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*Đorđe Mitrović**

BROADBAND ADOPTION, DIGITAL DIVIDE, AND THE GLOBAL ECONOMIC COMPETITIVENESS OF WESTERN BALKAN COUNTRIES

ABSTRACT: *The existing variation in economic performance between countries is significantly affected by the level, diffusion, and use of different types of information and communication technology. In the last several years economic competitiveness increasingly depends on broadband availability and the adoption, use, and speed of this technology. Broadband access to the internet fosters economic growth and development and increases a country's global competitiveness. This technology could have a big impact on the competitive advantage of Western Balkan countries because they currently experience a large digital divide, both within countries (between regions, urban and rural areas, different vulnerable groups, etc.) and with EU countries. The purpose of the paper is to analyse the current level and dynamics of the digital divide in Western Balkan countries using the Broadband Achievement Index (BAI), the Data Envelopment Analysis (DEA)-based model, the Global Competitiveness Index (GCI), the Corruption Perception Index (CPI), and cross-country methodology. This paper measures and compares Western Balkan countries' current level of broadband adoption and their position on the evolutionary path towards closing the existing economic and digital gap with EU countries. Comparative analysis of calculated BAI data values, GCI, and CPI shows that Western Balkan countries belong to the 'laggard' group regarding their broadband achievement and global economic competitiveness. The values of the calculated BAI sub-indexes in this paper indicate the strong and weak sides of the corresponding aspects of broadband technology implementation and give directions for setting further priorities for political intervention, not only in the building of information society but also in the improvement of the economic competitiveness of Western Balkan countries.*

KEY WORDS: *digital divide, broadband, economic growth, competiveness*

JEL CLASSIFICATION: E02, O11, O33, O38, O43, O47

* University of Belgrade, Faculty of Economics, Serbia, E-mail: djordjem@ekof.bg.ac.rs

1. INTRODUCTION – BROADBAND ECONOMY CONTEXT

In traditional economies, the developed, wealthy countries and the poor, developing countries have differed in terms of the availability of raw materials, physical capital (machines, factories, roads), and human capital (skilled labour) that are essential for economic development. In the new economy, developed and developing countries are polarized in terms of access to ideas, knowledge, and information and communication technology (ICT). Poor countries lack the ideas and knowledge that are used in developed industrial countries to create economic value. Gaps in terms of access to raw materials and knowledge that exist between countries do not exclude each other, but rather are complementary. The gap that exists between countries, regions, and individuals in terms of access to ICT is called the digital divide or digital gap (Van Dijk and Hacker 2003).

Today, the difference in countries' economic performance and their competitiveness as information societies largely depends on broadband availability and the adoption, use, and speed of this technology. Broadband access to the internet fosters economic growth and development and increases a country's global competitiveness. According to Qiang and Rossotto (2009), in high-income economies during the period 1980-2002 an increase of 100 broadband subscribers resulted in an increase in GDP per capita of 1.21 percentage point (all others factors being equal), while in developing countries the increase in GDP per capita was 1.38 percentage points. Koutroumpis (2009) found that in 2002-2007 in OECD countries, 10.54% of the country's average growth was attributable to broadband infrastructure and the average impact of broadband infrastructure on GDP was equal to 0.24%. The higher the broadband penetration, the greater the impact of broadband infrastructure on economic growth. Czernich et al. (2011) observed the relation between broadband penetration rate and GDP growth in OECD countries in 1996-2007. They concluded that after the introduction of broadband, the country's GDP per capita was 2.7%–3.9% higher on average than before its introduction. According to this research, "an increase in the broadband penetration rate by 10 percentage points raised annual growth in per capita GDP by 0.9–1.5 percentage points."

The link between investment in broadband infrastructure and productivity, especially in small and medium-sized businesses, is not immediately visible after adopting new broadband internet connectivity. Colombo et al. (2013) argue that the adoption of basic broadband applications does not have any positive effect on SMEs' productivity; nor does the adoption of advanced broadband applications appear to produce a sizable productivity gain for SMEs. Using a sample of Italian firms in 1998-2004, the authors found that productivity gains were only pronounced when SMEs a) adopted advanced broadband applications that were relevant to their industry and b) the adoption of advanced applications was combined with extensive strategic and organisational changes in the SMEs' way of doing business. However, this technology increases the competitiveness of the economy by facilitating the development of new products and services, new production processes and business models, and new ways in which to organize economic activity. Using a sample of German firms, Bertschek et al. (2013) showed that although broadband internet has no impact on labour productivity it has a positive and significant impact on firms' innovativeness. The use of broadband also gives small businesses access to larger markets than before.

Broadband access also contributes to improving overall social welfare: it reduces the cost of searching, collecting, and processing information, making it easier to compare prices and encouraging and enhancing competition and improving the quality of products. Gruber et al. (2014) demonstrate that for the EU the total economic benefits from investment in broadband infrastructure are 32% higher than the cost. Kolko (2012) found a positive link between higher penetration of broadband technology and local economic growth. However, there is no evidence that broadband availability reduces the unemployment rate (Czernich 2014). The impact of local broadband infrastructure development on economic activity as measured by local employment rates is positive, but economically rather limited (Fabritz, 2013). Similarly, Whitacre et al. (2014) concluded that between 2001 and 2010 in US rural areas there was a positive link between the level of broadband adoption and income growth and a negative relationship between the level of broadband adoption and unemployment growth.

There is also research that encompasses broadband characteristics other than simple broadband penetration and its impact on economic growth, like the speed of data transmission, type of broadband connection, and quality of broadband service and service providers. Kongaut and Bohlin (2014) analysed the relationship between broadband speed and economic growth. They used a sample of high- and low-income OECD countries and data for broadband speed and GDP from the period 2008-2012. The main conclusion of this research is that broadband speed contributes positively to economic outputs such as GDP and that the effects of broadband speed are greater in lower income countries. Despite the presence of several limitations in this analysis, the authors concluded that a 10% increase in broadband speed leads to a 0.8% increase in GDP per capita. Jung (2014) analysed the impact of broadband on regional productivity in Brazil and concluded that faster download speeds and critical mass to account for network externalities enhance the economic impact of broadband.

In order to compare the competitiveness of the Western Balkan economies, which differ according to their readiness and current level of use of broadband internet access, we will use the Broadband Achievement Index. This index shows the degree of diffusion of broadband internet technologies in each country, which will make it possible to compare the current levels of each country's digital divide. The index values will allow us to rank Western Balkan countries according to the level of use of broadband internet access, and thus according to their competitive advantage. The index takes into account factors that are specific to each country in order to achieve maximum objectivity and avoid value judgements. The European Commission developed the Broadband Performance Index (BPI) in 2008 to compare the degree of broadband internet adoption in EU countries. The BPI included indicators such as broadband adoption in rural areas, prices, speed, use of advanced services, and socio-economic factors. However, due to a lack of statistical data necessary to construct this index for Western Balkan countries and to a methodology that includes value (subjective) assessment of the weight of individual components for each country, we decided to use the Broadband Achievement Index instead.

