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DEVELOPING COMPOSITE READINESS AND INTENSITY INDICES FOR MEASURING B2C E-COMMERCE IN THE EUROPEAN UNION

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ABSTRACT. *There are strategic goals set for the various areas of e-commerce in the EU; however, there is no unified comprehensive methodology on how to evaluate e-commerce in individual economies as a whole. At this time, there is only one simple composite index for tracking countries' readiness for B2C e-commerce. There is no composite index available to evaluate B2C e-commerce intensity. In this article, we propose two composite indices to track and measure B2C e-commerce in the EU, both designed using the TOPSIS method. The benefit of the proposed composite indices is primarily the ability to assess B2C e-commerce in the various member states in the wider context of the EU. The values of B2C e-commerce indices indicate that there is still a large untapped potential for B2C e-commerce in all of the EU, not only in relatively less developed economies, but also in countries with high-performing economies.*

KEYWORDS: measuring B2C e-commerce, e-commerce readiness, e-commerce intensity, TOPSIS, European Union.

JEL classification: L81, M21, C43.

Introduction

E-commerce is becoming an increasingly significant factor in the prosperity and competitiveness of both individual businesses and entire economies. Countries, international organizations and the European Union devote an increasing amount of attention to e-commerce, which is reflected in the tracking and evaluation of e-commerce and the setting of strategic goals in e-commerce-related areas. E-commerce is evaluated based on various criteria and it is not uncommon for an economy that receives a high rating according to one criterion to achieve worse results based on a different criterion. This fact results in difficulties in evaluating e-commerce in a particular economy as well as in international comparisons, and presents limitations in identifying obstacles and driving forces as well as the adoption of appropriate measures aimed at supporting e-commerce and utilizing its potential.

This article focuses on one of the basic categories of e-commerce, specifically B2C e-commerce. The objective of this paper is to propose comprehensive composite indices for tracking and measuring B2C e-commerce in the European Union, and with their help evaluate the level of EU member states' engagement in B2C e-commerce.

In this paper, we also answer the following research questions: What are the specific features of the environment for B2C e-commerce in the EU? What are the positions of EU member states in terms of the key prerequisites for the development of B2C e-commerce? What are the positions of EU member states in terms of B2C e-commerce intensity? Is there a strong correlation between the use of B2C e-commerce and the prerequisites for B2C e-commerce on the part of individual EU member states? The answers to these questions can contribute to the evaluation of B2C e-commerce in EU member states.

This paper is divided into five sections. The first section presents the theoretical basis for tracking B2C e-commerce, including an overview of existing composite B2C e-commerce indices. The second section focuses on the specifics of the EU in terms of B2C e-commerce factors. The third section presents the empirical research procedure and results. In the empirical research, we used the TOPSIS method (the method of multi-criteria evaluation of alternatives) and statistical testing of the defined hypothesis. The output of the empirical part is the ranking of EU member states in terms of their readiness for B2C e-commerce and B2C e-commerce intensity. The fourth section contains a commentary on the research results and a discussion. The paper concludes with research limitations along with a suggestion for further research.

1. Theoretical Basis for Tracking B2C E-commerce

A necessary condition for e-commerce tracking and comparison on an international scale is a unified and internationally accepted definition of it. Eurostat and EU member states use the definition of e-commerce put forth by the OECD: *“An e-commerce transaction is the sale or purchase of goods or services, conducted over computer networks by methods specifically designed for the purpose of receiving or placing of orders. The goods or services*

are ordered by those methods, but the payment and the ultimate delivery of the goods or services do not have to be conducted online. An e-commerce transaction can be between enterprises, households, individuals, governments, and other public or private organisations.” (OECD, 2011, p.72; Eurostat, 2015).

That is also how e-commerce is understood in this paper. However, there are also other definitions of e-commerce out there (e.g., Dearlove, 1994; Harrington, Reed, 1995; Kalakota, Whinston, 1997, p.3), and differences in defining e-commerce persist to this day. For example, there are narrower or wider definitions of e-commerce (Lee, 2012, p.4; Turban *et al.*, 2015, p.7), or those according to which e-commerce equals e-business (e.g., Schneider, 2015, p.6).

B2C (business-to-consumer) e-commerce is one of the basic categories of e-commerce (Harrington, Reed, 1995; Kalakota, Whinston, 1997; Turban *et al.*, 2015; Zwass, 1996). It involves the electronic sale of goods and services by companies to consumers, while the participating parties are usually not in personal contact during the transaction. The typical B2C e-commerce models include online shops (e-shops) and online shopping centers (e-malls), which represent a number of online shops under one brand.

