriate return on investment. Insight into these operating ratios does not provide information on the influence of intangible performance drivers, such as knowledge and customer and partner relationship, which significantly affect the hotel's performance [48, p. 600]. This shortcoming is compensated by the introduction of non-financial, i.e., qualitative indicators, which are the measure of quality, flexibility and implementation of new technologies [6, p. 149]. Hotels that follow and meet the needs and desires of customers offer far more sophisticated products thus achieving defined financial goals and a competitive advantage [41, p. 555].

Regarding operational performance, the three most commonly used performance indicators in the hotel industry are the average daily rate, revenue per available room and occupancy rate [14, p. 22], [17, p. 2], [15, p. 143], [43, p. 11]. Given that information on intangible resources such as the level of hotel guest satisfaction is often only partially available and that hotel financial information almost always remain unavailable and inconsistent for comparison purposes [25, p. 39], in scientific literature occupancy rate becomes a general measure of lodging performance [28], [34]. Jeffrey et al. [26, p. 74] consider that the occupancy rate is the only performance indicator that is widely available and which is relevant for monitoring and evaluating the hotel performance at the individual hotel level across the entire industry. Measuring the occupancy of the facility is an extremely good solution for showing the success of the hotel owing to the frequent reluctance of hotel managers to give detailed financial results. For most hotels, the occupancy rate is an effective addition to the financial results [42, p. 207]. It also enables the identification of trends and fluctuations within the industry [38, p. 176].

However, decision making based only on the occupancy rate is inadequate, because it could lead to erroneous conclusions about business success of the hotel. Occupancy information needs to be supplemented by information on prices obtained from sophisticated revenue management systems, in order to best translate the occupancy into the room net income. In particular, it is necessary to maintain a balance in the level of prices and the level of occupancy, because even a small increase in prices could lead to a significant reduction in the occupancy rate [28, p. 58].

Some studies have explored the issue of occupancy rates' changes and forecasts [27], [28], [29], [33], while some have examined key determinants of hotel occupancy rates [1], [21], [30], [31], [34], [37]. The occupancy rate forecasting is of great importance as it provides important information for both government agencies and hotel managers [10, p. 55]. On the other hand, by identifying and managing the key determinants of the occupancy rate, managers have the opportunity to achieve the desired occupancy more efficiently as well as to achieve better bottom line results.

In view of these considerations, the hotel occupancy rate was used in this research to illustrate the business performance of hotels in Spain. The study examines the key determinants of the occupancy rate in Spanish hotels. In the model, the occupancy rate is determined as a dependent variable, while four explanatory variables were identified: total marketing expenses – TME, incentive management fees – IMF, average daily rate – ADR and consumer price index – CPI. According to the best of our knowledge, the model created in this way represents an original model that has not been presented in the scientific literature so far. Its originality lies in the selection and combination of independent variables, as well as in the research methodology. Specifically, panel data were used in the paper, which represents a new and modern approach in treating this kind of issue.

Previous research in this domain relied on all types of data. Some papers used panel data [9], [12], [21], [34], while some used time series data [10], [26], [27], [28], [33] or cross-sectional data [1], [20].

Our model clearly identifies variables of interest whose management could lead to an increase in the occupancy rate providing implications for hotel management practice.

Literature review and hypotheses development

To manage the hotel occupancy rate and to improve the bottom line financial results, it is necessary to understand

the determinants affecting hotel occupancy. Hotel occupancy rate depends both on external and internal factors. The external factors refer to the state of the economy and politics, legislation, technologies and demographics [1, p. 200]. On the other hand, there are many more internal factors and in the scientific literature they are grouped differently depending on their influence on the hotel's operations. The hotel's internal factors which could affect innovation behavior and business performance are: firm size, membership in a business group, organizational aspects, high costs of innovation, lack of qualified personnel [37, pp. 145-146]. According to Lockyer [35, p. 481], the four major internal factors which affect hotel demand, and hence the hotel's occupancy, are price, location, facilities and cleanliness. Factors that are also rated as significant for hotel occupancy are cleanliness, location, room rate and security [3, p. 13]. There are other independent variables used in modeling occupancy rates such as the size of hotel, annual average room rate, proportion of free individual travelers, proportion of domestic travelers and chain-affiliation. These variables are determinants of the hotels' characteristics and therefore could have impact on the occupancy rate performance [21, p. 25]. According to Lei and Lam [34, pp. 3-4], the most important factors that may affect hotel occupancy rate are: average room rate, total available rooms, number of tourist arrivals, gross domestic product, inflation, CPI, star rating, seasonality and casino facility. Within these variables only four were statistically significant: average room rate, total available rooms, star rating and casino facility. Kim, Cho and Brymer [30, p. 406] have also confirmed the positive impact of the number of available rooms on the occupancy rate of hotels.

Understanding cost behavior is crucial for creating accurate budgets and controlling operations to enhance hotel profitability. There has been little empirical work done in the domain of investigation of the impact of operating costs on the hotel business performance [13], [39]. These studies have shown that there is a significant impact of operating costs on bottom line indicators, but the question which arises is how these costs affect the indicator such as occupancy rate. On this basis, the following is hypothesized:

H_1: There is a significant positive impact of explanatory variable total marketing expenses on dependent variable occupancy rate.

Although trained, professional and proactive management is crucial for achieving the desired hotel performance, the question of the importance and impact of managers' salaries and their bonuses on hotel performance is almost nonexistent in the scientific literature. Specifically, the only paper that examined the relationship between hotel room revenues and gross operating profit on the one hand, and managerial fees and their bonuses on the other hand was written by Hua, DeFranco and Abbott [19, p. 4]. To the best of our knowledge, until now there was no scientific work that has examined the impact of incentive fees (bonuses) for managers on the degree of hotel occupancy. Consequently, the following hypothesis is proposed:

H_2: There is a significant positive impact of explanatory variable incentive management fees on dependent variable occupancy rate.

The ADR reflects the hotel's ability to generate revenue intensively from occupied rooms. This indicator is calculated as the mean price charged for all hotel rooms sold in a given period [14, p. 22]. The ADR and occupancy rate are usually treated as two major hotel business performance indicators [26, p. 86], [43, p. 11]. Determining the right room rates is one of the most crucial functions for any hotel [11, p. 65]. The prices charged by a hotel directly affect its daily basis performance in terms of competitive position, occupancy rate and revenues [16]. In that sense, as prices could significantly affect the behavior of hotel guests, it is important to consider whether price variations can significantly affect variations in capacity utilization. Hence, the following two hypotheses are proposed:

H_3: There is a significant negative impact of explanatory variable average daily rate on dependent variable occupancy rate.

During the past two decades in the countries of eurozone, inflation and changes in prices in the hospitality industry have received much attention from researchers and policymakers. One of the measures of the inflation rate is the consumer price index, which is even more relevant in small, open economies that have a large share of exports

in the total balance of payments [46, p. 94]. As Spain is on the list of 20 leading countries in terms of imports and exports, the CPI is a good measure of inflation in this country [45]. The CPI measures changes in the prices of products and services that households procure to fulfill their needs. Spending on tourism and hotel services is closely connected to the state of the economy and economic cycle. As rapid growth or falling of prices can significantly harm a healthy economy and stable business, it is important to see how a change in this index will affect changes in tourist behavior in terms of their decision to make reservations which will be measured in this study by occupancy rate. Therefore, it is important to consider the relationship between the CPI and the performance of the hotel sector measured by occupancy rate, and thus the following hypothesis is suggested:

H_4: There is a significant positive impact of explanatory variable consumer price index on dependent variable occupancy rate.

Research methodology

The first step in econometric modeling would certainly be descriptive statistics and testing [32, p. 54]. These activities belong to the area of preliminary analysis. When testing, we usually compare the average values of the dependent variable in relation to some groups.

Panel data will require two indexes to be able to exactly identify each observation. Panel data mainly combine time series and cross-sectional data. In that case, if we observe the variable *Y*, its individual value is denoted by $y_{i,t}$, where the index i takes the values $i = 1,\ldots,N$, while the index t takes the values $t = 1,\ldots,M$.

In order to test the equality of the arithmetic means of the dependent variable, in relation to different groups, it is necessary to first define between and within sums of squares using the formulas: $SS_B = H\sum_{i=1}^{N}(\bar{y}_i - \bar{y})^2$ and $SS_W = H\sum_{i=1}^{N}\sum_{t=1}^{M}(y_{i,t} - \bar{y}_i)^2$ [22, p. 803]. In the previous formulas, $\bar{y}_i$ denotes the sample arithmetic mean within group i, and $\bar{y}$ denotes the overall sample arithmetic mean. We are now able to define test statistics for testing the equality of arithmetic means by groups:

$$F = \frac{SS_B/(N-1)}{SS_w/(MN-N)} \tag{1}$$

where MN denotes the total number of observations. Test statistics have an F distribution with degrees of freedom (N-1, MN-N). The assumptions for the application of testing is that the observed data have a normal distribution by groups, as well as equal variance [23, p. 450]. If the variance is not equal across groups, a robust version of the previous test statistics will be used to test the equality of the sample environments, and such a test is called the Welch test. To create the Welch test statistics, we first need to calculate the weights w_i by the formula $\frac{M}{s_i^2}$, where s_i^2 represents the sample variance in the group i. The given test statistics are presented by the formula

$$F^* = \frac{\frac{1}{N-1}\sum_{i=1}^{N} w_i(\bar{y}_i - \bar{y}^*)^2}{1 + \frac{2(N-2)}{N^2-1}\sum_{i=1}^{N}\frac{(1-h_i)^2}{M-1}} \tag{2}$$

where h_i is the normalized weight which is calculated as , and $\bar{y}^*$ is the weighted grand mean, which is calculated as $\sum_{i=1}^{N} h_i\bar{y}_i$. This robust statistic has an approximate F distribution with (N – 1, DF^*) degrees of freedom, where DF^* is calculated as $\frac{N-1}{3\sum_{i=1}^{N}\frac{(1-h_i)^2}{M-1}}$.

Panel covariances

Panel data are quite complex, hence for a better understanding of panel data, it is useful to analyze them from the cross-section point of view, and from the periods point of view. For this reason, we can define measures of association between cross-sections or between periods for the dependent variable. The covariances ($\sigma_{i,j}$)) for the dependent variable between cross-sections are calculated by the formula $E\{[Y_i - E(Y_i)][Y_j - E(Y_j)]\}$, where $Y_i^T = (Y_{i,1}, Y_{i,2},\ldots,Y_{i,M})$ represents a random variable that refers to the i^{th} cross-sectional data of the panel variable Y, $i = 1,\ldots,N$. Covariance between cross-sections represents the association between data for different cross-setions, for a given moment in time [24, p. 1220].

Similarly, we can define the covariances within the cross-sections for the dependent variable *Y*. The given covariance is calculated by the formula $\sigma_{s,t} = E\{[Y_s - E(Y_s)][Y_t - E(Y_t)]\}$, where $Y_i^T = (Y_{1,t}, Y_{2,t},\ldots,Y_{N,t})$, . The within cross-section covariance measures the association between data

in different time periods, for a particular cross-section. For example, if we want to calculate, for a panel dependent variable, the covariance for different time periods, the following formula will be used:

$$\sigma_{s,t} = \frac{1}{N} \sum_{i=1}^{N} (Y_{i,t} - \bar{Y}_t)(Y_{i,s} - \bar{Y}_s) \quad (3)$$

where $\bar{Y}_t = \frac{1}{N} \sum_{i=1}^{N} Y_{i,t}$ and $\bar{Y}_s = \frac{1}{N} \sum_{i=1}^{N} Y_{i,s}$.