The purpose of the present paper is to analyse the current levels and dynamics of digital divide in Western Balkan countries using the Broadband Achievement Index (BAI), Data Envelopment Analysis (DEA)-based model, the Global Competitiveness index (GCI), the Corruption Perception Index (CPI), and cross-country methodology. We try to measure each country's current level of broadband adoption in relation to other countries and to provide insight into a country's policies that specifically target closing the existing digital gap with EU countries. This paper is structured as follows. After the introduction and discussion of the economic context of the measurement of achieved broadband level in Section 1, Section 2 explains BAI calculation methodology and the total BAI and sub-indexes are calculated for Western Balkan countries. Section 3 discusses the main results and explains the calculated values of the BAI regarding the priorities in a country's policies that aim to decrease the digital divide and increase global economic competitiveness. Section 4 presents the main conclusions and recommendations for further research.

2. BAI – DATA AND METHODOLOGY

The level of development of broadband internet access and countries' global economic competitiveness, based on its level of internet access, will be analysed for the group of Western Balkan countries (Croatia, Serbia, Macedonia, Albania, Montenegro, and Bosnia and Herzegovina). The relative position of these countries will be determined in relation to EU countries, plus Iceland and Turkey.

2.1. The components (sub-indexes) of the BAI

The basic methodology for calculating the BAI is presented in Badasyan et al. 2011. The authors calculated the original index for individual U.S. states, in order to rank them mutually in terms of the achieved level of digital divide. For this study we adapted the methodology for the available statistical data on availability and level of use of broadband internet access in the Western Balkans. The BAI is composed of five individual sub-indexes, which are the key indicators of the development and adoption of broadband internet access in a particular country. The following sub-indexes form the BAI: broadband availability, broadband adoption, broadband affordability, broadband speed, and ICT skills.

For each sub-index, a certain number of indicators are introduced. An overview of the recommended indicators is given in Table 1. Raw data values are given in Appendix 1.

Table 1. Statistical broadband indicators forming the BAI and sub-indexes

Main index	Sub-index	Indicator used
Broadband Achievement Index (BAI)	Broadband Availability (BAV)	BA1 – Percentage of households with internet access
		BA2 – Fixed lines per 100 population
		BA3 – 3G mobile subscriptions per 100 population
		BA4 – Investment in electronic communications (EUR)
	Broadband Adoption (BAD)	BD1 – xDSL penetration rate per population
		BD2 – Cable modem penetration rate per population
		BD3 – Dedicated data cards/wireless modems per 100 population
	Broadband Affordability (BAF)	BF1 – HHI based on mobile telephony market share by revenues
		BF2 – Fixed-broadband prices as a percentage of GNI p.c.
		BF3 – Mobile-broadband prices as a % of GNI p.c.
	Broadband Speed (BSP)	BS1 – Percentage of fixed broadband connections with speed in interval 1 Mbps – 2 Mbps downstream
		BS2 – Percentage of fixed broadband connections with speed in interval 2 Mbps – 10 Mbps downstream
		BS3 - Percentage of fixed broadband connections with speed > 10 Mbps downstream
	ICT Skills (BIS)	BI1 – Gross enrolment ratio – Secondary
		BI2 – Gross enrolment ratio – Tertiary
		BI3 – Adult literacy rate

Source: Adapted from (Badasyan et al. 2011).

2.2 Determination of the weights for individual indicators

The calculation of the BAI implies the determination of its individual sub-index weights. The simplest way is to give equal importance and weight to all sub-indexes so that, for example, the individual indicators within the broadband availability sub-index would have a weight of 0.25, whereas in the case of the broadband adoption sub-index it would be 0.33. However, this method of determining weights would only be suitable when the opportunity costs of moving from one technology to another (for example, from a cable modem to mobile broadband) is the same in all countries, which is, of course, far from the reality (Badasyan et al. 2011).

Therefore, in accordance with the methodology proposed in Badasyan et al. (2011), we decided on the Data Envelopment Analysis (DEA) methodology. The DEA methodology constructs an 'efficiency frontier' based on each country's individual data and using mathematical linear programming, which determines the best practice by measuring the relative position of each of the countries in terms of the value of the set of observed indicators.

In order to apply the DEA methodology and determine the weight, the values of all the individual indicators must be normalized. This is very important because different indicators are not expressed in the same direction. The raw values are normalized in an interval between 0 and 1 – the higher indicator value represents better performance of given country in the broadband area analysed. In the following we explain the way in which the values of the individual indicators are normalized.

If higher values of the relevant sub-indicator *i* for a generic country *j* mean better performance (for example, a higher mobile wireless adoption rate means that this country performs better than other countries in the analysed group), each value x_{ij} is transformed in

$$y_{ij} = \frac{x_{ij} - \min(x_i)}{\max(x_i) - \min(x_i)} \tag{1}$$

where $min\ (x_i)$ and $max\ (x_i)$ are the minimum and the maximum values of x_i across all countries. In this way, the normalised values y_{ij} have values lying between 0 *(laggard,* $x_{ij}=min(x_i)$*)* and 1 *(leader,* $x_{ij}=max(x_i)$*).*

On the other hand, if higher values of the relevant sub-indicator *i* for a generic country *j* means worse performance (for example, higher subscription charges for broadband services means that this country performs worse than other countries in the analysed group), each value x_{ij} is transformed in

$$y_{ij} = \frac{\max(x_i) - x_{ij}}{\max(x_i) - \min(x_i)} \tag{2}$$

The normalised values y_{ij} have values lying between 0 *(laggard, x_{ij}=max(x_i))* and 1 *(leader, x_{ij}=min(x_i))*.

There are several different opinions in the literature on what is the optimal size of the data set to complete DEA analysis. Our analysis uses the rule of thumb proposed in Golany and Roll (1989), that the number of analysed countries should be at least twice the number of indicators considered. The normalized values for the 16 broadband indicators are calculated for 35 countries: Austria (AT), Belgium (BE), Bulgaria (BG), Czech (CZ), Denmark (DK), Estonia (EE), Greece (EL), Spain (ES), France (FR), Croatia (HR), Ireland (IE), Italy (IT), Cyprus (CY), Latvia (LV), Lithuania (LT), Luxembourg (LU), Hungary (HU), Malta (MT), Netherlands (NL), Poland (PL), Portugal (PT), Romania (RO), Slovenia (SI), Slovakia (SK), Finland (FI), Sweden (SE), United Kingdom (UK), FYR Macedonia (MC), Montenegro (ME), Serbia (SR), Turkey (TU), Albania (AL), Bosnia and Herzegovina (BH), and Iceland (IC). The raw data for the analysis was taken from Eurostat and national statistics offices of the countries analysed (all values are for 2013). Calculated normalized numerical values are given in Table 2.

We then determined the BAI sub-index using the DEA methodology. The BAI is calculated as the weight sum of the corresponding individual indicators, where the weights are endogenously determined by mathematical linear programming so as to obtain the maximum possible value of the BAI sub-index for each individual country. In this way, a certain combination of the weight for the individual indicators within a country's sub-index is the best possible combination – there is no other combination of weights that will enable a country to achieve a greater BAI sub-index value. In other words, we consider the most favourable situation for each country.

