Review of Competitiveness Indices that Use Knowledge as a Criterion

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Abstract: Orientation towards a knowledge economy is visible in all development strategies of both the EU and Serbia. This article first shows the classification and systematization of the most relevant competitiveness indices, along with the participation assessment of components measuring the knowledge competitiveness within them. Secondly, the article examines and demonstrates the position of Serbia. The basic hypothesis confirmed in the article is that the position of Serbia, as a transition country, was not sufficiently analyzed, especially in terms of knowledge indicators. This developed a second hypothesis, also confirmed in this article, that the existing indicator models are not adequate for transition countries such as Serbia, and that there is a need for setting up a new revised model.

Keywords: competitiveness indices; knowledge society; knowledge as a criterion for competitiveness; Serbia

1   Introduction

In March 2010, The European Commission created a new strategy entitled "Europe 2020 – EU Strategy for Smart, Sustainable and Inclusive Growth", which points out the most important elements of the new program [1]. The top three priorities are:

- **Smart growth***: economic development based on knowledge and innovation;

- **Sustainable growth**: promoting a resource efficient, greener and more competitive economy;

- **Inclusive growth***: providing a high-employment economy delivering economic, social and territorial cohesion.

Seven key initiatives have been set for achieving these priorities, three of which are related to knowledge [2] [3] [4]. They are grouped within the first priority and are concerned with upgrading European performances in education, research and development and the digital society [5]. A number of indicators were established for monitoring the success of both Lisbon Strategy and Europe 2020, dealing with the competitiveness of European countries – the Competitiveness Indices [6]. Various organizations all over the world perform similar monitoring of global competitiveness. It is estimated that there are over 100 such indicators presented in different forms. The best known one is the Global Competitiveness Index (GCI), annually issued in a detailed report by the World Economic Forum (WEF), which includes 142 countries worldwide [7].

Following the latest round of EU enlargement that took place at the beginning of 2007, with Bulgaria and Romania becoming the 26th and 27th EU member states, the next prospective members appear to be the West Balkans region countries [8]. It is an open question, however, as to what extent the accession countries will be able to benefit from an increase in the quality of FDI that they receive due to EU membership [9]. The competitiveness dimension is especially significant in transition countries, considering that these countries experience dynamic changes in their socio-economic systems and are constantly challenged to be successfully involved in the global market race. Serbia and the countries of the West Balkans are particularly important, with their European (EU) perspective, their education tradition, their developed scientific research infrastructure and their prominent scientific results.

This article has two dimensions – descriptive and quantitative. The aim of the descriptive dimension is to conduct a systematization and a classification of these indices using knowledge as a criterion. It will present the ones related to knowledge, innovation and improvement of the citizens' education, which have their share in the overall competitiveness of one system, along with the level that a certain society has reached on its way to the "knowledge society", as the most competitive society to which the EU strives. These indices, also called knowledge society indices, will be specially analyzed from the aspect of Serbia and other transition countries, with critical assessment of their improvement. The aim of the quantitative dimension is to assess the role and participation of knowledge in competitiveness indices and the position of Serbia according to them. The results of the study of the European Competitiveness Index of Serbia, with the evaluation of the role that knowledge has in the overall ranking of Serbia, will be presented for this purpose [10] [11].

The main hypothesis of the article (H0) is that Serbia, as a transition country in the process of European integration, has not been well analyzed as regards knowledge competitiveness. The existing competitiveness indices do not provide enough information for detecting the so-called development bottlenecks. According to these indices, Serbia ranks very low, the lowest of all European countries, which results in a negative image of the country and unfavourable starting positions. The

main hypothesis generates the next one, (H1), which claims that there is a need to create a new knowledge society competitiveness index model for Serbia, which could be used for all transition countries. In this sense, the findings of this article may contribute to the development of further research of competitiveness.