Generalized method of moments estimation

Estimation using the generalized method of moments in panel data is based on moments [18, p. 100] which are of the form $g(\beta) = \sum_{i=1}^{N} g_i(\beta) = \sum_{i=1}^{N} Z_i^T u_i(\beta)$, where Z_i represents the matrix of instruments for cross-section *i*, and where the error term $u_i(\beta)$ is given by the equation $Y_i - f(X_{i,t}, \beta)$. Note that, when the estimation by the generalized method of moments in panel data is performed, the summation is done in some cases, in relation to periods *t* instead of cross-section *i*.

Estimation by the generalized method of moments, in essence, comes down to minimizing the following expression [47, p. 525]:

$$S(\beta) = (\sum_{i=1}^{N} Z_i^T u_i(\beta))^T W (\sum_{i=1}^{N} Z_i^T u_i(\beta)) = g(\beta)^T W g(\beta) \quad (4)$$

in relation to the parameter β and the corresponding weighting matrix *W*. Finally, we can conclude that, in the data panel, the estimation using the generalized method of moments includes the determination of the instruments (in the notation *Z*) and the determination of the weighting matrix *W*.

Dynamic panel data modeling

Dynamic panel data modeling is intended for panel data consisting of a large number of cross-sectional units and a small number of periods [7, p. 142], (as is the case with the panel data we analyze). Otherwise linear models of dynamic panels include *p* lags of dependent variables as covariates in the model. In addition to the given covariates, the model also contains cross-sectional effects [8, p. 4]. Thus, the model also contains past values of the dependent variable, as well as cross-sectional effects, which are correlated with each other, so that the estimation using standard methods is wrong, because the estimates are not consistent. This problem is overcome by using estimation with the generalized method of moments [4, p. 148].

A linear model of dynamic panel data, can be represented by an expression

$$Y_{i,t} = \sum_{j=1}^{p} \rho_j Y_{i,t-j} + X_{i,t}^T \beta + \delta_i + u_{i,t} \quad (5)$$

where δ_i represents cross-sectional effects. The given cross-sectional effect can be eliminated by applying the first-difference operator. In this way equation (5) becomes

$$\Delta Y_{i,t} = \sum_{j=1}^{p} \rho_j \Delta Y_{i,t-j} + \Delta X_{i,t}^T \beta + \delta_i + \Delta u_{i,t} \quad (6)$$

which can be estimated using the generalized method of moments. Also, efficient estimation using the generalized method of moments usually includes a different number of instruments for each period [44, p. 115]. The different number of instruments (for each period) is determined on the basis of the numbers of lagged dependent and predetermined variables that are available for a given period. For example, if we want to consider the use of lagged values of the dependent variable in equation (6) as instruments. If the error terms in equation (5) are independent and identically distributed, then the first period available for the use of the instruments is $t = 3$. We can easily see that $Y_{i,1}$ is a valid instrument because it is correlated with $\Delta Y_{i,2}$ while it is uncorrelated with $\Delta u_{i,3}$. Also, for the period $t = 4$, the potential instruments are $Y_{i,2}$ and $Y_{i,1}$. Continuing on this principle, we can create a set of instruments for case *i* using lags of the dependent variable:

$$H_i = \begin{bmatrix} Y_{i,1} & -1 & 0 & \dots & \dots & \dots & \dots & 0 \\ 0 & Y_{i,1} & Y_{i,2} & \dots & \dots & \dots & \dots & 0 \\ \dots & \dots & & & & & & \\ 0 & 0 & 0 & \dots & Y_{i,1} & Y_{i,2} & \dots & Y_{i,T-2} \end{bmatrix} \sigma^2.$$

Similarly, sets of instruments can be created for each predetermined variable. In this way we can determine the instruments needed for estimation using the generalized method of moments. It remains only to determine the weighting matrix. The weighting matrix used in the one-step Arellano-Bond estimator is given by the form $W = (\frac{1}{N} \sum_{i=1}^{N} Z_i^T A Z_i)^{-1}$, where the matrix *A* is defined as

$$A = \frac{1}{2} \begin{bmatrix} 2 & -1 & 0 & \dots & 0 & 0 \\ -1 & 2 & 0 & \dots & 0 & 0 \\ \dots & \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & 0 & \dots & 2 & -1 \\ 0 & 0 & 0 & \dots & -1 & 2 \end{bmatrix} \sigma^2.$$

Finally, note that the weighting matrix used in the two-step Arellano-Bond estimator is given by the form $W = (\frac{1}{N}\sum_{i=1}^{N} Z_i^T \Delta u_i \Delta u_i^T Z_i)^{-1}$, where u_i represents residuals from one-step estimation.

Sargan test

The Sargan test [40, p. 393] is used to test the null hypothesis that the over-identifying restrictions are valid. Thus, if the instrument rank (in the notation *p*) is greater than the number of estimated coefficients (in the notation *k*), we can use the Sargan test [5, p. 173]. The Sargan statistic (referred to as *J-statistic* in most software), if the null hypothesis is correct, has an approximately chi-square distribution with a degree of freedom. The p-value may be computed using the formula:

$$p - value = 1 - P(\chi^2_{p-k} \leq J - statistic) = 1 - F(J - statistic) = @chisq(J - statistic, Instrument\ rank - (\#estimated\ coefficients)) \quad (7)$$

where *F(x)* denotes cumulative distribution functions, while the expression in the last equation is a command in EViews software that is used to calculate the required p-value.

Arellano-Bond serial correlation test

The use of the generalized method of moments in dynamic panel data is correct only if there is no autocorrelation in model errors (at the level of original, undifferenced values) [2, p. 278]. Testing that there is no autocorrelation in errors in dynamic panel data models is complex, because transformed errors have a more complicated structure than untransformed (original) errors. The Arellano-Bond test for autocorrelation refers to transformed model errors, where the transformation is represented by the operator of the first difference.

If the untransformed model errors are independent and identically distributed, then the values of the first-difference model errors will be autocorrelated. So, the rejection of the null hypothesis of the non-existence of autocorrelation of order one, at the first-difference model errors, is quite correct. However, the rejection of the null hypothesis of the lack of second-order autocorrelation indicates that the application of the generalized method of moments in dynamic panel data is not correct. For that reason, we will calculate the autocorrelation of the first and second order. Therefore, to test the null hypothesis of the non-existence of autocorrelation in model errors, two test statistics will be created. One for first-order autocorrelation testing and the other for second-order autocorrelation testing.

If the untransformed error values of the model are independent and identically distributed, we expect the first-order autocorrelation value to be negative and statistically significant, while the second-order autocorrelation value to be insignificant. Thus we calculate the test statistics as:

$$m_j = \frac{AVE(p_j)}{\sqrt{VAR(p_j)}} \quad (8)$$

where $AVE(\rho_j)$ represents the average *j*th order autocovariance, which is obtained by the formula $\frac{1}{M-3-j}\sum_{t=4+j}^{M} \rho_{t,j}$, while autocovariance $\rho_{t,j}$ is obtained by applying the expected value operator $E(\Delta u_{i,t}, \Delta u_{i,t-j})$.

Descriptive statistics and sample

Five variables are described and used in this research. All data are secondary data provided by a global hotel market research company STR. The sample contains annual data for 49 hotels based in Spain spanning the period of twelve years, from 2006 through 2017. In the field of hospitality, this period of twelve years is especially

Table 1: Description and possible impact of explanatory variables in a dynamic model

Label	Name	Unit of measure	Role	Possible impact
OCC	Occupancy rate	capacity occupancy rate	dependent	
TME	Total marketing expenses	in U.S. $	explanatory	positive
IMF	Incentive management fees	in U.S. $	explanatory	positive
ADR	Average daily rate	in U.S. $	explanatory	negative
CPI	Consumer price index	2010 = 100	explanatory	positive

Source: The result of the analysis conducted by the authors.

challenging for research because it covers periods of both stable markets and periods of crisis. Spain was chosen as the subject of analysis as it is one of the most important tourist destinations in Europe.

Table 1 shows all the variables that will be included in the modeling. In addition to the variable name, a label of variables is given, which will be used in the labeling in the tables that follow. There will be four explanatory variables in the model, which are assumed to have a positive (except for one variable) effect on the dependent variable. It is only assumed that the explanatory variable "average daily rate" will have a negative impact, as dictated by economic logic. All explanatory variables (except one) were measured in U.S. dollars, only the variable "consumer price index" as its name indicates, is given as an index (with 2010 as the base year). The dependent variable is measured as a percentage, hence its range by definition is from 0% to 100%.

Table 2 shows the descriptive statistics of the analyzed variables. Looking at the realized values of descriptive statistics, we can see the basic characteristics of the analyzed variables, in the given period from 2006 to 2017. When considering the characteristics of the analyzed variables, it is important to observe whether the data distributions are symmetric. This is one of the basic assumptions to be examined, before we include the variable in the econometric model. The distribution of data is symmetric if mean statistics and median statistics have similar values, and if the skewness statistics is close to zero (approximately, in the interval from -1 to +1).

Analyzing the variable TME (total marketing expenses), it is observed that the value of statistics means is much higher than the value of median statistics, which indicates a potential problem of positive data asymmetry. This feature is confirmed by skewness statistics whose value is 3.7 (which is significantly higher than the value of +1). If the variable has the property of positive asymmetry, by using the transformation, the natural logarithm of the variable acquires the property of symmetry. The good side of the natural logarithm transformation is that the transformed variables have the same structure as the original variables. Because the data structure does not change, the transformed values are usually referred to as the original values. For the same reasons, the same

Table 2: Dependent and explanatory variables descriptive statistics

	OCC	TME	IMF	ADR	CPI
Mean	67.72453	387649.9	105601.8	111.9332	102.2904
Median	68.80000	143536.0	99.00000	93.78000	103.1961
Maximum	99.10000	4420058.	2618657.	374.9800	108.3753
Minimum	35.40000	0.000000	0.000000	32.06000	92.09113
Std. Dev.	11.94259	617619.0	249622.4	62.04151	5.247204
Skewness	-0.157994	3.740425	5.442653	1.981410	-0.590437
Kurtosis	2.604123	20.05336	45.05804	6.895838	1.988170
Observations	583	583	583	583	583

Source: Authors' calculations using EViews 12 software.

Table 3: Average values of dependent and explanatory variables by time periods

DATEID	OCC	TME	IMF	ADR	CPI	Obs.
2006	69.9	305353.5	66437.0	110.6	92.1	49
2007	69.8	336742.8	81528.4	126.9	94.7	49
2008	66.7	352555.0	88162.7	137.2	98.5	49
2009	60.7	322774.2	62038.5	109.7	98.2	49
2010	64.3	396338.6	0.0	105.0	100.0	49
2011	66.2	418048.9	636.8	112.9	103.2	48
2012	64.3	443234.3	129898.5	102.6	105.7	49
2013	65.6	409939.3	124162.6	105.0	107.2	48
2014	67.9	412862.0	140738.2	107.2	107.0	49
2015	70.7	371523.9	142620.2	96.1	106.5	48
2016	73.8	423275.7	206408.9	106.3	106.3	47
2017	73.2	461350.4	227696.4	122.9	108.4	49

Note: Categorized by values of *DATEID*; Sample: 2006-2017; Included observations: 583.
Source: Authors' calculations using EViews 12 software.

transformation was applied to the variables IMF (incentive management fees) and ADR (average daily rate).

As already mentioned, we are considering panel data. Panel data are two-dimensional data, hence the analysis of all data simultaneously (both in relation to the cross-section, and in relation to the periods) cannot see in detail the structure and descriptive characteristics of the analyzed variables. For this reason, when it comes to preliminary analysis of panel data, it is desirable to calculate descriptive statistics of variables, both in relation to cross-section, and in relation to periods.