According to Zhou et al. (2006 and 2007), Cherchye et al. (2006 and 2008), and OECD (2008), the basic DEA model assumed that sub-indexes' *CI* (composite indexes) for each country *j* (*j=0,1,...,m*) are calculated as the weighted sum of *n* indicators where the weights are endogenously determined to maximize the value of the composite index for each country. Optimal weights should be determined by solving the next linear programming problem:

Table 2. Normalized values of the individual indicators

Country	BA1	BA2	BA3	BA4	BD1	BD2	BD3	BF1	BF2	BF3	BS1	BS2	BS3	BI1	BI2	BI3
BE	0.772	0.608	0.278	0.166	0.478	0.907	0.049	0.500	0.880	0.857	0.025	0.316	0.711	0.514	0.697	0.880
BG	0.406	0.319	0.685	0.036	0.062	0.135	0.146	0.361	0.559	0.744	0.012	0.164	0.852	0.221	0.589	0.800
CZ	0.669	0.155	0.520	0.078	0.196	0.287	0.074	0.528	0.733	0.736	0.106	0.679	0.346	0.293	0.609	0.880
DK	0.949	0.530	0.475	0.115	0.640	0.617	0.250	0.944	0.868	0.945	0.056	0.335	0.677	0.874	0.813	0.880
DE	0.879	0.962	0.374	0.874	0.877	0.258	0.083	0.944	0.832	0.877	0.229	0.642	0.314	0.390	0.576	0.880
EE	0.776	0.444	0.857	0.015	0.303	0.328	0.209	0.444	0.703	0.862	0.639	0.569	0.162	0.510	0.775	1.000
EL	0.776	0.741	0.348	0.097	0.641	0.000	0.039	0.361	0.772	0.766	0.000	0.496	0.565	0.527	0.458	0.880
ES	0.630	0.596	0.230	0.491	0.565	0.270	0.064	0.722	0.751	0.701	0.054	0.487	0.544	1.000	0.879	0.733
FR	0.796	1.000	0.131	1.000	1.000	0.126	0.061	0.611	0.907	0.910	0.336	0.242	0.613	0.564	0.531	0.880
HR	0.558	0.524	0.303	0.038	0.489	0.113	0.093	0.250	0.664	0.756	0.103	0.998	0.028	0.331	0.575	0.893
IE	0.805	0.663	0.182	0.107	0.454	0.346	0.164	0.708	0.961	0.952	0.218	0.679	0.287	0.758	0.702	0.573
IT	0.618	0.468	0.848	0.816	0.638	0.000	0.191	0.833	0.862	0.922	0.046	1.000	0.092	0.378	0.587	0.880
CY	0.559	0.394	0.091	0.011	0.642	0.181	0.049	0.375	0.859	0.807	0.150	0.949	0.083	0.267	0.367	0.840
LV	0.655	0.249	0.583	0.005	0.150	0.081	0.093	0.583	0.847	0.842	0.081	0.432	0.578	0.316	0.621	1.000
LT	0.559	0.195	0.758	0.008	0.106	0.084	0.110	0.444	0.643	0.932	0.204	0.425	0.520	0.486	0.738	0.987
LU	0.974	0.793	0.726	0.015	0.874	0.187	0.090	0.236	0.952	0.922	0.006	0.746	0.339	0.384	0.000	0.267
HU	0.654	0.380	0.343	0.062	0.188	0.591	0.064	0.389	0.330	0.817	0.226	0.442	0.493	0.397	0.548	0.933
MT	0.755	0.861	0.502	0.002	0.439	0.840	0.059	0.000	0.811	0.832	0.005	0.850	0.247	0.081	0.305	0.000
NL	0.975	0.633	0.311	0.369	0.629	1.000	0.089	0.347	0.877	0.864	0.071	0.405	0.608	0.981	0.783	0.880
AT	0.784	0.570	0.816	0.072	0.501	0.461	0.231	0.778	0.955	1.000	0.046	0.805	0.265	0.316	0.718	0.880
PL	0.659	0.058	0.742	0.179	0.183	0.280	0.131	1.000	0.802	0.887	0.497	0.568	0.238	0.316	0.728	0.987
PT	0.526	0.637	0.303	0.103	0.270	0.506	0.119	0.500	0.658	0.734	0.036	0.188	0.819	0.630	0.672	0.280
RO	0.467	0.217	0.215	0.080	0.053	0.108	0.077	0.806	0.799	0.882	0.041	0.371	0.653	0.260	0.442	0.827
SI	0.711	0.546	0.270	0.021	0.362	0.392	0.026	0.167	0.751	0.824	0.322	0.573	0.326	0.314	0.898	0.973
SK	0.743	0.135	0.314	0.040	0.153	0.130	0.097	0.417	0.598	0.618	0.203	0.683	0.292	0.238	0.489	0.947
FI	0.900	0.058	1.000	0.086	0.613	0.292	1.000	0.569	0.913	0.950	0.237	0.522	0.416	0.523	1.000	0.880
SE	0.947	0.594	0.438	0.140	0.471	0.383	0.306	0.722	0.910	0.955	0.120	0.468	0.526	0.331	0.686	0.880
UK	0.889	0.841	0.431	0.663	0.756	0.392	0.101	0.861	1.000	0.877	0.000	0.305	0.734	0.269	0.579	0.373
MC	0.520	0.177	0.249	0.004	0.158	0.310	0.000	0.194	0.174	0.628	0.038	0.457	0.577	0.008	0.269	0.680
ME	0.424	0.327	0.855	0.000	0.264	0.035	0.154	0.417	0.207	0.307	0.719	0.626	0.059	0.176	0.494	0.800
SR	0.327	0.568	0.460	0.032	0.210	0.274	0.044	0.417	0.000	0.606	0.709	0.711	0.000	0.192	0.453	0.773
TU	0.342	0.151	0.037	0.321	0.200	0.040	0.024	0.222	0.766	0.744	0.247	0.874	0.098	0.076	0.678	0.333
AL	0.000	0.000	0.444	0.005	0.000	0.072	0.016	0.139	0.273	0.000	0.625	0.678	0.010	0.000	0.494	0.587
BH	0.320	0.243	0.000	0.013	0.131	0.198	0.029	0.472	0.541	0.023	1.000	0.513	0.000	0.143	0.258	0.773
IC	1.000	0.735	0.267	0.002	0.544	0.000	0.201	0.750	0.883	0.972	0.000	0.000	1.000	0.541	0.830	0.880

Source: Calculated by author.

$$CI_j = \max \sum_{i=0}^{n} y_{ij} w_{ij} \tag{3}$$

where

$$\sum_{i=0}^{n} y_{ij} w_{ik} \leq 1 \tag{4}$$

and

$$w_{ij} \geq 0 \tag{5}$$

for any $i=0,1,...,n,$ any $j=0,1,...,m,$ and any $k=0,1,...,m.$

The resulting sub-indexes range between zero (the worst possible performance) and 1 (the best possible performance – benchmark). The optimal calculated set of weights provides the best position for the given country in relation to all other analysed countries. Any other weighting profile would worsen the relative position of the given country.