The basis for tracking B2C e-commerce is the so-called S-curve, which captures three stages in the life cycle of e-commerce (OECD, 1999a, p.6). The *Readiness* stage includes the preparations of the technological, commercial and social infrastructure necessary for B2C e-commerce. The *Intensity* stage includes the use of B2C e-commerce in practice. The *Impact* stage is achieved at a time when “e-commerce goes beyond substitution effects and creates new value added” (OECD, 1999a, p.6). In each stage, there are different priorities in B2C e-commerce tracking. In the *Readiness* stage, what is being tracked is primarily the driving forces of and obstacles to B2C e-commerce. In the *Intensity* stage, the use of B2C e-commerce is tracked, and in the stage of developed e-commerce, it is the impact of e-commerce that is analyzed.

Tracking B2C e-commerce and creating favorable conditions for its development is crucial due to two main benefits of B2C e-commerce: market expansion and cost reduction (Khan, Sagar, 2015; OECD, 2013, p.4; Turban *et al.*, 2015, p.16). These benefits further increase with the involvement of cross-border B2C e-commerce; however, this also generates other costs (Gomez-Herrera *et al.*, 2014). B2C e-commerce also has a significant macroeconomic impact and can serve as a major factor in economic growth (Francois *et al.*, 2014; Cardona *et al.*, 2015), which is why it is one of the areas in the EU that are the focus of the *Digital Agenda for Europe* (European Commission, 2010).

The main driving force or obstacles in B2C e-commerce include primarily factors of the macro environment: information and communication technology (ICT) and telecommunications infrastructure, social/cultural infrastructure, commercial infrastructure and government/legal infrastructure (Javalgi, Ramsey, 2001; Singh *et al.*, 2001; Savrul *et al.*, 2014). According to Gibbs *et al.* (2003) and Singh *et al.* (2001), B2C e-commerce is heavily influenced particularly by the national environment, including cultural influences (language, risk aversion, lifestyles, and other cultural variables), and according to Rawat *et al.* (2013), the personal characteristics of consumers and religion also play an important role. Research by Ho *et al.* (2007) has confirmed a significant influence of three factors: penetration of Internet among users, investment intensity in telecommunications, and education level. Security threats present a substantial obstacle for B2C e-commerce (Zwass, 1996; Nath *et al.* 1998). A large part of the aforementioned factors can be quantified using appropriate indices, which make it possible to statistically track the readiness of an economy for B2C e-commerce.

In order to evaluate B2C e-commerce intensity, what is tracked is B2C e-commerce turnover and its growth rate, the sellers' activities, consumer behavior, etc. Tracking B2C e-commerce intensity allows us to monitor how economies utilize B2C e-commerce. The impact of B2C e-commerce includes the economic and social impact at the microeconomic as well as macroeconomic level. Knowledge of the effects of e-commerce is the result of scientific analyses (e.g., Cardona *et al.*, 2015; Duch-Brown *et al.*, 2015; Gomez Herrera *et al.*, 2014; OECD, 1999b).

B2C e-commerce is usually tracked using various indicators that quantify individual assessment criteria. However, it is not uncommon for an economy that receives a high rating according to one criterion to achieve worse results based on different criteria. This fact results in difficulties in evaluating e-commerce in a particular economy as well as in international comparisons. In order to get a comprehensive picture of B2C e-commerce, it is important for selected assessment criteria to be aggregated into a comprehensive indicator, the so-called e-commerce index. B2C e-commerce indices are relatively new indicators. Several indices have been introduced in recent years, each tracking different aspects of B2C e-commerce. *The G20 e-Trade Readiness Index* (The Economist Intelligence Unit, 2014) states the conditions for engagement in cross-border B2C e-commerce in G20 countries. *The Global Retail E-commerce Index* (AT Kearney, 2015) focuses on the attractiveness of 30 economies in terms of investments in B2C e-commerce. These two indices have not been updated. *The UNCTAD B2C E-commerce Index* (UNCTAD, 2017) presents the ranking of 144 countries based on their readiness for B2C e-commerce. The evaluation includes 4 criteria: individuals using the Internet, individuals with an account, postal service reliability and secure Internet server penetration. However, secure server penetration tends to be higher in economies identified as offshore financial centers, since banks are major users of security protocols (UNCTAD, 2017, pp. 2). Offshore financial centers also exist in the EU (Luxembourg and Malta), so for the purpose of evaluating EU member states it is more appropriate to use a different criterion instead of secure Internet server penetration that would express Internet penetration in the business sector, e.g., enterprises with broadband access (excluding the financial sector) – the data are available in the Eurostat database. The disadvantage of the UNCTAD B2C e-commerce index is the fact that this index does not include a component criterion to assess the education level or the ability of the population to use ICT technologies. There is also *The Readiness Index Forrester* (Forrester, 2017), which is a holistic assessment of the e-commerce setting that provides insights for global expansion needs. No specific information on this index is publicly available. The European Union, or more specifically, the European Commission has no special composite index to track B2C e-commerce. Each year, the *Digital Economy and Society Index* (European Commission, 2017) is published, which evaluates the progress of EU member states in the digital sector, but does not allow comprehensive tracking of B2C e-commerce.