Table 3 presents the average values of the analyzed variables in relation to years. Observing the dependent variable OCC, we notice that the capacity utilization rate varies from 60.7% in 2009 to 73.8% in 2016. Whether the given variation of some 13% can be attributed to randomness, and whether it can be stated that during the analyzed time the capacity utilization rate remains unchanged, or there are statistically significant differences, will be checked by applying the statistics given by formulas (1) and (2). Using formula (1), we perform a standard F-test. The realized value of the test statistics is 5.52, while the calculated degree of freedom is (11, 571). The corresponding p-value is 0.000, hence the null hypothesis of the equality of arithmetic means over time is rejected. When it comes to the Welch F-test, whose test statistics are given by formula (2), the realized value of the test statistics is 6.07, while the calculated degree of freedom is (11, 224.78). The corresponding p-value is 0.000, therefore, using this test, the null hypothesis of the equality of arithmetic means over time is rejected.

Table 4 presents the average values of the analyzed variables in relation to the hotels in the sample. Observing the dependent variable OCC, we notice that the occupancy rate varies from 51.9% for a hotel with code 108682288 to 88.5% for a hotel with code 106346849. The variation of 26.6% between hotels in the sample is probably statistically significant, and this can be verified by testing the statistical hypothesis that there is no variation in the occupancy rate between hotels. Using formula (1), we perform a standard F-test. The realized value of the test statistics is 21.6, while the calculated degree of freedom is (48, 534). The corresponding p-value is 0.000, hence the hypothesis

Table 4: Average values of dependent and explanatory variables by cross-sections

HOTEL_ID	OCC	TME	IMF	ADR	CPI	Obs.
100166086	80.2	278827.6	148744.6	76.1	102.3	12
100267940	65.8	180831.3	67895.3	91.2	102.3	12
100400406	55.9	79259.6	11927.8	65.7	102.3	12
100495193	64.3	38481.9	14523.1	76.3	102.3	12
100508515	83.1	352497.3	59422.8	104.7	102.3	12
101016492	84.1	399393.8	6.8	120.1	102.3	12
101316567	71.6	704317.7	160309.1	153.5	102.3	12
101435073	73.6	85602.3	70871.8	112.5	102.3	12
101846036	71.0	43453.8	21936.9	89.7	102.3	12
101869218	72.3	1015026.0	242510.5	162.4	102.3	12
102126665	63.1	509393.2	128719.3	94.8	102.3	12
102796244	57.0	51034.3	11884.4	76.4	102.3	12
103253890	74.1	77724.3	54508.1	111.8	102.3	12
103469179	79.6	228916.3	114094.3	100.7	102.3	12
103558280	77.3	1501121.0	211890.8	287.8	102.3	12
103759870	55.6	218901.9	33574.8	97.6	102.3	12
103910813	70.9	181407.9	43624.8	80.4	102.2	11
103978148	58.4	880068.1	96338.7	139.2	102.3	12
104408061	68.0	250938.5	77535.6	151.2	101.5	10
104412699	61.4	566058.3	281164.6	146.9	102.3	12
104578397	77.6	98499.8	65434.7	101.5	102.3	12
104964822	55.1	101458.3	17284.2	74.1	102.3	12
105063067	81.2	245207.3	158969.1	58.1	102.3	12
105070623	76.3	1516236.0	296737.3	166.5	102.3	12
105138211	61.2	35812.7	4325.0	38.9	102.3	12
105256687	64.0	822621.2	359250.7	305.2	102.3	12
105579030	59.5	374080.4	193468.2	116.7	102.3	12
105681357	67.7	666833.9	205094.9	75.1	102.3	12
105905349	62.4	90452.4	12753.0	73.6	102.3	12
106128128	62.9	233976.3	36882.9	89.6	102.3	12
106346849	88.5	129219.7	45397.6	94.5	102.3	12
106399414	85.0	251934.0	309100.9	66.1	102.3	12
106733672	58.5	42960.5	16878.6	79.7	101.9	11
107271489	55.2	31992.3	31.1	66.0	102.0	11
107284228	66.1	914102.4	215007.1	253.1	102.3	12
107434770	52.3	315210.9	34119.3	58.3	102.3	12
108056278	53.4	105929.8	12941.3	58.9	102.3	12
108425004	63.4	82011.5	74255.3	114.2	102.3	12
108629194	60.9	56242.8	37028.9	84.1	102.3	12
108682288	51.9	95131.2	22.6	88.8	102.3	12
109024518	53.2	78408.6	24935.5	65.5	102.3	12
109062560	58.7	182122.4	63000.0	99.5	102.3	12
109130453	76.5	57738.4	59126.5	161.7	102.3	12
109578035	71.7	3764618.0	757028.8	286.3	102.3	12
109632926	76.0	632431.1	105864.6	110.7	102.3	12
109790851	73.8	58625.8	37084.3	93.0	102.3	12
109994400	72.1	98487.5	46819.7	85.6	102.3	12
110008462	69.1	88668.0	33390.6	81.9	102.3	12
110056395	76.0	82240.5	74737.7	95.8	102.3	12

Note: Categorized by values of HOTEL_ID; Sample: 2006-2017; Included observations: 583.
Source: Authors' calculations using EViews 12 software.

that there is no variation in the occupancy rate between hotels is rejected. When it comes to the Welch F-test, whose test statistics are given by formula (2), the realized value of the test statistics is 30.5, while the calculated degree of freedom is (48, 185.066). The corresponding p-value is 0.000, thus even using this test, the null hypothesis that there is no variation in the occupancy rate between hotels is rejected.

By previous analysis, we observed the complexity of the structure of the dependent variable OCC. Its average values differ statistically significantly, both in the cross-sectional dimension and in the period dimension, therefore it is justified to analyze it as a panel structure.

Within the panel structure, the relationship of the dependent variable will be observed. Table 5 shows both the panel covariance and the panel correlation coefficients of the dependent variable in relation to the periods. Covariance coefficients are shown on the main diagonal, as well as in the upper right triangle of the coefficient matrix, which is given in Table 5. In the lower left triangle, in brackets, the correlation coefficients are shown. Covariance coefficients are calculated using formula (3), while correlation coefficients are obtained by applying the same formula, but over previously standardized data.

By analyzing the panel correlation coefficients, it is observed that there is a high correlation between the values of the dependent variable in different time periods, so that the past values of the dependent variable could be included in the model. This is made possible by the application of dynamic panel data model.

Empirical results

When the dynamic panel data model (given by formula (6)) is applied over the variables we have explained, and when the estimation is performed by the generalized method of moments, the estimates of unknown coefficients are given in Tables 6 and 7. Thus, when formula (6) is applied, we get the following form:

Table 6 gives a point estimate of the model coefficients, while Table 7 shows both 90% and 95% confidence interval values for estimates of unknown coefficients in the model. Table 6 in the last column shows the realized p-values of testing the statistical significance of unknown coefficients. Observing the given p-values, and comparing them with the value 0.05, we come to the conclusion that the following variables in the model are statistically significant: *OCC (-1)*, *LN_TME (-1)*, *LN_IMF*, *LN_ADR* and *CPI*.

Based on Table 6, we see that the variable OCC(-1) has a statistically significant and positive effect on the dependent variable OCC, which means that the occupancy rate of the hotel from the previous period has a positive effect on the occupancy rate of the hotel in the current period. Then, that the explanatory variable TME(-1) has a statistically significant and positive effect on the dependent variable. This means that the total marketing costs from the previous period positively affect the occupancy rate of the hotel in the current period. Then, that the explanatory variable IMF is statistically significantly and positively affects the dependent variable. Therefore, incentive management fees for managers have a positive effect on

Table 5: Panel covariance (correlation) coefficient values of the dependent variable

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
2006	138.3	115.3	106.6	71.5	88.1	95.0	86.4	73.3	59.2	54.0	49.8	62.7
2007	(0.93)	111.2	100.3	73.9	88.2	94.9	90.4	75.0	59.9	52.3	39.8	53.6
2008	(0.85)	(0.90)	112.5	84.3	95.8	102.9	91.0	81.5	64.4	55.4	54.3	60.9
2009	(0.60)	(0.70)	(0.79)	101.5	115.0	118.8	111.0	98.6	81.4	72.8	62.0	58.0
2010	(0.61)	(0.68)	(0.74)	(0.93)	149.9	156.0	145.6	133.5	113.8	100.8	77.5	68.9
2011	(0.59)	(0.66)	(0.71)	(0.87)	(0.94)	184.8	167.0	161.3	142.0	121.3	98.5	87.8
2012	(0.56)	(0.65)	(0.65)	(0.84)	(0.90)	(0.93)	172.7	163.6	142.1	122.8	91.1	82.2
2013	(0.46)	(0.52)	(0.57)	(0.72)	(0.80)	(0.87)	(0.92)	184.1	162.1	129.8	101.9	83.5
2014	(0.41)	(0.46)	(0.50)	(0.66)	(0.76)	(0.85)	(0.88)	(0.98)	150.0	116.3	89.1	72.1
2015	(0.44)	(0.48)	(0.50)	(0.70)	(0.79)	(0.86)	(0.90)	(0.92)	(0.91)	107.8	76.3	61.3
2016	(0.45)	(0.40)	(0.55)	(0.66)	(0.68)	(0.78)	(0.74)	(0.81)	(0.78)	(0.79)	86.9	71.7
2017	(0.62)	(0.59)	(0.67)	(0.67)	(0.65)	(0.75)	(0.73)	(0.72)	(0.68)	(0.69)	(0.89)	74.0

Note: Sample: 2006-2017; Included observations: 583; Analysis of clustered (between periods) relationships; Number of periods employed: 12; Balanced sample (listwise missing value deletion).
Source: Authors' calculations using EViews 12 software.

the occupancy rate of the hotel. Further, the explanatory variable ADR has a statistically significant and negative effect on the dependent variable. This means that the reduction of the average daily price of a hotel room has a positive effect on the occupancy rate of the hotel. Finally, the macro-explanatory variable CPI has a statistically significant and positive effect on the dependent variable, that is, the consumer price index has a positive effect on the hotel occupancy rate.

Based on the given results, we can infer that all hypotheses, which were set in this research, are accepted.

To verify the validity of the dynamic panel data model, if it is over-identified, the number of estimated coefficients in the model will first be established. By analyzing Table 7, we observe that the number of estimated coefficients is 16. In Table 8, we have information that the instrument rank is 49. Thus, the instrument rank is greater than the number of estimated coefficients, therefore the dynamic

Table 6: Dependent variable dynamic modeling using the panel generalized method of moments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OCC(-1)	0.627126	0.052644	11.91264	0.0000
OCC(-2)	-0.001272	0.023734	-0.053600	0.9575
LN_TME	-0.788545	1.035373	-0.761605	0.4500
LN_TME(-1)	1.486149	0.695413	2.137074	0.0377
LN_IMF	0.312245	0.102334	3.051218	0.0037
LN_ADR	-18.10350	4.513205	-4.011229	0.0002
CPI	5.171299	1.717308	3.011281	0.0041
@LEV(@ISPERIOD("2009"))	-6.003858	1.206782	-4.975097	0.0000
@LEV(@ISPERIOD("2010"))	-2.270099	3.316700	-0.684445	0.4970
@LEV(@ISPERIOD("2011"))	-17.11041	5.304079	-3.225896	0.0023
@LEV(@ISPERIOD("2012"))	-19.92523	4.535985	-4.392703	0.0001
@LEV(@ISPERIOD("2013"))	-5.991343	2.447494	-2.447950	0.0181
@LEV(@ISPERIOD("2014"))	3.169607	0.366827	8.640615	0.0000
@LEV(@ISPERIOD("2015"))	1.567405	1.022415	1.533043	0.1318
@LEV(@ISPERIOD("2016"))	3.654011	1.230511	2.969507	0.0046
@LEV(@ISPERIOD("2017"))	-10.03055	3.704190	-2.707893	0.0094

Note: Sample: Transformation: First differences; Sample (adjusted): 2009-2017; Periods included: 9; Cross-sections included: 49; Total panel (unbalanced) observations: 436; White period (period correlation) instrument weighting matrix; White period (cross-section cluster) standard errors and covariance (d.f. corrected); Standard error and t-statistic probabilities adjusted for clustering; Instrument specification: *@DYN(OCC,-2, -7) LN_TME LN_TME(-1) LN_IMF LN_ADR CPI @LEV(@SYSPER);* Constant added to the instrument list.
Effects specification: Cross-section fixed (first differences), Period fixed (dummy variables).
Source: Authors' calculations using EViews 12 software.