In order to avoid methodological difficulties related to the DEA base model, to improve discriminating power between countries receiving a composite BAI value of 1 and to reduce the number of linear programming models to solve (i.e., to have only one weight vector as the output), we decided to use the extended MCDA (multi criteria decision analysis)-DEA model proposed in Hatefi and Torabi (2010). This model can be formulated as follows:

$$\min M \tag{6}$$

$$M = \max\{d_j, j = 1, 2, ..., m\} \tag{7}$$

$$M - d_j \geq 0, j = 1, 2, ..., m \tag{8}$$

$$\sum_{i=1}^{n} w_i y_{ij} + d_j = 1, j = 1,2,\ldots,m \tag{9}$$

$$w_i \geq \varepsilon \tag{10}$$

$$d_j \geq 0 \tag{11}$$

for any $i=0,1,...,n,$ any $j=0,1,...,m,$ and any $k=0,1,...,m.$

d_j is the deviation of the efficiency of country j from unity when it is under evaluation. The composite sub-index of the jth country is calculated by $C_j=1-d_j$, for any $j=1, 2, \ldots, m$. Epsilon (**ε**) is a non-Archimedean infinitesimal value which present the lower limit of common weights. In order to increase the discriminating power of the model we set this value at 0.00001, so none of the indicators can have zero weight value. In our calculation of the BAI we only faced the problem of the existence of compensability among individual indicators in calculating the

BSP sub-index. This means that lower values in some individual indicators can be compensated by higher values in others. In the literature there are multiple proposals of how to avoid the compensability assumption, for example Vidoli and Mazziota (2013) and Fusco (2015). To calculate the BSP sub-index we used the simplest solution – introducing exogenous weight constraints. So, for BS1 the weight is equal to 0.2; for BS2 the weight is 0.3, and for BS3 it is 0.5. We gave higher importance to faster broadband technology.

The calculated numerical values of the individual broadband sub-indexes and total BAI for each country are given in Table 3.

Table 3. Calculated values of the broadband sub-indexes

Country	BAI sub-indexes					BAI
	BAV	BAD	BAF	BSP	BIS	
BE	0.683	0.875	0.778	0.776	0.820	0.897
BG	0.605	0.223	0.526	0.888	0.656	0.663
CZ	0.656	0.321	0.696	0.476	0.713	0.674
DK	0.851	0.778	0.963	0.744	0.980	**1.000**
DE	**1.000**	0.379	0.938	0.426	0.721	0.836
EE	0.904	0.460	0.652	0.225	0.903	0.742
EL	0.722	0.098	0.651	0.668	0.691	0.667
ES	0.654	0.342	0.785	0.641	**1.000**	0.794
FR	0.872	0.263	0.844	0.636	0.741	0.799
HR	0.536	0.216	0.541	0.188	0.709	0.518
IE	0.649	0.463	0.919	0.408	0.784	0.765
IT	0.998	0.201	0.912	0.292	0.723	0.767
CY	0.410	0.262	0.710	0.263	0.558	0.529
LV	0.676	0.150	0.793	0.662	0.767	0.720
LT	0.699	0.160	0.622	0.591	0.871	0.686
LU	**1.000**	0.321	0.713	0.492	0.191	0.667
HU	0.592	0.578	0.410	0.566	0.725	0.646
MT	0.780	0.820	0.527	0.420	0.191	0.642
NL	0.859	**1.000**	0.713	0.687	0.991	0.965
AT	0.920	0.614	0.948	0.426	0.780	0.877
PL	0.766	0.353	0.944	0.313	0.822	0.770
PT	0.549	0.551	0.641	0.858	0.634	0.737
RO	0.409	0.152	0.861	0.728	0.594	0.650
SI	0.603	0.399	0.561	0.416	0.911	0.665
SK	0.586	0.196	0.563	0.415	0.654	0.568
FI	**1.000**	**1.000**	0.832	0.504	0.991	1.000
SE	0.847	0.592	0.895	0.614	0.766	0.874
UK	0.967	0.494	**1.000**	0.799	0.519	0.903
MC	0.431	0.287	0.226	0.666	0.381	0.444
ME	0.689	0.164	0.316	0.117	0.591	0.445
SR	0.489	0.292	0.216	0.085	0.564	0.378
TU	0.300	0.074	0.588	0.255	0.510	0.416
AL	0.214	0.074	0.216	0.037	0.473	0.235
BH	0.214	0.206	0.512	0.000	0.442	0.333
IC	0.784	0.197	0.892	**1.000**	0.902	0.882

Source: Calculated by author.

3. BAI – THE INTERPRETATION OF CALCULATED VALUES

The ranking of countries according to the calculated BAI values are given in Table 4 and Figure 1.

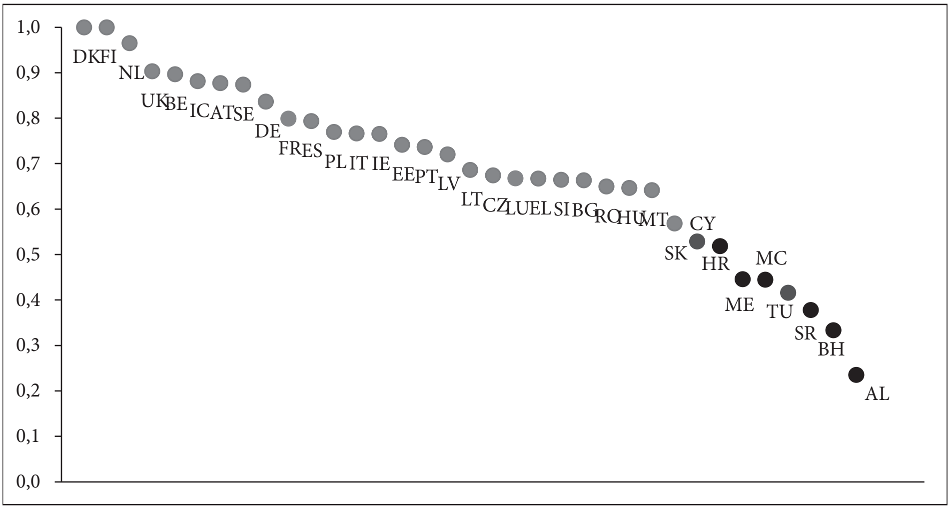
Table 4. Ranking of countries according to the calculated values of total and individual BAI sub-indexes