2   Theoretical Background

2.1   Knowledge Society as a Development Strategy in Europe and Serbia

The term "knowledge society" was first used by Peter Drucker in 1969, while its current meaning originates from the 1990s [12]. It is grounded on knowledge – a resource different from all the others, because it is enlarged by use and share. The knowledge society is a society of mobility and has been the most competitive society in the history of mankind [13].

The knowledge society needs to have a high percentage of academically educated citizens, huge investments in education, science and research, encouraging learning through the whole life, quality and available information and communication infrastructures and services, a propulsive and competitive economy, available information and easy access to it. Many recent studies maintain that regional characteristics influence innovative performance, innovation processes and the innovation patterns of firms [14]. A knowledge society is not just a society based on applying information and communication technologies, where knowledge is the most expensive product, but a society that enforces new ways of organization, gives new roles to known systems (with the education system being one of them), and redefines and revalues human and other resources, such as space and time [15]. In short, national economies are becoming more knowledge-based economies, where productivity and growth have become more dependent on knowledge [16].

Economic development has always been knowledge-based. However, the scope and significance of knowledge to economic processes has fundamentally changed over the past number of years [17]. The ever-accelerating creation and dissemination of knowledge has led to the modern rapid and efficient production techniques, plus the increased probability of leapfrogging, which has consequently resulted in the world economy becoming increasingly more competitive. Responding to the latter situation in the transforming engines of economic development, the European Commission launched the Europe 2020 Strategy in March 2010, to exit the crisis and prepare the EU economy for the challenges of the next decade. The agreement to launch the new EU strategy creates a need for research initiatives to develop a new concept of competitiveness, with much of the research focusing on how the knowledge society and competitiveness interact [18].

Strategy Europe 2020 defines "Smart growth" as strengthening knowledge and innovation as drivers of our future growth. This requires improving the quality of education, strengthening research performance, promoting innovation and knowledge transfer, making full use of information and communication technologies, and ensuring that innovative ideas can be turned into new products and services that create growth and quality jobs and can help address European and global societal challenges [1].

As a European Union candidate country preparing for accession, Serbia must foster the competitiveness of its economy [19]. The "Serbia 2020" strategy also focuses on knowledge as the key factor of development. According to current investments in science of 0.3% of Gross Domestic Product (GDP), Serbia is far behind in comparison to Europe and developed countries of the world [20]. The vision of the scientific and technological development of Serbia is that Serbia should become an innovative country where scientists can reach European standards, contribute to the overall level of social knowledge, and improve the technological development of the economy [21] [22] [23].

2.2   The Role of Knowledge in Raising National and Regional Competitiveness

Many policy makers express serious concerns about national competitiveness [24]. In the modern-day globalised world, competitiveness has become a milestone of both advanced and developing countries [25]. Thus, if the competitiveness of a nation is properly managed, enhanced human welfare should be a key expected outcome [26]. National competitiveness is a complex concept. It involves many aspects in measurement and requires much effort in data collection [35]. National competitiveness was first defined in the research of Porter (1990) [29] as a result of a nation's ability to generate innovation in order to accomplish or keep an advantage over other nations in the key industrial branches. Competitive regions and cities are places where both companies and people want to invest and be located [28]. Competitiveness is the ability of one economy to attract and keep firms active with stable and growing market share, managing to hold and raise the standard of living to all the participants [31].

The Organization for Economic Co-operation and Development (OECD) suggested that competitiveness should be understood as "the ability of companies, industries, regions, nations or supranational regions to generate, while being and remaining exposed to international competition, a relatively high factor of income and a factor of employment levels on a sustainable basis" [32]. The World Economic Forum (WEF) defines competitiveness as "the set of institutions, policies, and factors that determine the level of productivity of a country. The level of productivity, in turn, sets the sustainable level of prosperity that can be earned by an economy" [33].