Table 7: Coefficient confidence intervals values

		90% CI		95% CI	
Variable	Coefficient	Low	High	Low	High
OCC(-1)	0.627126	0.540344	0.713909	0.523648	0.730604
OCC(-2)	-0.001272	-0.040397	0.037853	-0.047924	0.045379
LN_TME	-0.788545	-2.495347	0.918256	-2.823703	1.246613
LN_TME(-1)	1.486149	0.339768	2.632530	0.119226	2.853072
LN_IMF	0.312245	0.143547	0.480942	0.111093	0.513396
LN_ADR	-18.10350	-25.54347	-10.66353	-26.97478	-9.232214
CPI	5.171299	2.340334	8.002264	1.795709	8.546888
@LEV(@ISPERIOD("2009"))	-6.003858	-7.993226	-4.014490	-8.375943	-3.631773
@LEV(@ISPERIOD("2010"))	-2.270099	-7.737645	3.197448	-8.789499	4.249301
@LEV(@ISPERIOD("2011"))	-17.11041	-25.85413	-8.366688	-27.53625	-6.684560
@LEV(@ISPERIOD("2012"))	-19.92523	-27.40276	-12.44771	-28.84130	-11.00917
@LEV(@ISPERIOD("2013"))	-5.991343	-10.02601	-1.956675	-10.80221	-1.180480
@LEV(@ISPERIOD("2014"))	3.169607	2.564897	3.774317	2.448563	3.890652
@LEV(@ISPERIOD("2015"))	1.567405	-0.118035	3.252846	-0.442282	3.577093
@LEV(@ISPERIOD("2016"))	3.654011	1.625526	5.682495	1.235284	6.072738
@LEV(@ISPERIOD("2017"))	-10.03055	-16.13687	-3.924231	-17.31161	-2.749490

Note: Sample: 2006-2017; Included observations: 436.
Source: Authors' calculations using EViews 12 software.

panel data model is over-identified. The validity of the over-identified dynamic panel data model is tested using the Sargan test.

Table 8: Sargan test

Root MSE	6.174196	Mean dependent var	0.766055
S.D. dependent var	5.870487	S.E. of regression	6.290700
Sum squared resid	16620.62	J-statistic	36.60987
Instrument rank	49	Prob(J-statistic)	0.304829

Source: Authors' calculations using EViews 12 software.

To apply the Sargan test, we need test statistics, which are in fact Sargan statistics, and are usually denoted by *J-statistic*. The given statistics are calculated and shown in Table 8, and their value is 36.6. We are now able to calculate the p-value using formula (7):

$$p - value = 1 - P(\chi^2_{p-k} \leq 36.6) = 1 - F(36.6) = @chisq(36.6,33) = 0.30$$

The calculated p-value is greater than the value 0.05, hence we do not reject the null hypothesis of the validity of the excessive identification of the dynamic panel data model.

Table 9: Arellano-Bond serial correlation test

Sample: 2006 2017 Included observations: 436				
Test order	**m-Statistic**	**rho**	**SE(rho)**	**Prob.**
AR(1)	-2.393830	-6381.675067	2665.884844	0.0167
AR(2)	-0.504390	-761.046063	1508.843979	0.6140

Note: This test is only available for equations estimated by GMM using first-difference cross-sectional effects.
Source: Authors' calculations using EViews 12 software.

Finally, it remains to check whether the model error terms from equation (5) are autocorrelated. To examine this, the Arellano-Bond serial correlation test is applied to the model given by equation (6). The test results are shown in Table 9. In fact, two tests were applied, one for determining if there is first-order autocorrelation in the model error terms (in the notation *AR(1)*), and one for determining if there is second-order autocorrelation (in the notation *AR(2)*). If the model error terms from equation (5) are uncorrelated, then we expect that the model error terms from equation (6) have a negative and statistically significant first-order autocorrelation without having a second-order autocorrelation. Table 9 shows that there is a statistically significant first-order autocorrelation (because the p-value is less than 0.05) and is negative (its value is -2.39), and that there is no second-order autocorrelation, because its p-value of 0.61 is greater than 0.05.

Limitations

The limitation of this research is that we cannot generalize the results for a given region of the European western Mediterranean, but only for the state of Spain, for the period from 2006 to 2017. In the next research, the results obtained could be validated over a larger sample that would in addition include hotels from France, Monaco, Italy, Malta and Gibraltar. Also, the analysis of the data did not take into account information on the types of hotels in terms of the number of hotel stars, their hotel chain affiliation, location, age or level of service. Future research should certainly take this information into account when identifying key variables of capacity utilization, since the different types of hotels have differing operating characteristics such as TME, IMF and level of ADRs.

For a deeper analysis in terms of giving the answer to the question as to why variables such as lagged occupancy rate, lagged incentive management fees, total marketing expenses, ADR and CPI have impact on occupancy rate, it is necessary to make an additional, qualitative research in the field of functioning, organization and earnings policy in hotels. It would also be necessary to analyze the state of the Spanish economy during the observed period as well as further analyze the structure of price changes included in the consumer price index.

Conclusion

This research investigated the impact of four factors on the occupancy rates of the hotels in Spain, hence four hypotheses were formed and tested. A generalized method of moments was used to estimate unknown coefficients in a dynamic panel data model. The use of panel data models proved to be justified, because the dependent variable hotel occupancy rate has statistically significant different average values, both in relation to cross sections and in relation to time sections. Also, the results of the analysis indicate that the current values of hotel occupancy rate are statistically significantly affected by the values of

hotel occupancy rate with a lag one, the values of total marketing expenses with a lag one, as well as the values of incentive management fees. In addition to these business and economic variables, the average daily rate as well as the consumer price index have a statistically significant impact. The given results were obtained on the basis of the analysis of 49 hotels from Spain for a period of 12 years. Also, the results of this analysis should be interpreted with caution, because the results have not been validated. For that reason, a more comprehensive research is planned, which will include other countries in the western part of the European Mediterranean. However, we still expect the results of this analysis to be very useful to the hotel management, should the focus of their activities be the hotel occupancy rate.

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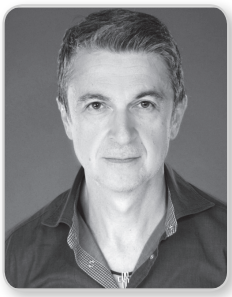

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INFLUENCE OF TRIPADVISOR REVIEWS ON GUEST SATISFACTION WITH RESTAURANTS IN MAJOR CITIES OF FORMER YUGOSLAVIA

Uticaj komentara sa sajta Tripadvisor na zadovoljstvo gostiju u restoranima velikih gradova bivše Jugoslavije

Abstract

In the era of urban tourism expansion, restaurants in major cities of former Yugoslavia (Belgrade, Zagreb, Ljubljana, Sarajevo, Skopje, Podgorica, which are also the capitals of the newly emerged countries) are very important factors in meeting the needs of tourists. The Internet with specialized websites and social networks provides a wealth of information to potential restaurant visitors. Tripadvisor is one of the most popular hospitality websites that gives its users an insight into past experiences of restaurant customers. Previous research has shown that there is a close relationship between the number of reviews on the website and the financial performance of restaurants. The aim of this paper is to examine the relationship of visitor satisfaction between the mentioned capitals, as well as the trends in the number of reviews and satisfaction over time, including the correlation between the number of written comments and visitor satisfaction via the analysis of ratings and comments left on the Tripadvisor site.

Keywords: *restaurant, Tripadvisor, restaurant visitor satisfaction, restaurant service, reviews on Tripadvisor*

Sažetak

U eri ekspanzije gradskog turizma restorani u glavnim gradovima bivše Jugoslavije (Beograd, Zagreb, Ljubljana, Sarajevo, Skoplje, Podgorica) predstavljaju značajan element turističke ponude na prostoru bivše SFRJ. Specijalizovani sajtovi i društvene mreže na internetu obezbeđuju izuzetno veliki broj relevantnih informacija potencijalnim posetiocima restorana. *Tripadvisor* je jedan od najpopularnijih sajtova u oblasti ugostiteljstva, koji korisnicima pruža uvid u prethodna iskustva posetilaca ugostiteljskih objekata. Ranija istraživanja su pokazala da komentari utiču na povećanje profita restorana. Cilj ovog rada jeste da se ispita odnos zadovoljstva posetilaca restorana u pomenutim glavnim gradovima, kao i trendovi u broju komentara i zadovoljstvu kroz vreme i povezanost broja napisanih komentara sa zadovoljstvom korisnika restorana u pomenutim gradovima kroz analizu ocena i komentara ostavljenih na *Tripadvisor* veb sajtu.

Ključne reči: *restorani, Tripadvisor, zadovoljstvo posetilaca restorana, restoraterska usluga, komentari na sajtu Tripadvisor*

Introduction

In contemporary times, most restaurants recognize the need to use specialized sites and social networks in their business. With the help of these modern information tools, restaurants are becoming more accessible to a large number of potential consumers [45].

In addition to their basic role of meeting consumers' needs in terms of food and drink, for different types of consumers (business people, families, groups of friends) restaurants have become presenters of national cuisines and drivers of new forms of tourism, such as gastro-tourism, wine tourism, rural tourism, etc. [20]. The caterers have an important task: to leave the best possible impression on visitors – not only by fulfilling their expectations, but also by striving to surpass them. Therefore, it is extremely important for the economy of each country to have educational institutions and good restaurant and hotel professionals, including practitioners from other fields fostering tourism development, as that is a prerequisite for financial growth of this economic activity [48]. Growing tourism trends are also reflected in restaurants in major cities, as guests are inclined to search for insightful information using IT technologies [54].

A large part of catering companies recognize the importance of social networks for business, as well as the necessity of using sites such as Tripadvisor, Booking.com, etc. With these tools, restaurants achieve greater market visibility generating thereby higher revenues. Today, the use of information technologies has become a necessity of every catering facility and restaurant [16].