Currently, there is only one simple composite index for monitoring the readiness of countries for B2C e-commerce (the UNCTAD B2C e-commerce index). However, this index is merely the arithmetic average of the values of four indicators that quantify four selected criteria (UNCTAD, 2017, p.16), none of which takes into account the level of knowledge or digital skills among the population or Internet users, and the indicator stating the number of secure servers is also questionable. There is no composite index available that would evaluate B2C e-commerce intensity.

In this paper, we propose two composite indices to track B2C e-commerce in the EU: *the B2C e-commerce readiness index* and *the B2C e-commerce intensity index*. The way the B2C e-commerce readiness index is constructed is based on factors influencing the readiness

of economies for B2C e-commerce. In terms of factors relevant to B2C e-commerce readiness, the European Union has several specific features that are summarized in the following segment.

2. The Specifics of the EU in Terms of B2C E-commerce Factors

In this part, we answer the following research question: What are the specific features of the environment for B2C e-commerce in the EU?

A distinct specific feature of the EU from the point of view of factors relevant to B2C e-commerce readiness is creating a unified digital market in the EU, where consumers and businesses from EU member states can conduct online commercial transactions regardless of which member state they are from. Creating a unified digital market is part of the *Europe 2020* strategy and its initiative, *Digital Agenda for Europe* (European Commission, 2010). Digital Agenda for Europe has set key performance goals that, among other things, also concern the **telecommunications infrastructure**. According to the statistical data of IHS Global Limited (European Commission, 2016, p.209), in 2015 overall broadband coverage of households in all EU member states already ranged between 99 and 100% (this figure includes all speeds of broadband Internet connection). The only exceptions were Slovakia (95.9% coverage) and Ireland (97.6% coverage). These data indicate that the telecommunications infrastructure necessary for the realization of B2C e-commerce has not, at least since 2015, been the differentiating factor in the readiness of EU member states for B2C e-commerce.

Building up a unified digital market in the EU also comprises **harmonization of ICT and e-commerce legislation**. EU member states are obligated to implement EU laws pertaining to ICT and e-commerce in their national legal systems (including the protection of personal data), which creates a favorable legal environment for the development of B2C e-commerce. Legislation pertaining to the areas of ICT and e-commerce thus cannot act as a strong differentiating factor in B2C e-commerce in EU member states, although there can be differences in the subjective perception of the level of legislation in the various member states.

Another specific feature of the European Union relates to **payment methods** used in B2C e-commerce. Scholarly articles often claim credit card penetration to be the main factor in B2C e-commerce (e.g., Hawk, 2004; Ho *et al.*, 2007; Singh *et al.*, 2001). According to WorldPay data (2017), there are big differences in EU member states when it comes to preferred payment methods in B2C e-commerce. Thus, credit card penetration cannot be considered a factor that would have a significant influence on the readiness of EU member states for B2C e-commerce. More important than credit card penetration is whether or not consumers have a bank account that would allow them to make electronic bank transfers and card payments or use mobile money services (UNCTAD, 2017).

The European Union is one of the most developed parts of the world, both economically and socially. In EU member states, there are no problems with the availability of secondary or tertiary education; however, there can be pronounced **differences in digital literacy** - this can concern even well-educated seniors.

In terms of life cycle, traditions, language and other cultural and social factors, the EU is a very heterogeneous body. The European Union is characterized by its **large language differentiation** and also **multilingualism**, which reduces the language barrier (Eurobarometer, 2012). Both these sociocultural factors can influence the engagement of EU member states in cross-border B2C e-commerce and thus also B2C e-commerce intensity as

such. According to the results of a Eurobarometer statistical survey (2012, p.5), the most widely used foreign languages in the EU are English, French and German. Some EU member states share the same official language (German, French or English) and in some member states, for historical reasons, the population speaks well the language of a country that is in close geographical proximity. (Eurobarometer, 2012, p.21).

3. Comparison of EU Member States in Terms of B2C E-commerce

The empirical section of this paper focuses on a comparison of the current B2C e-commerce in EU member states using the proposed composite B2C e-commerce readiness and B2C e-commerce intensity indices. This comparison answers the following questions: What are the positions of EU member states in terms of the key prerequisites for the development of B2C e-commerce? What are the positions of EU member states in terms of B2C e-commerce intensity? Is there a strong correlation between B2C e-commerce intensity and the prerequisites for B2C e-commerce on the part of individual EU member states? The empirical part of this study follows up on the methodology proposed by Kunešová, Eger (2017) for evaluation of B2C e-commerce intensity; in this paper, we apply the methodology also to the assessment of B2C e-commerce readiness.

3.1 Research Method

To assess and compare B2C e-commerce in EU member states, the method of multi-criteria evaluation of alternatives, which falls into the category of multi-criteria decision analysis methods, was chosen. Methods of multi-criteria evaluation of alternatives allow the aggregation of partial evaluations based on selected criteria into an aggregate assessment, which considers all the assessment criteria. The multi-criteria evaluation of the alternatives used results in the compilation of an order of alternatives (EU member states) from “the best” to “the worst” alternative (Kunešová, Eger 2017). Multi-criteria evaluation of alternatives makes it possible to assess a finite number of alternatives based on a finite number of criteria. Crucial to the evaluation of alternatives is the choice of evaluation criteria according to which the alternatives are assessed. The criteria should cover all the evaluation attributes, should not be too great in number to avoid making the problem chaotic (Šubrt *et al.*, 2015), and must be quantifiable. To resolve problems of multi-criteria evaluation of alternatives, it is important whether and how certain criteria are given preference.