Further research by Thurow (1993) emphasizes that in knowledge-based economies nations first need to develop specialization in order to reach a world-class standard of living for its citizens [30]. In order to advance effectively towards the knowledge-based economy, countries need to invest in both the creation and the diffusion of new knowledge [27]. Also, the individual states and regions must cope with impacts of globalization process due to create conditions for their higher productivity and competitiveness [34].

In many cases, neither Serbia nor its autonomous province were included in forming the competitiveness index. In the review given in tables 1-4, it is evident that only a part of indices shown includes Serbia, but none of them include its Autonomous Province of Vojvodina. This points to the requirement that European criteria and principles are to be applied internally, so that European competitiveness indicators of Serbia and Vojvodina respectively are achieved.

The first efforts towards reaching this goal were made in 2006, when the calculation of composite parameters was performed along with the comparison of obtained results within the study of "The Competitiveness Index of AP Vojvodina", where the obtained index of Vojvodina is regarded in relation to the matching index for EU countries (EU-25). A methodology devised by Huggins and Izushi (2002) was used for calculating Vojvodina's competitiveness index, which was also applied to ranking regions in Great Britain, as well as the regions and countries of the EU and metropolitan areas worldwide [36]. 2004 data was used in determining this index [37]. The results indicate that AP Vojvodina was ranked at the last place, the 26th place, out of the 25 EU countries and Vojvodina, with the index value of 62.55.

In a repeated study, completed in 2009, the comparison was based on 2007 data [10] pertaining to 27 EU countries, and this time Serbia was included in the ranking as well as AP Vojvodina (as a region). According to these results, the position of AP Vojvodina was not changed. It still held the last, i.e. 29th place, below the 27 EU countries and the Republic of Serbia.

The above study was repeated once again in 2009, this time for EU-27 and Serbia proper, in order to determine the position of Serbia [11]. The same methodology was used, but with more recent data (year 2008). The composite index of competitiveness of European countries and Serbia shows that Serbia was still positioned at the last place, i.e. the 28th place.

However, the composite index of competitiveness of Serbia in the field of education ranks Serbia at the 19th place [11]. It is obvious that Serbia is placed in the lower half according to the level of competitiveness in the field of education, but on a par with most countries of the European Union. The average value of the composite index of competitiveness in the field of education for the 27 European Union countries amounted to 100.31, while the value for Serbia was 91.3. This positions Serbia at 91% of the EU average, which can be considered a very good result. The composite index of competitiveness in the field of creativity ranks

Serbia at the 27th place, just above Romania. It is interesting to note that according to the number of patent requests per million Serbian citizens, Serbia is ranked in the tenth place, which again confirms in practice the assumption that the population of Serbia is very innovative. Despite this fact, Serbia is at the last place, the 28th place, according to the number of employees in research and development per 100 economically active citizens. This means that innovators and inventors in Serbia have not found their place in the real sector, and knowledge is not sufficiently used or patented, although it is generally known that investment in research and development is one of the basic requirements for creating and raising competitiveness.

3 Methodology

The presented methodology of work is related to its descriptive and quantitative dimension. Methods of synthesis and analysis were applied in the descriptive dimension of research. Theoretical research includes scientific description, classification, explanations and prediction, and methods appropriate to these segments of scientific research, e.g. compilation, classification, comparison and similar methods. The research results are presented in the analytical tables and charts, but also in the actual existing examples. Secondary data was used, mainly official studies and reports of various indices of competitiveness, available on the Internet. The position of Serbia, according to these indices, is highlighted.

The quantitative dimension of research relates to assessment of the role and participation of knowledge in competitiveness indices. Estimates which are made in paragraph 4.2 are based on percentage share of the parameters of knowledge in composite indicators.

As the first competitiveness research in Serbia and Vojvodina, the presentation of the methodology and results of studies on European Competitiveness Index of Serbia and AP Vojvodina are presented [37] [30].