In the modern age, digitally literate restaurant guests do not shy away from sharing their impressions of catering establishments on social networks, sites that specialize in certain types of reviews, and similar popular venues. In that sense, online social networks have been given primacy held until recently by traditional media. The population born after 1995 is characterized by the use of the Internet, mobile technologies and social networks – all to a large extent. It is a great unknown how these generations will behave as employees and as consumers in the future [38]. A "word-of-mouth" marketing, proven to be the best advertising, is becoming more and more present in the form of electronic "oral" marketing (eWOM). Today, accessing data via the Internet is rather easy, the problem is how to quickly get quality information from an often inconceivable amount of data [39]. Restaurant visitors leave an extremely large quantity of information about the service received on social networks (Facebook, Instagram, etc.) and specialized sites (Tripadvisor, Booking.com and others). Judging by the number of reviews left, customers are happy to write their impressions on Tripadvisor, while potential restaurant visitors, reading such comments, can get an impression about a particular catering facility – and even decide whether they would like to visit it. In addition to writing reviews on the site, and the overall satisfaction rating from 1-5, it is also possible to individually evaluate the four offered restaurant attributes (food quality, service quality, atmosphere and value for money). Guest satisfaction expressed through evaluation of these attributes on Tripadvisor is positively correlated with repeated purchase [46]. The analysis of these reviews is the starting point of the research part of our paper. The first objective of the paper is to examine the trend in the number of reviews in the observed period from 1 January 2015 through 31 December 2019. The second objective is to establish whether there are trends in the level of restaurant visitor satisfaction over time and whether such trends depend on the city. The third objective is to determine whether there is and what is the association between the number of reviews and the expressed satisfaction of restaurant visitors.

The conclusions drawn should serve as guidelines for caterers in designing future planning and operational activities of the catering establishment. On the other hand, the results will show the influence of reviews left by restaurant guests on visitors' satisfaction.

Literature review

Reliability of user-generated restaurant reviews on the Internet and Tripadvisor

Reviews that consumers leave on the Internet are one of the major sources of information prior to tourism consumption [52]. The survey has shown that in a situation

when one of the two catering establishments of the same type, with identical price lists and the same rating on the site, upgrades its current review score from 3 to 4, it can increase its prices by approximately 11%, while maintaining the same chances of being selected [3]. Data of the U.S. national hospitality industry for 2011 show that 59% of the adult population uses the Internet for food choice, while 33% of Americans choose restaurants based on online reviews [52]. Increased number of positive reviews boosts the consumer confidence in the service quality [3]. Restaurant consumers write reviews for three reasons. Care for other users is the first reason; in this way, future consumers are warned about an unsatisfactory product, or, to the contrary, they are given insight into a positive experience, which can help them in choosing a restaurant. Second, a satisfied customer has a desire to share his/her experience with other potential consumers. Third, by writing a review, a satisfied service user wants to help the catering facility [23]. As the number of Internet users is expected to grow in the future, the increase in the number of written reviews of catering facilities is also expected to increase. This refers particularly to the countries characterized by a high level of individualism. Such population is more inclined to write reviews than societies characterized by collectivism [27].

There are many empirical studies in various economic fields that have investigated the impact of written reviews on company performance. They obtained significant results regarding the manner of understanding as to how the number of reviews left affects revenues, reservations, sales [25]. A study from 2016 set up a hypothesis that reads [25]: "The number of online reviews is positively correlated with restaurant performance". It was concluded that online reviews have a positive effect on both the sales and the number of guests, as well as on the financial results. It was also concluded that the satisfaction of a future guest with such initial information they read is the first and very important step of their overall satisfaction with the catering facility and its service [18]. Public posting of consumers reviews (eWOM) increases the business value of a restaurant [45].

Tripadvisor is one of the most popular sources of information in the hospitality industry [5]. Many restaurant-related articles raise the issue of reliability of information posted on Tripadvisor; more precisely, it's effectiveness in helping guests decide about dining in a potential restaurant [10].

The issue of validity of Tripadvisor ratings is also owed to the fact that it allows writing of reviews for a large number of facilities, without recognizing differences in consumers' attitudes as a psychologically and socially important factor which does not have to have the same effect on all types of review readers and potential service users which the comment referred to: users can have different views about the same item, and expectations may differ as well. A study from 2013 [10] claims that Tripadvisor is a reliable tool for managers and consumers. On the other hand, the study also points to the presence of fake reviews on this site, as well as the presence of comments intentionally written in a positive fashion with a view to attracting guests (for which the tourists concerned are offered discounts by such restaurants as a counter-service). The authors estimate that Tripadvisor should look for mechanisms which would prevent publishing of false comments [10]. On the other hand, numerous studies have confirmed the veracity of reviews posted on Tripadvisor: they are often the main precondition for a decision of the future service user on where and how to spend the money in hospitality industry [3]. In cases where a potential guest is thinking about several restaurants, comments on Tripadvisor help make a choice [47].

Issues are also raised as to how effective this platform is for creation of positive or negative consumer attitudes, as well as whether there is a connection between the ratings assigned to a restaurant and the financial performance of the company providing the service. One of the problems encountered is a noticeable number of biased comments, which can diminish the credibility not only of the reviewers, but also of the facility concerned, and even the platform itself which enables such a thing.

Restaurant sector in the countries of former Yugoslavia

Countries created from the breakup of the former Yugoslavia and their capitals recorded a steady increase in the number of tourists in the 2015-2019 period.

Foreign exchange inflows in the tourism sector in the countries of former Yugoslavia are constantly increasing, and accordingly this industry has a positive impact on GDP of these countries [21]. For every 1% growth in tourist arrivals in the Western Balkans, GDP grows by 0.08% per capita [41]. Consumption growth in the business and recreational tourism sectors has a direct impact on GDP and employment [2]. The increase in the number of tourists also requires former Yugoslav countries to adjust the offer to their expectations; the adjustment would also result in an improvement in the economic effects expressed in these countries' GDP [12]. A study of restaurants [51] showed that the perception of local gastronomy significantly depends on demographic and sociological characteristics of restaurant visitors. The level of service and quality of the restaurant can be enhanced by monitoring these elements.

Popular festivals strongly attract visitors coming to the countries of the former Yugoslavia, while restaurants, in particular those with an authentic offer, play a major role in completing the overall experience of these guests [11]. However, the restaurants of the countries that emerged from the disintegration of Yugoslavia are experiencing a "problem" of Europeanization of cuisine. The rapprochement of the countries of the Western Balkans with the EU has brought certain changes in the restaurant service and production processes, which to a lesser or greater extent endangers the authentic service establishments and their national cuisines [42]. On the other hand, the authentic offer of restaurants in the countries of the Western Balkans region is similar. Offered food specialties such as sarma (cabbage leaves stuffed with minced meat), baklava, moussaka, feta cheese are similar products with, depending on the country, different names [9]. The restaurants of the countries of the region are important in creating an image [35]. That said, the Western Balkans countries face a challenge mirrored in the need to overcome the existing differences and find ways to initiate/improve mutually beneficial cooperation [41].

The tourist market in Serbia follows world trends. In the period from 2014 to 2019, the tourism growth rates in Serbia exceeded the world and European average [7]. Foreign tourists obtained most information about the tourist offer of Serbia via the Internet (64%), then from magazines (10%) and, to a lesser extent, through print materials, TV and other media [31]. Of all tourist destinations in Serbia, Belgrade attracts the largest number of tourists. The diversity of the offer in the capital includes rich cultural heritage, a larger number of shopping centers, entertainment facilities and restaurants. The richness of the content satisfies the individual demand of a modern tourist [33]. According to the data of the Statistical Office of the Republic of Serbia

Table 1: Summary of tourist arrivals and overnights in the Western Balkans countries in the 2015-2019 period

	Tourist arrivals (in 1000)					Overnights (in 1000)				
Country	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Croatia	14343	15594	17431	18667	19566	71605	78050	86200	89652	91243
Slovenia	4374	4834	5503	5933	6230	11654	12648	14209	15695	15775
Bosnia and Herzegovina	1030	1115	1308	1468	1641	2143	2376	2678	3040	3374
Macedonia	816	857	999	1127	1185	2394	2461	2775	3177	3262
Montenegro	1713	1814	2000	2205	2645	11055	11250	11953	12930	14456
Serbia	2437	2754	3086	3431	3690	6652	7534	8325	9336	10732

Table 2: Overview of the number of overnight stays in capital cities of the Western Balkans countries

	Overnights				
Capital	2015	2016	2017	2018	2019
Zagreb	120308	128255	148810	202606	225561
Ljubljana	1373436	1553802	1782983	2179916	2227669
Sarajevo	351321	502571	605052	652604	771130
Skopje	378253	392798	498661	565812	607786
Podgorica	155410	177191	261219	282757	310593
Belgrade	1686017	1867150	2190674	2480516	2696832

(SORS), of the total number of foreign tourists who visited Serbia in the period March 2019 – February 2020, 57% had overnight stays in Belgrade. Restaurants in Belgrade have modern and attractive traditional dishes in their gastronomic offer, and they make use of the fact that food has become one of the main reasons for travelling [8].

For the Republic of Croatia, tourism is one of its most important economic branches. Tourism in Croatia directly or indirectly accounts for 22% of GDP and 40% of exports [6].

Tourism in Croatia is characterized by a long tradition and offer that relies on mass "sun and sea" tourism. Croatia wants to complete its offer and that is why new, specific types of tourism are emerging [37]. Croatia is the country with the richest heritage in the tourism industry of all the countries of the former Yugoslavia – it accounted for 75% of the total tourist visits. Croatian tourismologists have recognized the importance of gastronomic offer in the tourist industry of their country, promoting branding of food heritage as one of the most important goals of Croatian tourism. Croatian restaurants with local gastro offer attract millions of tourists. The poor supply of local food in the best Croatian restaurants, however, turned out to be a problem. According to research, the offer in Croatian restaurants relies on foreign cuisines although its restaurants have quality chefs. By enriching local gastronomic offer, Croatia would gain a lot in quality. Restaurants in Croatia need to promote their own cuisine. Such cuisine is easily associated with culture, heritage and identity [19].

In Slovenia, tourism is one of the most important industries. In 2015, it accounted for 13% in GDP [34].

Data of the Statistical Office of Slovenia [43] show that in the 2015-2019 period there was a constant growth in the number of tourists in Slovenia, which is directly correlated with the growth of tourism-generated revenue.

Slovenia has a wide range of tourist products. Catering in this country took a new direction in the '90s of the last century, when the country gained independence, and when significant funds, through privatization, were invested in tourist facilities. Thanks to European funds for regional development, Slovenia has invested 97 million euros in 96 infrastructural projects. Such investments have significantly raised the level of the restaurant offer of this country [4]. Most restaurants are part of the SME sector, operating mainly as family restaurants. Restaurants in Slovenia have a great impact on transport, trade, natural environment and society [26].

Bosnia and Herzegovina (BIH) has the potential to achieve notable results in the tourism. Tourism industry can become its largest export branch. Tourism composed of elements essentially consisting of local products, tradition, culture, natural heritage and human resources are an integral part of the plan adopted by the country in its Development Strategy of the Federation of Bosnia and Herzegovina for the period 2008-2018 [22]. To make a satisfactory shift in tourism development, Bosnia and Herzegovina needs a fundamental approach based on raising the visitor satisfaction to a higher level [17]. The Agency for Statistics of Bosnia and Herzegovina records a steady increase in the number of tourists in the country [1].

Bosnia and Herzegovina is dominated by Sarajevo as one of the most important geopolitical centers in Southeast Europe. Tourists find Baščaršija to be the most attractive; even today, with its restaurants, it is the main point of tourist visits [15].

North Macedonia is currently not an attractive tourist destination globally, although statistics show a steady increase in the number of tourists [29].