Country	BAI sub-indexes					BAI
	BAV	BAD	BAF	BSP	BIS	
DK	10	5	2	6	4	1
FI	1	1	12	17	2	1
NL	9	1	17	8	3	3
UK	5	10	1	4	29	4
BE	18	3	15	5	10	5
IC	12	27	9	1	7	6
AT	6	6	3	21	12	7
SE	11	7	8	14	14	8
DE	1	14	5	20	18	9
FR	8	21	11	13	15	10
ES	21	16	14	12	1	11
PL	14	15	4	26	9	12
IT	4	26	7	27	17	13
IE	22	11	6	25	11	14
EE	7	12	20	30	6	15
PT	27	9	22	3	24	16
LV	19	32	13	11	13	17
LT	16	30	23	15	8	18
CZ	20	17	19	19	19	19
LU	1	18	16	18	35	20
EL	15	33	21	9	21	21
SI	24	13	26	23	5	22
BG	23	23	29	2	22	23
RO	32	31	10	7	25	24
HU	25	8	31	16	16	25
MT	13	4	28	22	34	26
SK	26	28	25	24	23	27
CY	31	22	18	28	28	28
HR	**28**	**24**	**27**	**31**	**20**	**29**
ME	**17**	**29**	**32**	**32**	**26**	**30**
MC	**30**	**20**	**33**	**10**	**33**	**31**
TU	33	34	24	29	30	32
SR	**29**	**19**	**35**	**33**	**27**	**33**
BH	**34**	**25**	**30**	**35**	**32**	**34**
AL	**35**	**34**	**34**	**34**	**31**	**35**

Source: Calculated by author.

Croatia is the leading country in the Western Balkans in terms of implementation of broadband internet access, followed by Montenegro, Macedonia, and Serbia. Serbia is in a better position than Croatia when it comes to the adoption and implementation of broadband internet access (infrastructure development), but is worse in terms of availability and paying ability or affordability of these services for residents and businesses. Montenegro is in a better position than Serbia when it comes to service price (affordability), different modalities of use of broadband internet access services, and available internet speeds, but its position was worsened by the degree of adoption of this technology by users. Albania and Bosnia and Herzegovina occupy the last place according to the value of the total BAI, primarily owing to uneven broadband access, worst infrastructure, and poor degree of adoption of broadband internet by the user.

Figure 1. The ranking of countries according to total BAI



Source: Calculated by author.

The above sub-indexes indicate precisely the weak points in broadband technology application in each country, or those aspects that need to be paid special attention in the economic and political development of an information society and when overcoming the digital divide. In Table 5 the calculated weighted values for each indicator are presented for the case of Serbia.

Table 5. Calculated weighted values of individual broadband indicators for Serbia

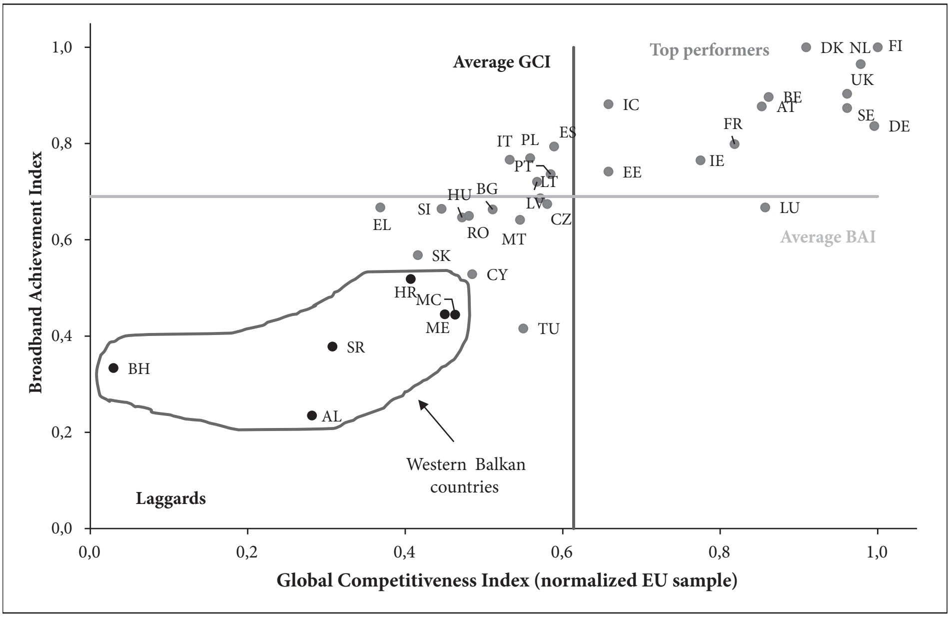
BAV (0.127)				BAD (0.058)			BAF (0.062)			BSP (0.017)			BIS (0.113)		
BA1	**BA2**	**BA3**	**BA4**	**BD1**	**BD2**	**BD3**	**BF1**	**BF2**	**BF3**	**BS1**	**BS2**	**BS3**	**BI1**	**BI2**	**BI3**
0.179	0.083	0.220	0.007	0.024	0.238	0.030	0.175	0.000	0.042	0.142	0.213	0.000	0.050	0.252	0.261

Source: Calculated by author.

Concerning broadband availability in Serbia, more policy attention should be paid to investment in electronic communications (indicator BA4). The most urgent areas requiring policy attention regarding broadband adoption are increasing the penetration of both fixed broadband technologies like xDSL (indicator BD1) and mobile/wireless modem technologies (indicator BD3). In the field of broadband affordability the Serbian government needs to pay more attention to the institutional, regulatory, and legal framework, which is inadequate: state regulations impose burdens on businesses, individuals, and households that discourage broadband adoption and make related services less affordable. For example, according to indicator BF2 (fixed-broadband prices as a percentage of GNI p.c.), Serbia ranks last in the total analysed sample. The predominant market share of fixed broadband technology remains in the hands of the state-owned telecom company. The weakest aspect of Serbian broadband infrastructure is broadband speed. Very few users have an internet connection speed faster than 10 Mbps (indicator BS3).

For economic purposes it is important to analyse if broadband achievement influences global economic competitiveness in Western Balkan countries. Therefore a simple comparison of the calculated values of the BAI and the Global Competitiveness Index (GCI) is particularly interesting. Pearson's correlation test indicates that there is a positive correlation between the two sets of index data (BAI and GCI). According to the results, Pearson's correlation coefficient equals 0.84516. A brief look at Figure 1 and the calculated data values shows that Western Balkan countries belong to the 'laggard' group regarding broadband achievement and global economic competitiveness. As is to be expected, the top performers are the advanced EU countries, except Luxembourg. The BAI value for this country is below average because of the country's weak ICT skills – the projected gross enrolment in tertiary education is only 18.4%.