In our study, we used the TOPSIS method (the Technique for Order of Preference by Similarity to Ideal Solution - TOPSIS), which was developed by Yoon, Hwang (1995) and represents methods based on the principle of minimization of the distance from the ideal solution and maximization of the distance from the negative-ideal solution. The wide use of the TOPSIS method is documented by, e.g., Behzadian *et al.* (2012). The TOPSIS method allows us to determine the order of all the alternative solutions. The required input data include cardinal information (the actual values of the alternatives based on individual criteria in different units) and individual criteria weights.

The TOPSIS method evaluates the decision matrix which refers to p alternatives which are evaluated in terms of k criteria. The TOPSIS method consists of the following six steps (for example, Behzadian *et al.*, 2012; Šubrt *et al.*, 2015).

Step 1: Construct the normalized decision matrix

This process tries to convert the various attribute dimensions into non-dimensional attributes. For the normalization of input values, the TOPSIS method uses an approach based

on the Euclidean distance (formula 1). The element r_{ij} of the normalized decision matrix R can be calculated as follows:

$$r_{ij} = \frac{y_{ij}}{[\sum_{i=1}^p (y_{ij})^2]^{1/2}} \quad (1)$$

where y_{ij} is the input value of the i alternative assessed by the j criterion; p is the number of alternatives, $i = 1, 2, \dots, p, j = 1, 2, \dots, k$

Step 2: Construct the weighted normalized decision matrix

The weighted normalized criteria matrix $W = (w_{ij})$ is based on the normalized criteria matrix $R = (r_{ij})$ in such a way that each element r_{ij} of the R matrix is multiplied by the appropriate weight v_j (formula 2):

$$w_{ij} = v_j r_{ij} \quad (2)$$

where v_j is the weight of criterion j , and r_{ij} are the matrix elements of the normalized criteria matrix R .

Step 3: Determine the ideal and the negative-ideal solutions

The elements of the matrix W determine the ideal solution H_j with criteria values (H_1, H_2, \dots, H_k) and the negative-ideal solution D_j with criteria values (D_1, D_2, \dots, D_k) , given the values in the weighted criteria matrix W . The ideal solution delivers the best values based on each criterion; the negative-ideal solution delivers the worst values based on each criterion.

Step 4: Calculate the separation distances of each alternative to the ideal solution and the negative-ideal solution:

$$d_i^+ = \sqrt{\sum_{j=1}^k (w_{ij} - H_j)^2}, i = 1, 2, \dots, p \quad (3)$$

where d_i^+ is the separation (in the Euclidean sense) of each alternative from the ideal solution.

$$d_i^- = \sqrt{\sum_{j=1}^k (w_{ij} - D_j)^2}, i = 1, 2, \dots, p \quad (4)$$

where d_i^- is the separation (in the Euclidean sense) of each alternative from the non-ideal solution.

Step 5: Calculate the relative distances of each alternative from the negative-ideal solution:

$$c_i = \frac{d_i^-}{d_i^+ + d_i^-}, i = 1, 2, \dots, p \quad (5)$$

where c_i is the indicator of the relative distance of an alternative from the negative-ideal solution.

Step 6: Rank the preference order.

Rank the alternatives, sorting them by the value of the indicator c_i , in decreasing order. The best alternative is the one that has the longest distance from the negative-ideal solution.

3.2 Criteria for Evaluating B2C E-commerce Readiness and B2C E-commerce Intensity

Based on the analysis of scientific research (see section 1) and taking into consideration the specifics of the EU (see section 2), five criteria were selected to evaluate **B2C e-commerce readiness** in EU member states. These criteria take into account the key and differentiating factors of B2C e-commerce readiness in the EU. *Table 1* details the

selected criteria, their quantification in the form of a specific indicator, and the data source. The study uses the latest data from the sources listed.

Table 1. Criteria for evaluating B2C e-commerce readiness

Criterion No.	Criterion	Quantification of the criterion	Data source
1.1	Internet penetration (individuals)	% of individuals (aged 16-74) who used the Internet in the past 12 months, data obtained in 2017	Eurostat (2018)
1.2	Internet penetration (enterprises)	Enterprises with broadband access, fixed or mobile, in 2017 (% of enterprises, excl. the financial sector)	Eurostat (2018)
1.3	Digital skills (individuals)	Individuals (aged 16-74) who have basic or above basic overall digital skills (% of individuals who used the Internet in the past 3 months), data obtained in 2017	Eurostat (2018)
1.4	Account (individuals, age 15+)	% of respondents who report having an account (themselves or together with someone else) at a bank or another type of financial institution or report personally using a mobile money service in the previous 12 months, data obtained in 2017	World Bank (2018)
1.5	Postal delivery	The UPU postal reliability score (0-100) in 2016	UNCTAD (2017)

Source: created by the authors, 2018.