From the aspect of the restaurant industry, the long-term strategy of Macedonian tourism development puts Skopje in the first place as a destination, whose potential should be used. A better and more present offer on the market may generate more significant financial effects in the country in the future (increase in the share of GDP). The policy should define the tourism development with a view to achieving better results in all segments of the tourism industry [30]. That is why North Macedonia has adopted several strategic documents in the field of tourism, such as the National Strategy for Regional Development 2009-2019, the National Strategy for Rural Tourism 2012-2017 and the National Strategy for Tourism 2016-2021 [13]. In 2017, the contribution of tourism to GDP was 6.6%, while the share in GDP and the number of tourists continue to grow in 2018 [32]. There are restaurant chains in Skopje that operate on a global level, but for the reasons of future catering industry development, the emphasis is

on promoting national restaurants. National restaurants called "Meani" are attractive for both domestic and foreign guests. According to the law on catering of the Republic of North Macedonia, national restaurants must include in their offer a minimum of 70% of local traditional dishes followed by 80% of local wines. The exterior and interior decoration of the facility, as well as the accompanying music in restaurants should exude tradition (Strategy for the Development of the City of Skopje 2020-2023).

Montenegro is a coastal country with access to the warm sea and is therefore attractive to tourists from around the world. Its weakness is a pronounced seasonal character, i.e., influx of a large number of tourists in a short period during the year (July and August). Having in mind the number of tourist arrivals, coastal places have a share of 90% in the tourism of Montenegro, while the capital of Podgorica participates with only 4.6% and only 1.7% of overnight stays. In order to complete the tourist offer to make Montenegro an attractive destination not only 45 days a year but longer, it is necessary to activate other tourist offers that will be less contingent on weather conditions, such as cultural monuments, gastronomic offer, wine tours and rural tourism [28]. According to the World Tourism and Travel Council (WTTC), Montenegro ranks 34th in the world in terms of contribution of the hospitality and restaurant industries to the national economy. According to the long-term growth forecast for the 2015-2025 period, it ranks third in the world. Tourism's direct contribution in Montenegro has been growing over the years, reaching a share of 9.5% in 2014, with projected increase in 2015 and 2016 [28]. The Statistical Office of Montenegro Bulletin [49] records a rise in the total number of tourists in the 2014-2019 period.

The pronounced seasonal character has a direct impact on the restaurant business in Montenegro, with revenues increasing along with the hotel occupancy increase. Montenegrin restaurants achieve the best results in the peak season [35].

Methodology

The research part of this paper relies on the restaurant visitors' comments collected from the Tripadvisor website (www.tripadvisor.com). Each comment contains the name of the reviewer, location, user information (its level, date of joining the site...), restaurant rating, review title, view date and experience date. Analyzed were the reviews of restaurants in the capital cities (Belgrade, Zagreb, Ljubljana, Sarajevo, Skopje, Podgorica) of the six countries that emerged from the disintegration of Yugoslavia (Serbia, Croatia, Slovenia, Bosnia and Herzegovina, Macedonia and Montenegro) which, according to the author's opinion, are the main presenters of the restaurant industry of their respective countries. Data from the site were automatically generated in January of 2020 using R script [44]. First, a list of all restaurants on Tripadvisor from the indicated cities was collected, and then, for each of these restaurants the following data were collected: 1. review ID, 2. review date, 3. user location, 4. rating (1-5), 5. review web address on Tripadvisor site, 7. name of the restaurant, 8. city, 9. year. Initially, all available comments were collected, and then the data from the beginning of 2015 to the end of 2019 were filtered.

Based on established objectives, the following hypotheses were formulated:

H1: Satisfaction of restaurant visitors is the same for all cities examined over a five-year period.

H2: There is a positive growth trend in the number of comments by Tripadvisor users over a five-year period.

For hypothesis H2 we can say that positive growth is expected. Such conclusion can be inferred from the data illustrated in Table 1 (consolidated table) (Table 1).

H3: There is a positive trend in restaurant user satisfaction on Tripadvisor site over time.

For hypothesis H3 we can say that positive trend in restaurant user satisfaction over time is expected as restaurants are expected to constantly look for ways to improve their business service and image over time.

H4: There is a positive correlation between guest satisfaction and the number of their comments regarding the restaurant offer on Tripadvisor.

For hypotheses H4 we can say that a positive correlation between guest satisfaction and the

number of their comments is expected. It is to be expected that customers will visit restaurants they are satisfied with more often. It is to be expected that this will lead to an increase in cash flows. Consequently, restaurants with increased turnover can invest in improvement of their services.

Before testing the validity of the hypotheses, the reviews were divided on the basis of the ratings left of the overall impression (1 – 5) into two groups: satisfied (ratings 4 and 5) and dissatisfied (ratings 1 – 3). This was done to simplify the analysis, primarily the statistical methods used, as well as to simplify the conclusions that can be drawn based on statistical models. Logistic regression was used to statistically model the relationship between satisfied and dissatisfied reviews [50, pp. 190-199]. Logistic regression is a general linear statistical method that can be used to model the relationship between independent predictors (such as city or year) and binary dependent variables (satisfied/dissatisfied visitor). The author is convinced that in this way it is possible to draw broader conclusions than modeling the trend for each 1-5 rating separately. For the analysis of trends in the number of reviews, Poisson regression was used [50, pp. 190-199]. Poisson regression is a linear statistical method that serves to describe the relationship between a predictor that can be continuous and/or categorical and a dependent variable that has a Poisson distribution. Variables with Poisson distribution can have integers and cannot be negative, and in this paper, it is the number of reviews for a restaurant in one year. Poisson distribution can describe the number of events in an interval, and in the case of this paper, it can be used for the number of reviews for a restaurant in the course of one year. Hypergeometric distribution [36, pp. 39-40] was used to determine data that can describe whether positive or negative trends are significantly more represented in a city than expected based on their global representation. Hypergeometric distribution is a discrete probability distribution that describes the probability of "k" successes (random draws for which the object drawn has a specified feature) in "n" draws, without replacement, from a finite population of size N containing K object with a given specific feature.

There is an extremely large number of restaurants on Tripadvisor with a small number of reviews written. Of 2,986 restaurants in these cities that exist on the site, as many as 1,135 restaurants have 5 or fewer reviews for the observed five-year period (Table 3).

Such small samples can negatively affect the robustness of the conclusions, and therefore only restaurants having more than ten reviews per year were considered in the scope of the research. In this way, a large number of restaurants poorly represented by the number of reviews were eliminated, and the analysis included restaurants that had more than 10 comments per year during the observed five-year period, which means 68,599 reviews distributed over 242 restaurants in six cities (Table 4).

Research results

Hypothesis H1 reads: "Satisfaction of restaurant visitors is the same for all cities examined over a five-year period."

To determine whether hypothesis H1 is true, differences in the level of satisfaction of restaurant users were examined. Satisfaction of restaurant visitors by cities is shown in Figure 1. The different letters above the

Table 3: Total number of restaurants on the site and total number of reviews

City	Number of reviews	Number of restaurants
Belgrade	36,093	1,110
Ljubljana	32,026	488
Podgorica	2,850	139
Sarajevo	11,775	329
Skopje	6,579	260
Zagreb	35,598	660
Total	124,921	2,986

Source: Author's calculations

Table 4: Number of restaurants with more than 10 comments per year and the total number of reviews written by their visitors, by city

City	Number of restaurants	Number of comments
Belgrade	58	17,603
Ljubljana	72	21,390
Podgorica	4	988
Sarajevo	27	6,480
Skopje	13	3,096
Zagreb	68	19,042

Source: Author's calculations.

distribution indicate statistically significant differences ($p < 0.05$) which were determined by post-hoc Tukey method comparison using the emmeans (ref) R package.

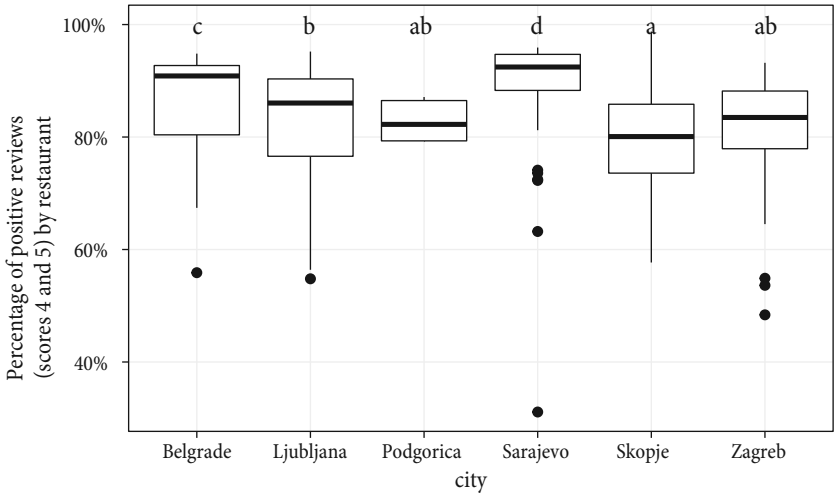
When distributions share the same letter, the difference is not statistically significant. Thus, "a" and "ab" or "b" and "ab" are distributions that are not statistically significantly different, while "a" and "b" are statistically significantly different. The results showed that Sarajevo, followed by Belgrade, had the largest share of satisfied restaurant services' users in the observed period, while Skopje, Podgorica and Zagreb were the cities with the least satisfied users. Based on the above, it can be concluded that hypothesis H1 is not true, because the satisfaction of restaurant visitors is not the same for all the examined cities over a five-year period.

Hypothesis H2 reads: "There is a positive trend of growth in the number of comments by Tripadvisor users over a five-year period." Statistically significant trends ($p<0.05$) as well as their confidence intervals are shown in Figure 2.

We examined general trends by cities. Poisson regression modeled the annual share of the number of comments for each restaurant in relation to the number of comments for the five-year period. The obtained results are graphically represented by lines with 95% confidence intervals. Lines represent trends, thus in cases where there are lines there are also trends. In the case of Podgorica, probably due to the small sample size, there is no trend.

Figure 2 gives an insight into the decline in the number of comments written about restaurants in all cities that are part of this research, and it also shows that the city of Belgrade has the largest decline in the number of comments left. In order to more realistically describe this drop and gain a more detailed insight into the decreasing number of reviews, trends at the restaurant level were analyzed by Poisson regression. A separate model of the share of the number of comments for each year in relation to the five-year period was developed for each restaurant. The results showed that as many as 104 out of 242 examined restaurants recorded a statistically significant negative trend in the 2015–2019 period, while in only 12 restaurants there was a statistically significant increase in the number of comments (Table 5).

Figure 1: Distribution of percentages of positive comments per restaurant. Each observation is one restaurant.