In order to obtain comparable data, a conversion of all variables (input data) has been made to obtain the average for all that equal 100:

$$s_{ij} = \frac{x_{ij}}{\overline{x}_j} \cdot 100 \qquad\qquad (1)$$

where the symbols are:

i   ordinal number of the region/country

j   ordinal number of indicators

x_{ij} value of the j-indicator of the i-indicator of the region/country

s_{ij} standardized value of the j- indicator, indicators of the i-region, country

$\overline{x}_j$ average value of j-indicator

A factor analysis was performed over the set of converted variables, where the choice of the number of factors is done on the basis of this Catell's test according to the linear diagram of distinctive values. The actual orientation of factors in the factor space is arbitrary, so it is reasonable to make a rotation of factor values to obtain the most appropriate structure for the practical interpretation [30].

The study used a standard computer varimax rotation technology. Based on the rotated factors, the dimensions obtained indicate a link between factors and original indicators. It also provides sub-composite indicators f_{ik} (for i-region/country and k-factor), the points that belong to individual cases; in this case the regions, according to various factors.

The formation of the composite index methodology was carried out by Huggins-Izushi, using Data Envelopment analysis, which is a special application of linear programming methods that maximize the weighted sum of factor points f_{ik} for individual regions with weight p_{ik}:

$$p_{i1}f_{i1} + ... + p_{iq}f_{iq} = z_i \rightarrow \max \tag{2}$$

where the total number of factors, k=1 ,..., q at limitations

$$\begin{aligned} p_{i1}f_{i1} + ... + p_{iq}f_{iq} = z_{ii} \leq 1, \quad &\forall i \\ p_{ik} > 0, \quad &\forall k \end{aligned} \tag{3}$$

The procedure returns the value of weights that gives the maximized weighted sum of factor points z_{ii} for a given region, and for the same set of weights the weighted sum of factors for all other regions is calculated.

In this manner, a set of weighted factor sums is obtained from which the geometric average value is calculated as a composite indicator, i.e. a general competitiveness index for a given region or country. Due to the standardization of the obtained DEA indicators, the geometric average of deviation is multiplied by the converted indicators (square root of variance), more precisely

$$\sigma_j = \sqrt{\frac{\sum_{i=1}^{m}(x_{ij} - \bar{x}_j)}{n}} \tag{4}$$

and then 100 is added. The final result represents the index with an average of 100, with reverberation of real deviations between regions/countries [30].

4   Data and Results

As this article involves two dimensions of research, this section will primarily present results and discussion about the descriptive part. Afterwards, we can see the quantitative dimension of the research, which demonstrates the role and participation of knowledge component within competitiveness indices and position of Serbia according to these.

4.1   Analysis of Existing Competitiveness Indices with Participation of the Knowledge Component

The knowledge-based economy has become a major trend in international society in the 21st Century [38]. This article deals with 17 indices that define the competitiveness of a certain economy and involve the knowledge parameters. The authors propose that they can be classified into the following four categories:

1)   Competitiveness Indices

2)   Knowledge Competitiveness Indices

3)   Innovation Competitiveness Indices

4)   Information Technology Competitiveness Indices

In tables 1-4 below, the key indices are displayed according to the above categories and basic characteristics: the name of the index; the name of the institution which issues it; the beginning year of publication; the frequency of publishing; the highest ranked countries in the latest report; the number of countries ranked; the number of variables (the relationship between quantitative and qualitative data); the relationship of the weight coefficient, the number and name of sub-indices (the number of spaces/the number of parameters); and the position of Serbia and the percentage ratio to other countries.

The Competitiveness Indices, as the most general category, including the analyzed IMD World Competitiveness Index (Yearbook), Global Competitiveness Index – GCI [7] [40], Index of Economic Freedom and European Competitiveness Index, contains a small portion of knowledge components, except The European Competitiveness Index in which 3 out of 5 elements are related to the role of knowledge. The Index of Economic Freedom [53] does not contain any knowledge component. The highest ranked countries according to these indices are Switzerland, Singapore, Hong Kong, the USA and Scandinavian countries. Serbia is not ranked according to the IMD World Competitiveness Index (Yearbook) and the European Competitiveness Index [41], whereas according to the Global Competitiveness Index – GCI and the Index of Economic Freedom, it is ranked in the third quarter of countries. Thus, it is clear that Serbia is not analyzed adequately when it comes to knowledge components.