The first two selected assessment criteria are **Internet penetration among the population** and **Internet penetration in the business sector**. Internet penetration is the result of other factors, including ICT and telecommunications infrastructure, the cost of new technologies, the attitude to new technologies, income level, government policy, and others. Another criterion is the **level of digital skills of Internet users**. Digital skills are important in order to use the Internet for the purpose of B2C e-commerce as well as for the protection of one's personal data and privacy. An important assessment criterion is the **ownership (or joint ownership) of an account**, as having an account allows users to make electronic bank transfers and card payments or use mobile money services. The last selected criterion is **postal delivery**. To quantify this criterion, "the UPU postal reliability score" was used, which reflects performance in terms of speed and predictability of delivery across all the key segments of physical postal services. The reliability score is used for the UNCTAD B2C e-commerce index (UNCTAD, 2017). There is no other publicly available internationally comparable indicator evaluating the quality of parcel delivery in European countries.

Assessment criteria do not comprise criteria that cannot act as strong differentiating factors in B2C e-commerce in EU member states according to current statistical data, for example overall broadband coverage or legislation pertaining to the areas of ICT and e-commerce (see section 2). Chosen assessment criteria for B2C e-commerce readiness index eliminate disadvantages of the UNCTAD B2C e-commerce index, which are mentioned in section 1. We included the criterion "Internet penetration in the business sector" instead of "secure Internet server penetration" to the proposed composite index, which may be affected by the existence of offshore financial centers in some EU countries, and added the "digital skills" criterion that is not included in the UNCTAD B2C e-commerce index. The inclusion of new criteria to evaluate the B2C e-commerce readiness in EU member states is possible due to the availability of up-to-date and internationally comparable data in the Eurostat database. Due to the fact that all used assessment criteria quantify key B2C readiness factors, they were assigned the same weight.

For the purpose of comparing EU member states in terms of **B2C e-commerce intensity**, two criteria were selected that relate to the engagement of consumers and sellers in B2C e-commerce, and one criterion that relates to commercial transactions within B2C e-commerce. *Table 2* details the selected criteria, their quantification in the form of a specific

indicator, and the data source. The study uses the latest data from the sources listed.

Table 2. Criteria for evaluating B2C e-commerce intensity

Criterion No.	Criterion	Quantification of the criterion	Data source
2.1	Internet purchases by individuals	% of individuals (aged 16-74) who made an online purchase in the past 12 months, data obtained in 2017	Eurostat (2018)
2.2	Enterprises selling via a website or apps - B2C	The share of enterprises that sold online on the B2C market in 2017 (% of enterprises excluding those in the financial sector)	Eurostat (2018)
2.3	Relative size of the enterprises' turnover from web sales - B2C	The share of the turnover from web sales - B2C in the total turnover of enterprises in 2017 (in %)	Eurostat (2018)

Source: created by the authors, 2018.

Table 3. The decision matrix for evaluating B2C e-commerce readiness and B2C e-commerce intensity

Criterion No.	B2C e-commerce readiness					B2Ce-commerce intensity		
	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3
Type of criterion	max.	max.	max.	max.	max.	max.	max.	max.
Period	2017	2017	2017	2017	2016	2017	2017	2017
Alternative / unit	%	%	%	%	Score (1-100)	%	%	%
Austria	88	98	77	98.2	89	62	14	1
Belgium	89	98	69	98.6	79	60	18	2
Bulgaria	66	89	47	72.2	72	18	8	1
Croatia	69	95	61	86.1	89	29	14	2
Cyprus	81	96	62	88.7	93	32	11	1
Czech Republic	85	98	71	81.0	86	56	16	3
Denmark	97	100	73	99.9	80	80	15	2
Estonia	89	95	68	98.0	86	58	13	3
Finland	94	100	81	99.8	90	71	14	3
France	88	99	66	94.0	92	67	12	3
Germany	91	95	76	99.1	92	75	15	3
Greece	70	85	66	85.5	89	32	11	1
Hungary	79	91	65	74.9	87	39	11	1
Ireland	82	96	59	95.3	98	53	23	9
Italy*	73	96	63	93.8	69	32	8	0 (n)
Latvia	82	99	59	93.2	99	46	8	1
Lithuania	79	100	71	82.9	90	38	18	3
Luxembourg**	97	97	87	98.8	94	80	8	2.5
Malta	81	95	70	97.4	71	52	16	2
Netherlands	96	100	83	99.6	95	79	15	3
Poland	78	95	61	86.7	77	45	8	1
Portugal	75	98	68	92.3	37	34	11	3
Romania	70	82	46	57.8	88	16	6	2
Slovakia	83	95	72	84.2	92	59	12	2
Slovenia*	80	99	68	97.5	90	46	13	1
Spain	85	98	65	93.8	62	50	12	2
Sweden	97	97	80	99.7	93	81	16	3
United Kingdom	95	95	75	96.4	95	82	16	5