Source: Author's calculations

Table 5: Number of restaurants with significant trends in the number of comments

City	Negative trend (number of restaurants)	Positive trend (number of restaurants)	Total number of restaurants
Belgrade	31	1	58
Ljubljana	27	4	72
Podgorica	1	0	4
Sarajevo	10	1	27
Skopje	2	1	13
Zagreb	33	5	68

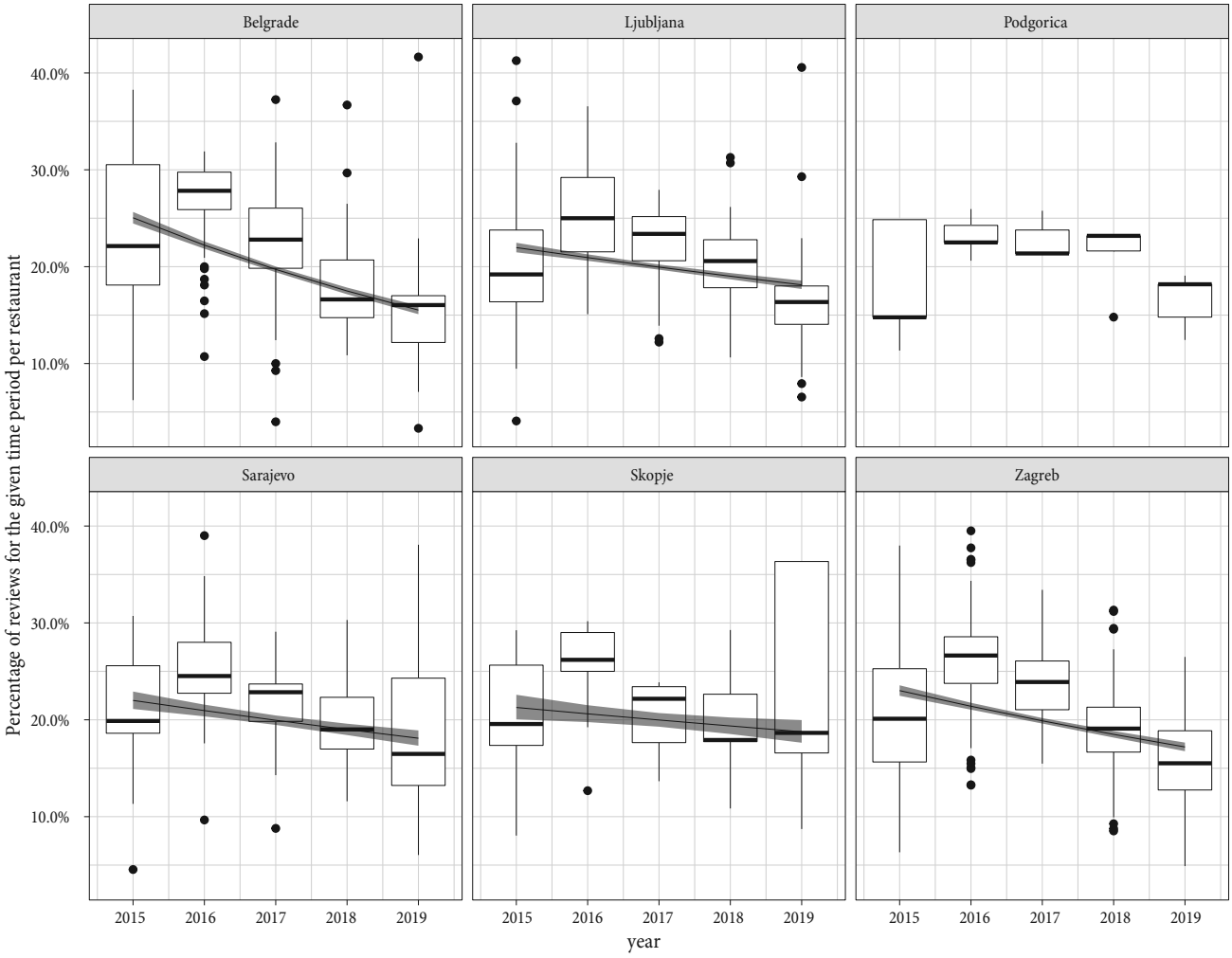
Source: Author's calculations.

A hypergeometric test was used to determine whether the number of restaurants with a significantly negative trend differed from city to city. The test showed that Belgrade has significantly more restaurants with a negative number of comments than expected based on the total frequency in all cities; also, the test provides an explanation as to why Belgrade has the largest decline of all examined cities – it has the largest number of restaurants with a statistically negative trend, as many as 33 out of a total of 58.

Analysis of a sample of 242 restaurants suggests that hypothesis H2 should be rejected, as the number of restaurants with a significant negative trend in the number of written comments far exceeds that with a positive trend.

Hypothesis H3 reads: "There is a positive trend in restaurant user satisfaction on Tripadvisor over time."

Figure 2: Restaurant reviews trend for the 2015–2019 period, with confidence intervals



Source: Author's calculations

Table 6: Hypergeometric test for overrepresentation / underrepresentation of the city depending on the number of restaurants with a significant trend in the number of written comments

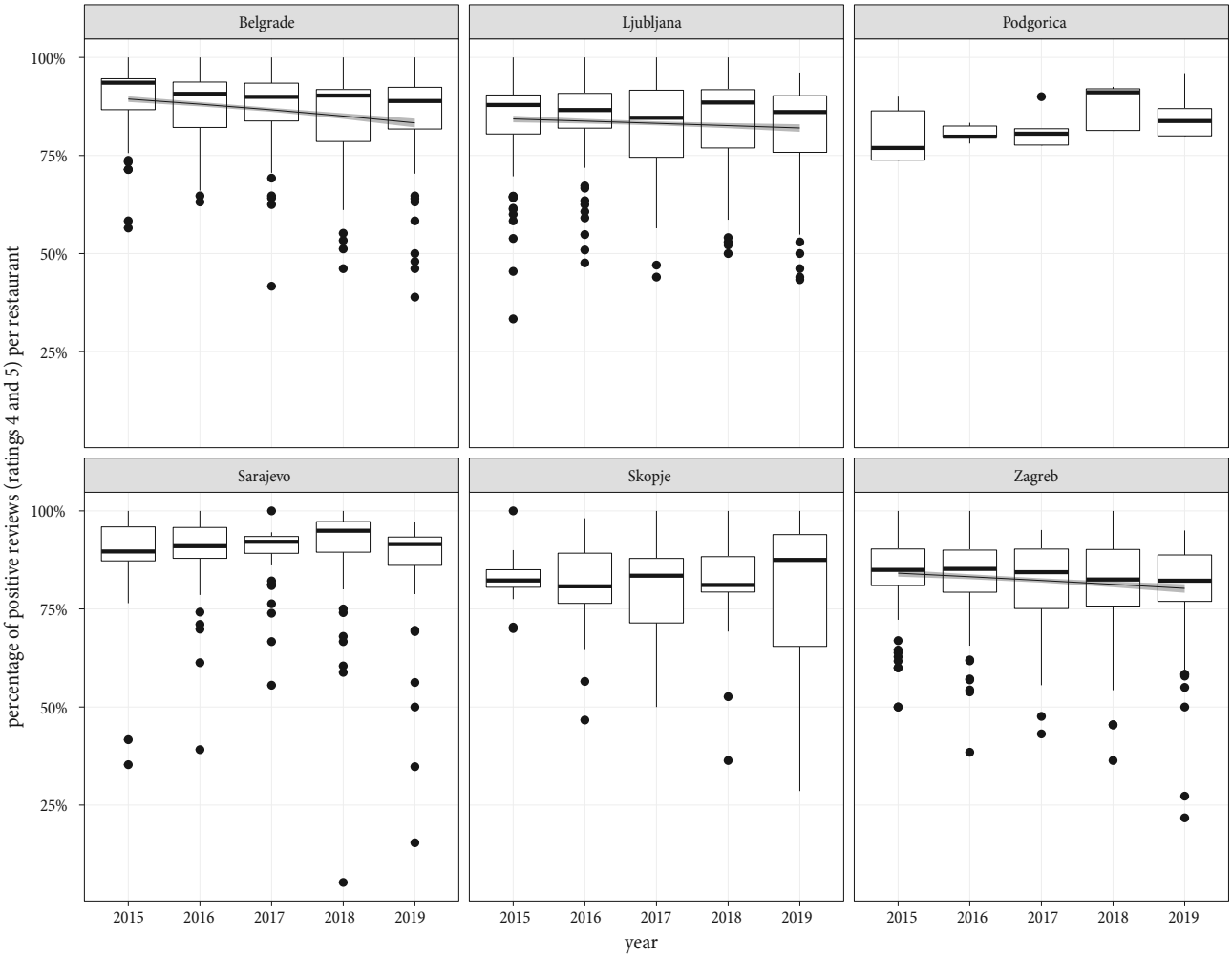
City	Overrepresentation p-value	Underrepresentation p-value	Number of restaurants with a significant negative trend
Belgrade	0,0454	0,977	31/58
Zagreb	0,172	0,891	33/68
Sarajevo	0,806	0,327	10/27
Podgorica	0,896	0,423	¼
Ljubljana	0,897	0,164	27/72
Skopje	0,994	0,033	2/13

Source: Author's calculations.

For statistically significant trends (p<0,05), Figure 3 shows the models and their confidence intervals. The results were obtained by logistic regression and graphically represented by lines with a 95% confidence intervals. In cases where the year as an independent variable has an impact on the satisfaction of restaurant users in cities, the model is shown in the figure.

The analysis showed that in Belgrade, Ljubljana and Zagreb there are significant trends in user satisfaction, while for Sarajevo, Podgorica and Skopje there are no trends. In order to check the validity of hypothesis H3 in more detail, the trends in the share of satisfied users at the restaurant level were analyzed. Out of 242 restaurants, 40 had significant trends in the observed period, namely eight restaurants with a positive trend and as many as 32 with a negative trend. Summary data on trends in the share of comments expressing user satisfaction by city are shown in Table 7.

Figure 3: Trends of guest satisfaction and confidence intervals in restaurants in the 2015–2019 period



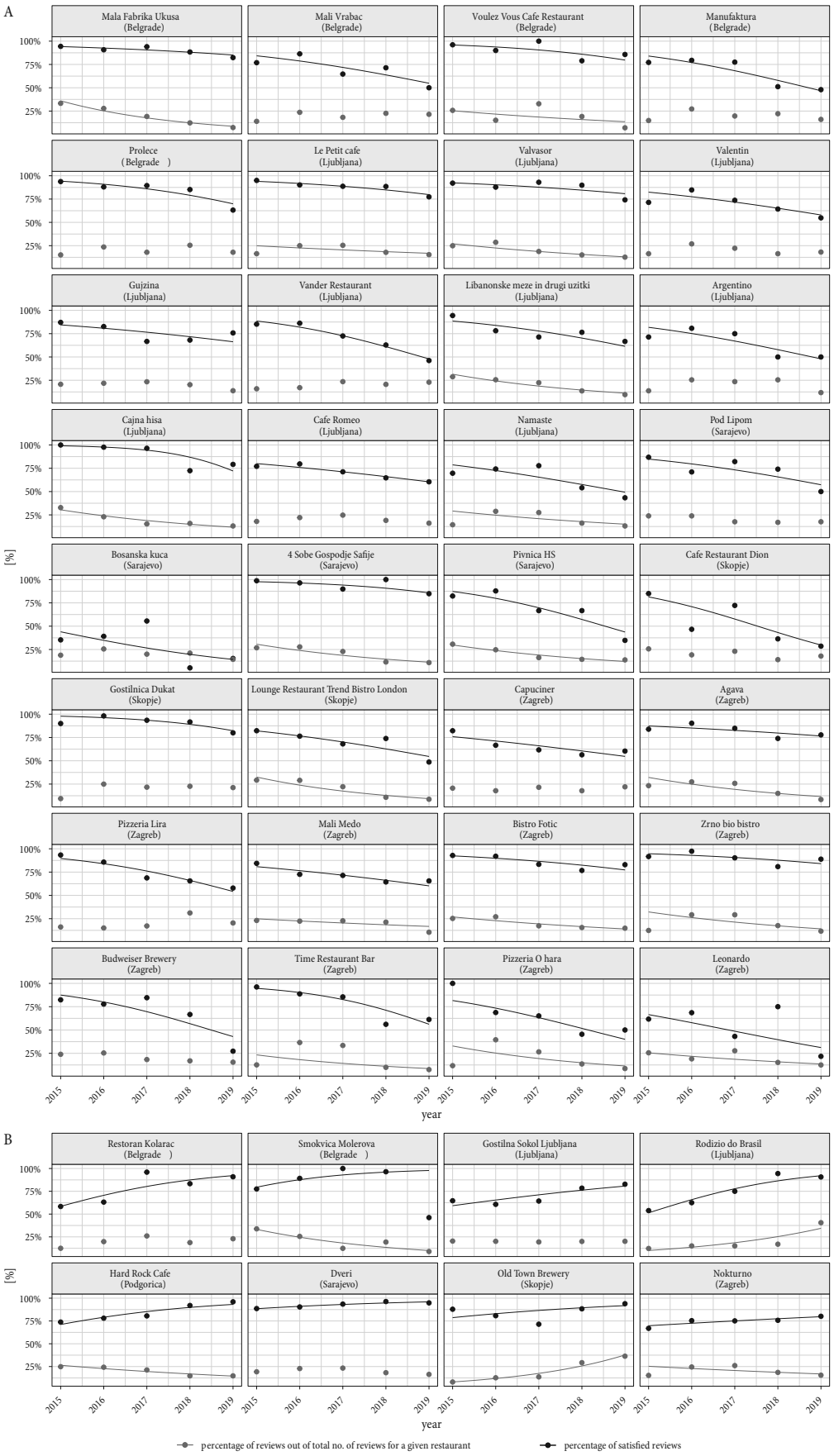
Source: Author's calculations.