Economic activities associated with the production and utilization of information and knowledge has become an engine of economic growth [42]. The Knowledge Competitiveness Indices, as a narrower category that includes the analyzed Knowledge-based Economy Index (former New Economy Index) [43], the Metropolitan New Economy Index [43], the Knowledge Economy Index (KEI) and Knowledge Index (KI) and the World Knowledge Competitiveness Index (WKCI) [54], contain a great portion of knowledge components. The highest ranked countries and regions according to these indices are the USA and Scandinavian countries. It is typical for these types of studies not to be published regularly, but rather periodically. Also they analyze not only the Knowledge

Economy Index (KEI) and the Knowledge Index (KI), but the regional knowledge competitiveness as well. Out of the above mentioned indices, Serbia is ranked only according to the Knowledge Economy index (KEI) and Knowledge Index (KI), and is placed in the second quarter of countries [55]. Due to the fact that the mentioned index is published periodically (1995, 2000, 2008), we can again conclude that Serbia is inadequately analyzed in terms of the knowledge component.

The Innovativeness Competitiveness Indices refer to the ability of a single economy to introduce innovation and innovative changes into the environment [45] [46]. Innovative capacity is the capacity to generate new knowledge and transform it into new products, processes and forms of organization [47] [48]. The Innovativeness Competitiveness Indices, with the analyzed Global Innovation Index [56], the Innovation Union Scoreboard [57], the Atlantic Century Benchmarking EU & US Innovation and competitiveness [49], the BCG Report entitled "The Innovation Imperative in Manufacturing" [50], and Report: Innovation: Transforming the way business creates [58] are oriented towards innovativeness as one of knowledge components, while other knowledge components are less analyzed. Today, many developing countries around the world are oriented towards innovation as a means of spurring regional economic development and wealth creation while preserving national competitiveness [59]. The highest ranking countries and regions appearing among these indices are Singapore, Japan, South Korea and Scandinavian countries. Out of the mentioned surveys, Serbia is ranked in 3 out of 5 of these indices, one of which is a single study. This means that Serbia is inadequately analyzed in terms of the innovation component.

The Information technology Competitiveness indices, as a specialized category, involving the Global Information Technology Report – Networked Readiness Index [51] [52], the Information Society Index [60] and Measuring the Information Society – The ICT Development Index [61], are committed to the usage of information technologies as one of the knowledge components, while other components are less analyzed. The highest ranked countries and regions are Scandinavian countries, South Korea and the USA. Serbia is ranked only according to the Global Information Technology Report – Networked Readiness Index and by the ICT Development Index. This means that Serbia is inadequately analyzed in terms of the usage of information technologies.

Based on the analysis of different groups of indices that include parameters of knowledge, one can observe a very poor ranking of Serbia, and its absence in case of several studies. The main hypothesis (H0), that Serbia as a transition country in the process of European integration is insufficiently analyzed in terms of knowledge competitiveness, has been evaluated as correct. The existing competitiveness indices do not provide enough information to help detect the so-called development bottlenecks. It is evident that the ranking of Serbia is very low according to the knowledge indices.