Notes: (n) not significant. * For countries marked with an asterisk, data for criterion 2.3 for the year 2017 were not available and the last known data were used instead (Italy: 2014, Slovenia: 2016). In the case of Italy, data for criterion 1.3 for the year 2017 were not available and the last known data were used instead (year 2016).** In the case of Luxembourg, there were no data for criterion 2.3 available for any year (according to Eurostat, data for Luxembourg are confidential). The missing value of criterion 2.3 for Luxembourg was set as the average of the values for criterion 2.3 of Belgium and the Netherlands (countries of the Benelux). See Tab. 1 and Tab. 2

Source: created by the authors, 2018.

Aggregation of the three criteria into one composite index provides more comprehensive view of B2C e-commerce intensity. None of the criteria is preferred; all of

them have equal weight, as it is assumed that all the criteria are equally important in evaluating e-commerce.

All the criteria in *Tables 1 and 2* above are maximization criteria, i.e., the higher the value of the particular criterion, the better the result of the country in the area that is being evaluated.

Table 3 shows the decision matrix for evaluating B2C e-commerce readiness and the decision matrix for evaluating B2C e-commerce intensity. The input data indicate that none of the evaluated alternatives is either the best or the worst in all the criteria.

The following text presents the output of the selected method of multi-criteria evaluation of alternatives that was applied to the selected evaluation criteria. All the calculations were performed in MS Excel.

3.3 The Order of EU Member States Determined by the TOPSIS Method

The ranking of alternatives (EU member states) in terms of B2C e-commerce readiness was determined based on the procedure detailed in section 3.1. The values of the B2C e-commerce readiness criterion listed in *Table 3* were used for the purpose of this calculation. The same procedure and values of B2C e-commerce intensity stated in *Table 3* were used to calculate the ranking according to B2C e-commerce intensity. The ranking of the member states according to the B2C e-commerce readiness index and the ranking according to the B2C e-commerce intensity index are presented in *Table 4*. The differences between the countries are expressed by the value of each index (i.e., the value of the indicator c_i) in *Table 4*. The alternatives are arranged in descending order, from the highest to the lowest values of the indicator c_i . This way, all the alternatives are ordered according to their relative distance from the hypothetical negative-ideal solution.

4. The Results of the TOPSIS Method and Discussion

The values of the **B2C e-commerce readiness index** indicate that there are large differences between the countries that were evaluated. The top ten countries that are best prepared for B2C e-commerce include highly developed countries of western and northern Europe and Estonia, which ranked No. 10, surpassing two western European countries (Belgium and Ireland), three central European countries (Slovakia, Slovenia and the Czech Republic) and several other European countries (Cyprus, Malta, Spain, Italy and Portugal) with superior economic performance. The comparison of the input data for the criteria (*Table 4*) shows that the lower ranking of Belgium compared to Estonia is merely due to the lower value of indicator 1.4, i.e., “postal reliability score”. However, this indicator evaluates the delivery of consignments by the postal service, but does not include the evaluation of delivery services provided by other entities. However, there is no indicator available that would be more accurate in evaluating parcel delivery reliability. The relatively worse position of Ireland compared to Estonia is the result of lower Internet penetration among the population, particularly the lower share of Internet users who have at least fundamental digital skills. Because of these two factors, Estonia also surpasses other countries listed above, with Internet penetration in Estonia higher than that of any of the aforementioned countries. At the bottom of the list are only countries located in the south of the EU: Spain, Italy, Romania, Portugal and Bulgaria. The variance in the index value is more pronounced in these countries. Particularly noticeable are the problems in Bulgaria and Romania, where less than half of Internet users have basic or higher digital skills (47% and 46% respectively). These values are

the lowest of all EU member states and well below the average within the EU. The ranking of Portugal is due to the low value of the “postal reliability score”. Overall, it can be said that all EU member states have room for improvement particularly when it comes to the level of digital skills of Internet users. On the other hand, the results for Internet penetration among enterprises are very good, with only three countries (Greece, Bulgaria and Romania) having a share of businesses with Internet connection lower than 90%.