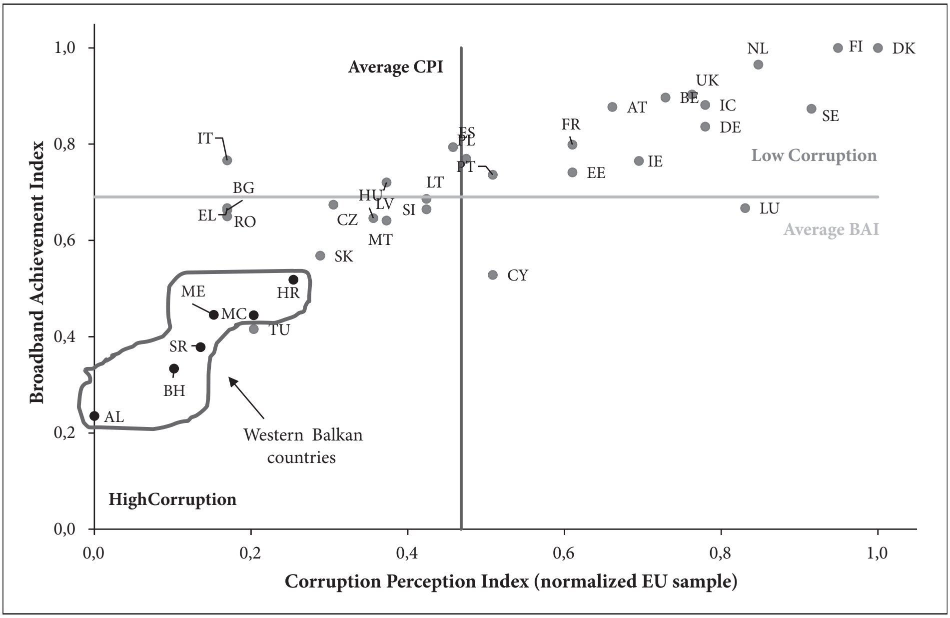
Figure 2. BAI and GCI for EU and Western Balkan countries



Source: Calculated by author.

It seems that the main obstacle to greater use of broadband technology in Western Balkan countries (and thus these countries' increased competitive advantage based on broadband technology) is not insufficient funds, as is often alleged, but rather non-economic and institutional factors such as corruption, deficit in the rule of law, and a lack of awareness of the need for more rapid development of an information society. Pearson's correlation test indicates that there is also a positive correlation between the BAI and the Corruption Perception Index (CPI). In this case the Pearson's correlation coefficient is 0.83710. Figure 3 presents the relative position of Western Balkan countries in relation to EU countries in the two dimensions of broadband achievement and corruption. Western Balkan countries belong to group of countries with low broadband achievement and high perceived corruption. This is the signal that the institutions required for an information society are weak and underdeveloped.

Figure 3. BAI and CPI for the EU and Western Balkan countries



Source: Calculated by author.

In the literature, a country's institutional framework is often given as a key factor that enhances or impedes the application of broadband internet in the economy. It determines how the government organizes and encourages the development and application of broadband strategies. For example, a properly set up institutional framework in developing economies (even if economic activity slows down or is in a recession) can ensure that the use of broadband will not radically decline in comparison to developed economies. If the government does not have an active policy to encourage the use of broadband, the gap between developing and developed economies will grow, which is exactly what is shown in Figure 3. But, as Clark (2003 p.28) states, "Policymakers must guard against 'technology fundamentalism', or the idea that investment in ICT within the new economy is the only need of developing countries and that it be given priority over all other competing development needs".

The information society is not just something to be passively accepted, but a process that should be actively utilized at the right time, which of course is not possible for all countries. Those that are not able to actively embrace the information economy will have to accept the fact that another barrier is being created between them and developed countries and the existing gap is increasing. The significance that the digital divide will have for the further development of the world economy can be compared to the importance of the divide between the literate and illiterate. On the other hand, Western Balkan countries that have poorly developed infrastructure to serve information technology (for example, Albania) can find themselves in a 'technology trap'. The information economy cannot develop in countries that do not invest in the creation and continuous improvement of broadband and computer networks. It is well known that undeveloped and developing countries are far behind developed countries when it comes to internet and communications infrastructure. In such countries, yields from information technology and its associated infrastructure are very small (Piatkowski 2002, p.12). In addition, undeveloped countries still suffer from traditional forms of poverty (lack of basic infrastructure such as waste water treatment plants, solid and hazardous waste treatment, and adequate health and education services). This raises the question of whether these countries should divert already scarce resources to close the digital divide (Clark 2003, p.15).

An interesting and important topic for further research is whether there is a positive correlation between BAI sub-indexes showing broadband availability, adoption, and affordability and the indexes that indicate the degree of digital divide in Western Balkan countries. This can be analysed by using DIDIX and TDI indexes, as proposed by Hüsing and Selhofer (2004), Vehovar (2006), and Howard et al. (2010). In the literature there is an example of analysis showing that there is a negative correlation between the level of digital divide and accessibility (affordability) of broadband technology (Badasyan et al. 2011). This is to be expected, because increasing competition in broadband services leads to a reduction in price and greater availability for end users. However, increased competition is expressed more in urban than in rural areas, and therefore, although there might be an increase in the affordability of these services, at the same time the digital divide might increase, resulting in a lower value in the digital divide sub-index.

4. CONCLUSION

Increasingly, broadband internet access is influencing business efficiency and competitiveness and therefore the overall competitiveness of an economy in the global market. Broadband internet access can have a big impact on the competitive advantage of countries like the Western Balkans that have a large digital divide. In the surveyed countries the digital divide exists both within country (between regions, urban and rural areas, different vulnerable groups, etc.) and between these and developed countries. Our analysis shows that the BAI is a good tool for classifying goals and priorities when designing development policies in the Western Balkans countries and evaluating achievement (by comparing to other countries in the region and the European Union). Such policies require investment in new ICT, ongoing education of the population, research and development processes in businesses, scientific institutions, and universities, and an improved legal and institutional framework regarding intellectual property rights. Based on recent research and using methodology that takes into account broadband availability, adoption, affordability, speed, and coverage, this contribution provides a comprehensive picture of the global competitiveness of Western Balkan countries and their position on the evolutionary path towards the high economic performance of advanced EU countries. The values of the calculated sub-indexes indicate the strong and weak sides of the corresponding aspects of broadband technology implementation and help set further priorities for political intervention, not only in building an information society but also in improving the country's competitive advantage.

The methodology presented in this paper is only basic. When calculating the BAI we did not take into account the degree of broadband technology implementation in businesses, as the main generators of a country's competitive advantage. Also, countries like the US, Canada, Japan, South Korea, Russia, and China should be included in the analysis in order to place Western Balkan countries in a global context. Finally, it is necessary to accurately determine the level of digital divide in the surveyed countries. Unfortunately, in this study, the lack of statistical data for Western Balkan countries, at the regional and urban-rural levels and as regards vulnerable groups, prevented us from doing so.