Table 1

Indices of competitiveness

Index name	Name of the institution releasing the index and the start year of the release	Frequency of publication	Best ranked countries in the latest report	Number of countries ranked	Number of variables (quantitative / qualitative data ratio)	Ratio of weighted coefficients	Sub-composite indices and number of fields/number of parameters	Serbia's rank and % rank among other countries
IMD World Competitiveness Index (Yearbook)	International Institute for Management Development – IMD, since 1989.	Annually	1. Hong Kong 2. USA 3. Switzerland 4. Singapore 5. Sweden Report: 2012	59	329 (219/110)	quantitative - 1 qualitative – 0,64	1. Economic performance (5/76) 2. Government Efficiency (5/71) 3. Business Efficiency (5/67) 4. Infrastructure (5/113)	Serbia is not ranked
Global Competitiveness Index (formerly: Global Competitiveness Report)	World Economic Forum since 1979. (upgraded in 2004)	Annually	1. Switzerland 2. Singapore 3. Sweden 4. Finland 5. USA Report: 2011/2012	142	111 (35/76)	Not same for all countries – dependent on the level of development	1. Basic requirements (4 fields/46) 2. Efficiency enhancers (6 fields/49) 3. Innovation and sophistication factors (2 fields/16)	95/142 (2011/2012) (66.9%, in the 3rd quarter among states)
Index of Economic Freedom	The Heritage Foundation and The Wall Street Journal since 1995.	Annually	1. Hong Kong 2. Singapore 3. Australia 4. New Zealand 5. Switzerland Report: 2012	179	Each sub-composite index uses a different methodology for its formation	Each sub-composite index is weighted equally	1. Business freedom 2. Trade freedom 3. Fiscal freedom 4. Government size 5. Monetary freedom 6. Investment size 7. Financial freedom 8. Property rights 9. Freedom from corruption 10. Labour freedom	98/179 (2012) (54.7%, in the 3rd quarter among states)

| European Competitiveness Index | Robert Huggins Association | Periodically (2004, 2006.) | 1. Finland 2. Luxembourg 3. Switzerland 4. Norway 5. Denmark Report: 2006 | 27 states and 118 regions | 36 quantitative data | Each sub-composite index is weighted equally | Creativity Economic Performance Infrastructure and Accessibility Knowledge Employment Education | Serbia is not ranked |

Source: the authors

Table 2

Knowledge indices of competitiveness

Index name	Name of the institution releasing the index and the start year of the release	Frequency of publication	Best ranked countries	Number of countries ranked	Number of variables (quantitative/qualitative data ratio)	Ratio of weighted coefficients	Sub-composite indices and number of fields/number of parameters	Serbia's rank and % rank among other countries
Knowledge-based Economy Index (formerly: New Economy Index) **since 2001.**	Milken Institute, University of California	Two times study	n/a	n/a	12	n/a	n/a	Serbia and Europe are not ranked
The Metropolitan New Economy Index 2001.	Progressive Policy Institute (PPI)	Single study	1. San Francisco 2. Austin 3. Seattle 4. Gainesville 5. San Diego Report: 2001.	All the states of the USA	21 (total)	2/1,5/3/4/4 (each field has different weight)	1. Knowledge jobs 2. Globalization 3. Economic dynamism and competition 4. Transformation into digital economy 5. Innovation capacity	Serbia and Europe are not ranked

| Knowledge Economy Index (KEI) and Knowledge Index (KI) | The World Bank Institute's Knowledge for Development Program (K4D) Since 1995. | Periodically (1995, 2000, 2008) | 1. Denmark 2. Sweden 3. Finland 4. Netherlands 5. Norway

Report: 2008. | 146 | 83 (total) | Equal weight | 1. Economic and institutional regime 2. Education and skills 3. Information and communication infrastructure 4. Innovation system | 53/146 (0.36% in the second quarter) |
| World Knowledge Competitiveness Index (WKCI) | Centre for International Competitiveness | Periodically (five releases), Latest: 2008. | 1.San Jose-Sunnyvale-Santa Clara, US 2.Boston-Cambridge-Quincy, US 3.Hartford, US 4.Bridgeport-Stamford-Norwalk, US 5.San Francisco-Oakland-Fremont, US Report: 2008. | 145 world regions | 19 quantitative | Equal weight | 1. Capital components 2. Knowledge economy production 3. Regional economy outputs (including economic knowledge outputs) 4. Sustainability | Serbia is not ranked |