Table 4. Determining the order of alternatives according to the TOPSIS method

The B2C e-commerce readiness index			The B2C e-commerce intensity index		
Order	Alternatives	Indicator c_i	Order	Alternatives	Indicator c_i
1	Luxembourg	0.9411	1	Ireland	0.8696
2	Netherlands	0.9334	2	United Kingdom	0.5997
3	Sweden	0.8891	3	Sweden	0.4449
4	Finland	0.8763	4	Netherlands	0.4348
5	United Kingdom	0.8345	5	Germany	0.4275
6	Germany	0.8267	6	Finland	0.4130
7	Austria	0.8107	7	Czech Republic	0.3995
8	Denmark	0.7471	8	France	0.3916
9	France	0.7185	9	Lithuania	0.3867
10	Estonia	0.7170	10	Estonia	0.3803
11	Slovakia	0.7118	11	Denmark	0.3729
12	Slovenia	0.7044	12	Luxembourg	0.3637
13	Belgium	0.6896	13	Belgium	0.3550
14	Lithuania	0.6785	14	Portugal	0.3223
15	Czech Republic	0.6741	15	Malta	0.3204
16	Latvia	0.6617	16	Slovakia	0.3020
17	Ireland	0.6611	17	Spain	0.2800
18	Cyprus	0.6488	18	Austria	0.2702
19	Malta	0.6122	19	Croatia	0.2590
20	Greece	0.5922	20	Slovenia	0.2176
21	Hungary	0.5814	21	Romania	0.1892
22	Croatia	0.5739	22	Hungary	0.1776
23	Poland	0.5444	23	Latvia	0.1759
24	Spain	0.5288	24	Poland	0.1725
25	Italy	0.5182	25-26	Cyprus	0.1601
26	Romania	0.4124	25-26	Greece	0.1601
27	Portugal	0.3937	27	Bulgaria	0.1059
28	Bulgaria	0.3503	28	Italy	0.0853

Source: created by the authors, 2018.

The ranking of EU member states according to **the B2C e-commerce intensity index** and the values of this index indicate a high degree of heterogeneity of EU member states in terms of the use of B2C e-commerce. The input data in *Table 3* show that the leading position of Ireland in B2C e-commerce intensity, despite the average value of the B2C e-commerce readiness index, is due to the above-average engagement of the business sector in B2C e-commerce. Following well behind Ireland, there is Great Britain and the countries of Western, Northern and Central Europe. The position of Great Britain is given by the well above-average share of people shopping online and the above-average share of turnover from B2C e-commerce in the total turnover of businesses operating on the B2C market. The countries at the bottom of the list (Cyprus, Greece, Bulgaria and Italy) differ only slightly from the hypothetical worst alternative. What is alarming is Italy’s position in last spot. However, it needs to be noted that the data for criterion 2.3 (relative size of the enterprises’ turnover from web sales - B2C) for the year 2017 for Italy and Slovenia were not available and the last

known data were used instead (see available flags under *Table 3*). In the case of Luxembourg, there were no data for criterion 2.3 available for any year (according to Eurostat, data for Luxembourg are confidential). The missing value of criterion 2.3 for Luxembourg was set as the average of the values for criterion 2.3 of Belgium and the Netherlands (countries of the Benelux).

Before calculating the two indices, it was assumed that there is a strong direct correlation between the countries' B2C e-commerce intensity and B2C e-commerce readiness. The validity of this assumption was verified by the statistical testing of hypothesis H1: "There is a correlation between the order of EU member states in terms of B2C e-commerce readiness and their order in terms of B2C e-commerce intensity." The correlation between these orders was calculated using the Spearman Rank Correlation Coefficient (Sharma, 2012, p.462.). The calculated value of the Spearman Coefficient is 0.6936, which indicates a moderate and statistically significant correlation of the said rankings (the critical value of Spearman's coefficient for a two-tailed test, $n = 28$ and significance level $\alpha = 0.05$ is 0.3749). The H1 hypothesis was thus confirmed. B2C e-commerce readiness appears to be a significant factor in B2C e-commerce intensity; however, it does not sufficiently explain the differences in B2C e-commerce intensity in the various EU states (see *Table 4*).

The results of the multicriteria evaluation of alternatives are generally influenced by the assessment methods used, the choice of assessment criteria and their preference. That is why we compared the order of countries resulting from the generated "B2C e-commerce readiness index" with the order of EU member states according to "The UNCTAD B2C E-commerce Index" (UNCTAD, 2017, p.17), which also expresses their economies' B2C e-commerce readiness. The correlation between the order of the EU member states in terms of the B2C e-commerce readiness index (*Table 4*) and in terms of the UNCTAD B2C e-commerce index (UNCTAD, 2017, p.17) was calculated using the Spearman Rank Correlation Coefficient. The calculated value of the Spearman Coefficient is 0.9294. This demonstrates a very strong and statistically significant correlation between the two rankings. To construct "The B2C e-commerce readiness index", we used a different method than that used by UNCTAD (see UNCTAD, 2017, p.16), partly also different evaluation criteria and different values, despite which the two rankings of countries are largely similar. That shows that the ranking of EU member states in terms of their B2C e-commerce readiness is dependent neither on the evaluation method used nor on the partial changes in the assessment criteria.

Conclusions and Research Limitations

To compare B2C e-commerce in EU member states, we propose the use of two composite indicators: the B2C e-commerce readiness index and the B2C e-commerce intensity index. Each of these composite indices focuses on B2C e-commerce from a different point of view. The various assessment criteria comprised in B2C e-commerce readiness include the key prerequisites for the development of B2C e-commerce (use of the Internet among the general population and the business sector, Internet users' digital skills, payment and delivery). They do not include the criteria that are not considered to be differentiating factors in B2C e-commerce on the unified EU market (telecommunications infrastructure coverage and ICT legislation).