REFERENCES

Badasyan, N., Shideler, D. & Silva, S. (2011). Broadband Achievement Index: Moving Beyond Availability. *Telecommunications Policy,* 35 (11), pp. 933–950. DOI: 10.1016/j.telpol.2011.09.004

Bertschek, I., Cerquera, D. & Klein, G. J. (2013). More bits – more bucks? Measuring the impact of broadband internet on firm performance. *Information Economics and Policy,* 25 (3), pp. 190–203. DOI: 10.1016/j.infoecopol.2012.11.002

Cherchye, L., Moesen W., Rogge, N., & Puyenbroeck, T. V. (2007). An introduction to 'Benefit of doubt' composite indicators. *Social Indicators Research,* 82 (1), pp. 111-145. DOI: 10.1007/s11205-006-9029-7

Cherchye, L., Moesen W., Rogge, N., Puyenbroeck, T. V., Saisana, M., Saltelli, A., Liska R. & Tarantola, S. (2008). Creating Composite Indicators with DEA and Robustness Analysis: The Case of Technology Achievement Index. *The Journal of Operational Research Society,* 59 (2), pp. 239-251. DOI: 10.1057/palgrave.jors.2602445

Clark, M. (2003). *E-development? Development and the New Economy.* (WIDER Policy Brief № 7). UNU WIDER. Retrieved from http://www.wider.unu.edu/publications/policy-briefs/en_GB/pb7/_files/78807311701704847/default/ pb7.pdf

Colombo, M., Croce, A. & Grilli, L. (2013). ICT services and small businesses' productivity gains: An analysis of the adoption of broadband Internet technology. *Information Economics and Policy,* 25 (3), pp. 171–189. DOI: 10.1016/j.infoecopol.2012.11.001

Czernich, N., Falck, O., Kretschmer, T. & Woessmann L. (2011). Broadband infrastructure and economic growth. *The Economic Journal,* 121 (552), pp. 505–532. DOI: 10.1111/j.1468-0297.2011.02420.x

European Commission (2014). *Monitoring regulatory and market development for electronic communications and information society services in Enlargement Countries, Report 4 – Annex.* DOI 10.2759/43116. Retrieved from http://www.cullen-international.com/asset/?location=/content/assets/research/studies/2011/11/final-report-4-annex-february -2014.pdf/final-report-4-annex-february-2014.pdf

Fabritz, N. (2013). *The Impact of Broadband on Economic Activity in Rural Areas: Evidence from German Municipalities.* (Ifo Working Paper No. 166). Retrieved from http://www.cesifo-group.de/portal/page/portal/DocBase_Content/WP/WP-Ifo_Working_Papers/wp-ifo-2013/IfoWorkingPaper-166.pdf

Fusco, E. (2015). Enhancing non-compensatory composite indicators: A directional proposal. *European Journal of Operational Research,* 242 (2), pp. 620-630. DOI: 10.1016/j.ejor.2014.10.017

Golany, B. & Roll, Y. (1989). An Application Procedure for DEA. *Omega,* 17 (3), pp. 237-250. DOI: 10.1016/0305-0483(89)90029-7

Gruber, H., Hätönen, J. & Koutroumpis, P. (2014). Broadband access in the EU: An assessment of future economic benefits. *Telecommunications Policy,* 38 (11), pp. 1046–1058. DOI: 10.1016/j.telpol.2014.06.007

Hatefi, S. M. & Torabi, S. A. (2010). A common weight MCDA–DEA approach to construct composite indicators. *Ecological Economics,* 70 (1), pp. 114–120. DOI: 10.1016/j.ecolecon.2010.08.014

Howard, P.N., Anderson, K., Busch, L. & Nafus, D. (2009). Sizing Up Information Societies: Toward a Better Metric for the Cultures of ICT Adoption. *The Information Society,* 25 (3), pp. 208-219. DOI: 10.1080/01972240902848948

Hüsing, T. and Selhofer, H. (2004). DIDIX: A Digital Divide Index for Measuring Inequality in IT Diffusion. *IT & Society,* 1 (7), pp. 21–38.

Jung, J. (2014). *Regional inequalities in the impact of broadband on productivity: Evidence from Brazil.* (MPRA Paper No. 56177), University Library of Munich, Germany. Retrieved from http://mpra.ub.uni-muenchen.de/56177/1/MPRA_paper_56177.pdf

Kolko, J. (2012). Broadband and local growth. *Journal of Urban Economics,* 71 (1), pp. 100–113. DOI: 10.1016/j.jue.2011.07.004

Kongaut, C. & Bohlin, E. (2014). *Impact of broadband speed on economic outputs: An empirical study of OECD countries.* 25th European Regional Conference of the International Telecommunications Society (ITS), Brussels, Belgium, 22-25 June 2014. Retrieved from http://econstor.eu/bitstream/10419/101415/1/795234465.pdf

Koutroumpis, P. (2009). The economic impact of broadband on growth: A simultaneous approach. *Telecommunications Policy,* 33 (9), pp. 471-485. DOI: 10.1016/j.telpol.2009.07.004

Mitrovic, Dj., Pokrajac, S. & Tanaskovic, S. (2012). Does global economic crisis increase digital divide in developing countries? The Case of Serbia. *In* B. Cerovic et al. (Eds.), *From Global Crisis to Economic Growth. Which Way to Take? – Volume 1* (pp. 363-387). Belgrade: CID – Faculty of Economics.

OECD (2008). *Handbook on Constructing Composite Indicators – METHODOLOGY AND USER GUIDE.* Retrieved from http://www.oecd.org/std/42495745.pdf

Piatkowski, M. (2002). *The Institutional Infrastructure of the "New economy" and Catching-up Potential of Post-Socialist Countries.* (TIGER Working Paper № 16), Warsaw. Retrieved from http://tiger.edu.pl/publikacje/TWPNo16.pdf

Qiang, C. Z. & Rossotto, C. M. (2009). Economic Impacts of Broadband. In *Information and Communications for Development 2009: Extending Reach and Increasing Impact* (pp. 35–50). Washington, DC: World Bank.

Van Dijk, J. & Hacker, K. (2003). The Digital Divide as a Complex and Dynamic Phenomenon. *Information Society,* 19 (4), pp. 315-326. DOI: 10.1080/01972240309487

Vehovar, V., Sicherl, P., Hüsing, T. & Dolnicar, V. (2006). Methodological Challenges of Digital Divide Measurements. *Information Society,* 22 (5), pp. 279-290. DOI: 10.1080/01972240600904076

Vidoli,F. & Mazziotta, C. (2013). Robust weighted composite indicators by means of frontier methods with an application to European infrastructure endowment. *Statistica Applicata – Italian Journal of Applied Statistics,* 23 (2), pp. 259–282.