Source: the authors

Table 3

Innovativeness indices of competitiveness

Index name	Name of the institution releasing the index and the start year of the release	Frequency of publication	Best ranked countries	Number of countries ranked	Number of variables (quantitative/qualitative data ratio)	Ratio of weighted coefficients	Sub-composite indices and number of fields/number of parameters	Serbia's rank and % rank among other countries
Global Innovation Index	Confederation of Indian Industry along with	Annually	1. Switzerland 2. Sweden 3. Singapore	125	60 (36/24) (divided into input and output	Equal weight	Inputs: 1. Institutions, 2. Human Capacity	55/125 (0.44 in the 4th quarter

	INSEAD (The Business School for the World) Since 2008.		4. Hong Kong 5. Finland Report: 2011.		parameters)		3. General and ICT 4. Infrastructure, Market Sophistication 5. Business Sophistication Outputs: 1. Scientific Outputs 2. Creative Outputs and Well-Being.	among states)
Innovation Union Scoreboard since 2010, (formerly European Innovation Scoreboard)	Maastricht Economic and social Research and training centre on Innovation and Technology (UNU-MERIT)	Annual ly	1. Sweden 2. Denmark 3. Finland 4. Germany 5. UK Report: 2011.	34 Europea n countries and 6 world countries	25 (quantitative data, divided into input parameters, firm activities and output parameters)	unweighted average of the re-scaled scores for all indicators	Inputs: 1. Human resources Human resources 2. Open research systems 3. Finance and support 4. Firm activities 5. Firm investments 6. Linkages & entrepreneurship 7. Intellectual assets Outputs: 1. Innovators 2. Economic effects	29/34 (0.85 in the 4th quarter among states)
The Atlantic Century Benchmarking EU & US Innovation and Competitiveness	The Information Technology and Innovation Foundation	Annual ly	1. Singapore 2. Finland 3. Sweden 4. USA 5. S. Korea Report: 2011.	40	16 (quantitative data)	10/20/12/20 /13/25 (each field has different weight)	1. Human capital 2. Innovation capacity 3. Entrepreneurship 4. Information technology (IT) infrastructure 5. Economic policy 6. Economic performance	Serbia is not ranked
The BCG Report: The Innovation Imperative in Manufacturing	Boston Consulting Group, National Association of Manufactures, and the US-based Manufacturing Institute	Single study 2009.	1. Singapore 2. S. Korea 3. Switzerland 4. Iceland 5. Ireland	110 world countries + 50 USA states	n/a	n/a	Inputs: 1. Fiscal policy 2. Business performance 3. Other policies Outputs: 1. R&D results 2. Innovation environment 3. Public impact of innovation	Serbia is not ranked
Report: Innovation:	Economist Intelligence Unit	Single study	1. Japan 2. Switzerland	82	18 (6/12)	7/3 (each field has	1. Direct innovation inputs 2. Innovation environment	67/81 (in the 4th

Transforming the way business creates		2007.	3. USA 4. Sweden 5. Finland			different weight)		quarter among states)

Source: the authors

Table 4

Information technology indices of competitiveness

Index name	Name of the institution releasing the index and the start year of the release	Frequency of publication	Best ranked countries	Number of countries ranked	Number of variables (hard/qualitative data ratio)	Ratio of weighted coefficients	Sub-composite indices and number of fields/number of parameters	Serbia's rank and % ratio among other countries
The Global Information Technology Report - Networked Readiness Index (using their methodology)	World Economic Forum since 2001. Centre for International Development (CID) at Harvard University	Annually	1. Sweden 2. Singapore 3. Finland 3. Denmark 4. Switzerland Report: 2012.	142	53 (25/28)	Equal weight	1. Environment 2. Readiness 3. Usage 4. Impact	85/133 (in the 3rd quarter among states)
Information Society Index - payable	n/a	n/a	n/a	53	15	n/a	n/a	n/a
Measuring the Information Society – The ICT Development Index	Market Information and Statistics Division within the Telecommunication Development Bureau of ITU	Annually	1. S. Korea 2. Sweden 3. Island 4. Denmark 5. Finland Report: 2011 (data for 2010.)	154	11 (quantitative data)	40/40/20	1. ICT access 2. ICT use 3. ICT skills	50/152 (in the 2nd quarter)