Table 7: Summary – trends in the share of comments expressing satisfaction with the restaurant, by city

City	Negative trend Number of restaurants	Positive trend Number of restaurants	Number of restaurants
Belgrade	5	2	58
Ljubljana	10	2	72
Podgorica	0	1	4
Sarajevo	4	1	27
Skopje	3	1	13
Zagreb	10	1	68

Source: Author's calculations.

Figure 4: Relationship between the total number of written comments and comments expressing satisfaction



Source: Author's calculations.

The hypergeometric test showed that no city has statistically significant greater or lesser number of restaurants with a positive or negative trend in the share of comments expressing satisfaction. Only 8 out of 242 restaurants have a positive trend in user satisfaction. In the vast majority (202 restaurants), user satisfaction is stable, while in 32 restaurants there is a negative trend in satisfaction over time. Based on the above, it can be concluded that most restaurants are failing to adapt their operations so as boost user satisfaction experience, thus H3 hypothesis should be rejected.

Hypothesis H4 reads: "There is a positive correlation between guest satisfaction and the number of their comments regarding the restaurant offer on TripAdvisor." In order to examine the validity of hypothesis H4 i.e., to test the relationship between trends in the number of written comments and the share of satisfied users, we compared trends in the number of comments for 40 restaurants that had significant trends in the share of satisfied users (Figure 4).

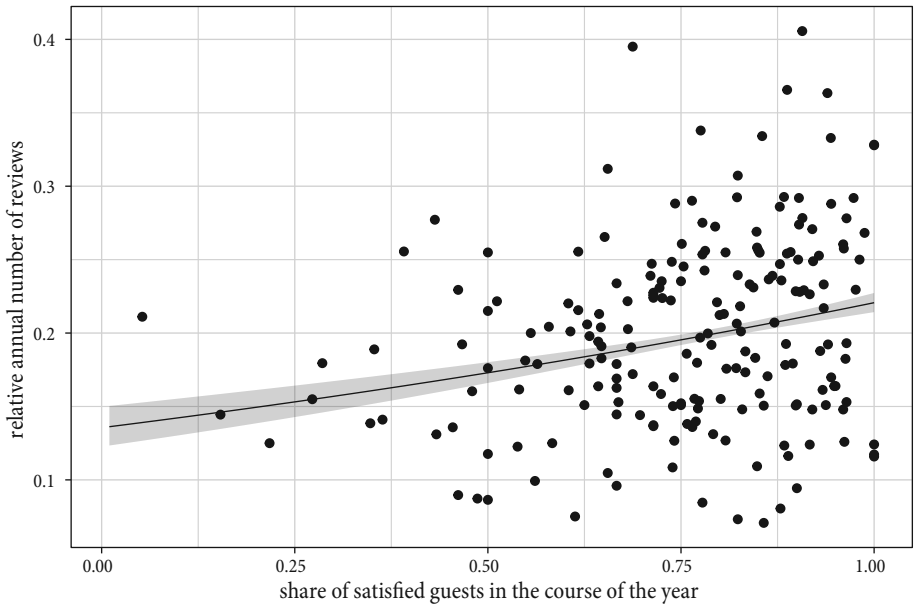
Black lines represent models of logistic regression used to model the trend in the share of satisfied users (ratings 4 and 5) depending on the year, and the model is present in each graph given that the subject of this analysis are restaurants that had a significant negative or positive trend. Figure 4A shows all restaurants with a negative trend in satisfaction, while Figure 4B shows a positive trend in satisfaction.

Red lines are Poisson regression models used to model the trend in the annual share of reviews in relation to the examined five-year period depending on the year for each restaurant. A model (line) exists only if the trend is significant.

Of the 32 restaurants with a significant negative trend in the share of satisfied users, 17 had a significant downward trend in the number of written comments, and no restaurant had a significant upward trend in the number of comments over time (Figure 4A). Of the eight restaurants that had a significant positive trend in the share of satisfied users, two restaurants had a significant upward trend in the number of comments, while three had a significant downward trend (Figure 4B). These results support hypothesis H4 because it is obvious that the negative trend in the percentage of satisfied users results in no restaurants with a positive trend, while among restaurants with a positive satisfaction trend there are restaurants that have a pronounced positive trend in the number of written comments (2/8, i.e., 25%).

Hypothesis H4 was further tested by modeling the relationship of written comments in the course of the year depending on the share of satisfied users. We analyzed the relative number of written comments for

Figure 5: Relationship between the number of written comments and user satisfaction



Source: Author's caculations.

the restaurant (the relationship between the number of written comments in the course of the year and the total number of comments for the restaurant over a five-year period observed) against the share of satisfied guests in the course of the year. Figure 5 illustrates the model trend ($p<0.05$) and the confidence interval.

Based on the previous analysis, we can conclude that hypothesis H4 can be accepted, i.e., it has been clearly demonstrated that there is a positive correlation between guest satisfaction and the number of their comments regarding the restaurant offer on Tripadvisor.

Conclusion

Investing in social media promotion is becoming one of the priority tasks for restaurant managers. Understanding how comments on specialized sites affect consumers and the business of catering establishments is essential for restaurant industry. Electronic advertising and publicizing quickly spreads information about restaurants' business, and therefore this paper examined the connection between the comments written on Tripadvisor and satisfaction expressed by restaurant customers. Relevant literature has shown that the Tripadvisor website is frequently visited and used in the restaurant industry, with the aim of posting or reading reviews and impressions about restaurants. The conducted research analyzed comments related to consumer satisfaction with restaurants in capital cities of the former Yugoslavia in the 2015–2019 period. The analysis included 242 restaurants with 68,599 comments. The paper provided an insight into the relationship between satisfaction, displayed in the form of comments left on Tripadvisor site, and their number.

The study also showed that there is a negative trend, which is reflected in the number of comments in the observed period, as well as the decline in restaurant user satisfaction over time. Further analysis, which correlated the number of comments written on a particular restaurant with user satisfaction, led to the conclusion that catering establishments in the years with a larger number of comments have a higher share of satisfied users.

Based on the above, in order to ensure successful business management and increase in profitability rates, managers should seek out mechanisms increasing the number of users willing to express their opinion about the restaurant on the Tripadvisor site. Such an approach would enhance the number of reviews, providing managers with more information necessary for rendering a higher-level service in the future. A quality interactive frontline employees' customer-oriented service would probably encourage guests to take a more intensive approach to the Tripadvisor site.

On the other hand, greater commitment is needed from other employees in the restaurant service and production activity system in order to achieve a set of superior services that will lead to higher traffic rates of a catering facility and thereby higher revenues. Although these conclusions are obvious, the study showed that many restaurants are not able to run and manage their business operations in a way that would allow them to reach the expected results.

Finally, it is necessary to emphasize that this paper did not take into account the structure of the geographical and cultural origin of guests (local population, guests from different parts of the world). Accordingly, for instance, visitors from Asian countries evaluate restaurant attributes differently from the guests originating from the so-called Western countries [24]. Therefore, further research should be directed toward the analysis of the answer to the question as to which of the individual groups (e.g., local guests, guests from China or guests from Western countries) have a greater impact on the decline in the number of publicly written comments. Such a study would certainly provide a more complete picture than the present research, and it would also offer new practical advice to restaurant managers.

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www.kombank.com

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MEDIGROUP SEE
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TEL: 011/4040-100
http://bolnica.medigroup.rs/

EUROBANK DIREKTNA a.d.
BEOGRAD, VUKA KARADŽIĆA 10
TEL: 011/206-5816
FAX: 011/302-8952
www.eurobank-direktna.rs

MEĐUNARODNI CENTAR ZA RAZVOJ FINANSIJSKOG TRŽIŠTA DOO
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FAX: 011/3085-782
www.mcentar.rs

JEDINSTVO
UŽICE, PRVOMAJSKA BB
TEL: 031/533-681
FAX: 031/533-685
www.mppjedinstvo.co.rs

НОВОСАДСКИ САЈАМ

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FAX: 021/4830-263
www.sajam.net

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TEL: 011/2022-860
www.rochesrbija.rs

POINT GROUP Int doo
BEOGRAD, FRANCUSKA 6
TEL: 011/7346 661
FAX: 011/7234 431
www.pointint.com

SAVA NEŽIVOTNO OSIGURANJE a.d.o.
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FAX: 011/3644-889
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NOVI BEOGRAD, ĐORĐA STANOJEVIĆA 16
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FAX: 011/220-7186
www.raiffeisenfuture.rs

JP SRBIJAŠUME
NOVI BEOGRAD, BULEVAR MIHAJLA PUPINA 113
TEL: 011/311-5036
FAX: 011/311-5036
www.srbijasume.rs

REPUBLIČKI FOND ZA PENZIJSKO
I INVALIDSKO OSIGURANJE
BEOGRAD, DR ALEKSANDRA KOSTIĆA 9
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FAX: 011/206-1127
www.pio.rs

SRPSKA BANKA A.D.
BEOGRAD, SAVSKA 25
TEL: 011/3607-200
www.srpskabanka.rs

TRANSNAFTA AD
NOVI SAD, Bulevar oslobođenja 5
TEL: 021/3861-000
www.transnafta.rs

VISOKA POSLOVNA ŠKOLA STRUKOVNIH STUDIJA NOVI SAD
NOVI SAD, VLADIMIRA PERIĆA VALTERA 4
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FAX: 021/334-055
www.vps.ns.ac.rs

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FAX: 011/3305-138
www.triglav.rs

JAVNO PREDUZEĆE „VOJVODINAŠUME"
PETROVARADIN, PRERADOVIĆEVA 2
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FAX: 021/431-144, lokal 217
www.www.vojvodinasume.rs

UNIVERZITET U BEOGRADU EKONOMSKI FAKULTET
BEOGRAD, KAMENIČKA 6
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FAX: 011/2639-560
www.ekof.bg.ac.rs

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FAX: +381 11 2209 900
http://www.wiener.co.rs

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NOVOSADSKI SAJAM 2022

KALENDAR PRIREDBI

28/9 - 2/10	54. MEĐUNARODNI SAJMOVI **„LORIST"** ufi Approved Event **SAJAM LOVA I RIBOLOVA** **SAJAM EKOLOGIJE** **SAJAM SPORTA**
21 - 23/10	**VIBE FACTORY FESTIVAL**
2 - 3/11	11. MEĐUNARODNI **DANI ENERGETIKE I INVESTICIJA**
17 - 19/11	53. MEĐUNARODNI **SAJAM TURIZMA**

DOGAĐAJI NA SAJMU

16 - 18/9	**AUTO MOTO BERZA**
14 - 15/10	**NOVOSADSKI OKTOBERFEST**

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