Zhou, P., Ang B.W. & Poh, K.L. (2006). Comparing aggregating methods for constructing the composite environmental index: An objective measure. *Ecological Economics*, 59 (3), pp. 305-311. DOI: 10.1016/j.ecolecon.2005.10.018

Zhou, P., Ang B.W. & Poh, K.L. (2007). A mathematical programming approach to constructing composite indicators. *Ecological Economics*, 62 (2), pp. 291-297. DOI: 10.1016/j.ecolecon.2006.12.020

Whitacre, B., Gallardo, R. & Strover, S. (2014). Broadband's contribution to economic growth in rural areas: Moving towards a causal relationship. *Telecommunications Policy,* 38 (11), pp. 1011–1023. DOI: 10.1016/j.telpol.2014.05.005

Appendix 1. Raw values data used to calculate BAI

Country	Broadband Availability				Broadband Adoption			Broadband Affordability		
	BA1	BA2	BA3	BA4	BD1	BD2	BD3	BF1	BF2	BF3
	Households with Internet Access (%)	Fixed lines per 100 population	Mobile subscriptions per 100 population	Investment in electronic services (000 €)	xDSL penetration rate per population (%)	Cable modem penetration rate per population (%)	Dedicated data cards/ wireless modems per 100 population	Mobile Telephony -HHI based on market share by revenues	Fixed-broadband prices as a percentage of GNI p.c.	Mobile-broadband prices, postpaid computer base 1Gb as a % of GNI p.c.
BE	80.0	41.3	110.9	1,233,000	16.98	15.21	4.30	3.450	0.88	0.70
BG	53.7	26.9	145.2	280,397	4.80	2.27	11.10	3.700	1.95	1.15
CZ	72.6	18.7	131.3	591,546	8.72	4.81	6.10	3.400	1.37	1.18
DK	92.7	37.4	127.5	862,298	21.71	10.35	18.40	2.650	0.92	0.35
DE	87.7	58.9	119	6,400,000	28.64	4.33	6.70	2.650	1.04	0.62
EE	80.3	33.1	159.7	131,000	11.84	5.50	15.50	3.550	1.47	0.68
EL	80.3	47.9	116.8	728,511	21.74	0.00	3.60	3.700	1.24	1.06
ES	69.8	40.7	106.9	3,600,000	19.52	4.53	5.40	3.050	1.31	1.32
FR	81.7	60.8	98.5	7,317,000	32.24	2.11	5.20	3.250	0.79	0.49
HR	64.6	37.1	113	299,441	17.30	1.90	7.40	3.900	1.60	1.10
IE	82.4	44.0	102.8	804,424	16.27	5.80	12.40	3.075	0.61	0.32
IT	68.9	34.3	158.9	5,973,334	21.66	0.00	14.30	2.850	0.94	0.44
CY	64.7	30.6	95.2	102,271	21.76	3.04	4.30	3.675	0.95	0.90
LV	71.6	23.4	136.6	59,200	7.38	1.35	7.40	3.300	0.99	0.76
LT	64.7	20.7	151.3	76,980	6.09	1.41	8.60	3.550	1.67	0.40
LU	94.5	50.5	148.6	133,000	28.55	3.13	7.20	3.925	0.64	0.44
HU	71.5	29.9	116.4	473,563	8.50	9.90	5.40	3.650	2.71	0.86
MT	78.8	53.9	129.8	34,000	15.82	14.09	5.00	4.350	1.11	0.80
NL	94.6	42.5	113.7	2,710,000	21.40	16.77	7.10	3.725	0.89	0.67
AT	80.9	39.4	156.2	546,255	17.65	7.74	17.10	2.950	0.63	0.13
PL	71.9	13.9	150	1,324,906	8.35	4.70	10.10	2.550	1.14	0.58
PT	62.3	42.7	113	768,685	10.90	8.49	9.20	3.450	1.62	1.19
RO	58.1	21.8	105.6	604,679	4.54	1.82	6.30	2.900	1.15	0.60
SI	75.6	38.2	110.2	173,000	13.58	6.58	2.70	4.050	1.31	0.83
SK	77.9	17.7	113.9	309,000	7.45	2.19	7.70	3.600	1.82	1.65
FI	89.2	13.9	171.7	650,000	20.94	4.90	70.90	3.325	0.77	0.33
SE	92.6	40.6	124.4	1,041,467	16.76	6.41	22.30	3.050	0.78	0.31
UK	88.4	52.9	123.8	4,857,742	25.10	6.57	8.00	2.800	0.48	0.62
MC	61.9	19.8	108.5	47,941	7.61	5.19	0.90	4.000	3.23	1.61
ME	55.0	27.3	159.5	20,348	10.72	0.59	11.70	3.600	3.12	2.89
SR	48.0	39.3	126.2	252,485	9.14	4.59	4.00	3.600	3.81	1.70
TU	49.1	18.5	90.6	2,364,552	8.85	0.67	2.60	3.950	1.26	1.15
AL	24.5	11.0	124.9	58,174	2.99	1.22	2.00	4.100	2.90	4.11
BH	47.5	23.1	87.5	113,042	6.83	3.32	2.90	3.500	2.01	4.02
IC	96.4	47.6	110	36,784	18.90	0.00	15.00	3.000	0.87	0.24

Appendix 1. Raw values data used to calculate BAI (cont.)

Country	Broadband Speed			ICT Skills		
	BS1	BS2	BS3	BI1	BI2	BI3
	% of fixed broadband connections with speed in interval 1 Mbps - 2 Mbps downstream	% of fixed broadband connections with speed 2 - 10 Mbps downstream	% of fixed broadband connections with speed > 10 Mbps downstream	% of the population of official secondary education age	% of the total population of tertiary education age	Adult literacy rate
BE	1.30	27.96	70.75	107.3	70.8	99.0
BG	0.65	14.52	84.83	93.1	62.7	98.4
CZ	5.58	59.96	34.45	96.6	64.2	99.0
DK	2.96	29.63	67.41	124.7	79.6	99.0
DE	12.02	56.73	31.24	101.3	61.7	99.0
EE	33.52	50.29	16.19	107.1	76.7	99.9
EL	0.00	43.80	56.20	107.9	52.8	99.0
ES	2.83	43.00	54.17	130.8	84.6	97.9
FR	17.62	21.39	60.98	109.7	58.3	99.0
HR	5.42	88.20	2.77	98.4	61.6	99.1
IE	11.43	60.01	28.56	119.1	71.2	96.7
IT	2.44	88.35	9.22	100.7	62.5	99.0
CY	7.87	83.88	8.25	95.3	45.9	98.7
LV	4.26	38.21	57.53	97.7	65.1	99.9
LT	10.69	37.58	51.74	105.9	73.9	99.8
LU	0.34	65.88	33.78	101.0	18.2	94.4
HU	11.87	39.09	49.04	101.6	59.6	99.4
MT	0.29	75.11	24.60	86.3	41.2	92.4
NL	3.71	35.80	60.49	129.9	77.3	99.0
AT	2.41	71.15	26.43	97.7	72.4	99.0
PL	26.10	50.20	23.71	97.7	73.2	99.8
PT	1.88	16.61	81.51	112.9	68.9	94.5
RO	2.16	32.82	65.02	95.0	51.6	98.6
SI	16.92	50.65	32.43	97.6	86.0	99.7
SK	10.63	60.30	29.07	93.9	55.1	99.5
FI	12.43	46.16	41.41	107.7	93.7	99.0
SE	6.29	41.30	52.41	98.4	70.0	99.0
UK	0.00	26.90	73.10	95.4	61.9	95.2
MC	1.98	40.34	57.40	82.8	38.5	97.5
ME	37.72	55.31	5.94	90.9	55.5	98.4
SR	37.18	62.79	0.02	91.7	52.4	98.2
TU	12.96	77.26	9.74	86.1	69.4	94.9
AL	32.82	59.86	1.06	82.4	55.5	96.8
BH	52.47	45.31	0.05	89.3	37.7	98.2
IC	0.00	0.00	99.53	108.6	80.9	99.0

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