Source: the authors

4.2   The Role and Participation of Knowledge in the Competitiveness Indices and the Position of Serbia

It can be seen from the above mentioned division of indices which include the parameters of knowledge that they can be treated differently in the case of the Competitiveness Index. 60% of overall indicators appear in the case of European Competitiveness Index; in the case of Global Competitiveness Index they are present in 25%, while they are not mentioned at all in the case of the Index of Economic Freedom. By the analysis of a group of indices treated as Knowledge Competitiveness Indices, one can see that the results are not updated enough and that they are mainly focused on the area of the USA.

The data presented in this article show that education is one of the few development opportunities of Serbia, and that it can be a real source of increased competitiveness of its economy. However, in addition to education, the knowledge society also requires a willingness to develop entrepreneurial spirit, promotes innovation and encourages creativity. It is therefore necessary to invest more in this area as well as to recognize their importance by public and private initiatives.

In most cases, Serbia is ranked in the third quarter of the world's states, while this is even worse if compared with the countries of Europe, where it is always placed almost at the bottom. However, very few studies analyze the ranked countries according to individual factors, and it is difficult to determine the specific reasons for the poor positioning. Also, most of the presented indices are made for the developed countries and do not reflect enough the real situation in Serbia as a country in transition. Hence, the great importance of a few national studies that analyze the position of Serbia is recognized. In the European Competitiveness Index [11], Serbia is placed in the second half according to the level of competitiveness in the field of education, and on a par with most countries of the European Union. This suggests not only a good position of Serbia in this segment, but also that Serbia's competitiveness would be far better if the knowledge and education aspects were valued more. Given that education is a key factor in the knowledge society, it can be concluded that in order to monitor the progress of Serbia and other transition countries, it is necessary to redefine the weighting factors for calculation of competitiveness indices, i.e. to redefine the share of certain areas, but also the number of input parameters in this field. The second hypothesis (H1), which claims that there is a compelling need for the formation of a new competitiveness index of the knowledge society for Serbia, and which could also be a model for all countries in transition, is accepted. In this sense, the findings of this article may contribute to developing further research on competitiveness.

Conclusions

Commitment to knowledge economy and the development of technological and scientific capacity are evident in all basic development strategies in the European Union and Serbia. Due to the development of the information revolution and the increasing availability of information, the further progress of social community is not entirely dependent on purely economic factors. Knowledge, innovativeness, enterprise, adoption of new technologies etc. also become the key requirements for the growth of national competitiveness. Numerous indices reflecting the competitiveness of both national and regional economies are defined for the purpose of following the progress in this area.

In order to conduct comprehensive research, this article reviewed two dimensions – descriptive and quantitative. In this context, the object of the research of the descriptive part of the study was the analysis of the most relevant indices of competitiveness available, while the evaluation of the proportion of components measuring the knowledge competitiveness within the indices was presented in the quantitative part. Another object of research was the evaluation of the position of Serbia as a potential candidate country for the EU membership according to all indices analyzed.

It can be concluded from the set hypotheses that Serbia is inadequately analyzed regarding knowledge competitiveness, that the existing indices in which Serbia is analyzed do not offer enough information on knowledge development in Serbia, and also that Serbia is at the very bottom in comparison to European and world countries.

Also, the analysis implies that existing models of knowledge are not appropriate for countries in transition, such as Serbia. In order to achieve the set goals, it is necessary to make a new revised model to better indicate specific problems, for example the development bottlenecks in the development towards the achievement of a knowledge society. The key parameters of this new model would be knowledge, innovation, education, use of IT technology and development of knowledge jobs.

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