No composite index for B2C e-commerce intensity measuring is currently used in scientific sources or professional practice. B2C e-commerce intensity is evaluated only with the use of various sub-indices, which limits the overall rating.

We included three basic criteria in the composite B2C e-commerce intensity index that track the engagement of consumers and enterprises in B2C e-commerce and the relative share of turnover from B2C e-commerce.

The TOPSIS method was used for the aggregation of the component criteria into the composite indices. None of the criteria was preferred in the calculations, because we use a relatively small number of partial criteria for evaluation, which they consider to be key and for B2C e-commerce assessment equally significant.

The proposed methodology allows the countries to be ordered based on the values of each composite index and thus determine the position of a particular country within the EU. **The benefit of this methodology** is the possibility to evaluate B2C e-commerce in individual member states within the wider context of the European Union and evaluate separately the prerequisites for the development of B2C e-commerce and B2C e-commerce intensity. The proposed methodology is a contribution to the discussion about the B2C e-commerce measurement and evaluation (especially to the discussion about the B2C e-commerce intensity, where the composite index for international comparisons is missing) and can be used by business entities and public institutions to develop B2C e-commerce strategic documents in the EU.

The calculated values of the B2C e-commerce indices indicate a high level of heterogeneity of the EU in terms of B2C e-commerce and also prove that there is still a large untapped potential for B2C e-commerce throughout the EU, not only in the relatively less developed economies, but also in countries with high-performing economies. The research results also prove that the use of B2C e-commerce is influenced by the countries' readiness for B2C e-commerce, although the correlation between the two is not particularly strong. This indicates that B2C e-commerce intensity is influenced by factors that were not included in the evaluation of the countries' B2C e-commerce readiness.

In a situation where the entire EU is equipped with telecommunications infrastructure suitable for the realization of B2C e-commerce and the legislation pertaining to this area is being harmonized, there are a number of questions without an unequivocal answer arising for further research into B2C e-commerce intensity, for example: How can EU member states motivate consumers and retailers to engage more in B2C e-commerce? What role in the use of B2C e-commerce is played by the country's geographical location, the influence of other economies, the national language and the language competence of the population? Why does a significant percentage of Internet users not have even basic digital skills? These questions indicate a possible direction further research might take. First question is addressed in current research by Pencarelli *et al.* (2018). The authors propose measures to increase the motivation of Italian consumers and retailers to engage more in the online market. Vejačka, Štofa (2017) conducted research on the impact of security and trust on the electronic banking adoption in Slovakia. Their model might be used also in the field of B2C e-commerce adoption in both, national and international conditions. In terms of B2C e-commerce intensity, it is also important to examine the benefits of B2C e-commerce to increase the export performance of the EU member states where there is a high heterogeneity (Fojtíková, 2014), as in the case B2C e-commerce.

This proposal of the methodology for the evaluation and comparison of B2C e-commerce in EU member states has several limitations. The biggest limiting factor is the unavailability of comparable statistical data for all EU member states. Particularly problematic is the availability of reliable and comparable data on B2C e-commerce transactions due to the high competitiveness in the commercial sector. This limiting factor partially affected the choice of assessment criteria and indicators used in their quantification.

Another limiting factor is the certain degree of subjectivity in selecting assessment criteria and the indicators for their quantification, which can be reduced, for example, by involving prominent experts in the evaluation process. The team of experts can also be used to determine the weights of assessment criteria.

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SUDĖTINIO PASIRUOŠIMO IR INTENSYVUMO INDEKSO PROJEKTAVIMAS IŠMATUOTI B2C ELEKTRONINĘ KOMERCIJĄ EUROPOS SĄJUNGOJE**Hana Kunešová, Michal Mičík****SANTRAUKA**

Elektroninė prekyba pastaruoju metu yra itin svarbi prekybai atskirose (individualiose) ekonomikose. Tačiau nėra vieningos išsamios metodikos, kaip atskirose ekonomikose vertinti elektroninę prekybą. Šiuo metu yra tik vienas paprastas indeksas, skirtas stebėti šalių pasirengimą B2C elektronei prekybai. Nėra jokio sudėtinio indekso, skirto įvertinti B2C elektroninės prekybos intensyvumą. Šiame straipsnyje siūlomi du sudėtiniai rodikliai, skirti stebėti ir matuoti B2C elektroninę prekybą ES. Abu rodikliai projektuoti taikant TOPSIS metodą.

Surinkti duomenys parodė, kad B2C elektroninės komercijos pasirengimas yra svarbus veiksnys, lemiantis B2C e. prekybos intensyvumą. Tačiau jis nepakankamai paaiškina skirtingų ES valstybių narių B2C e. prekybos intensyvumo skirtumus. Siūlomų sudėtinių indeksų privalumas, visų pirma, yra gebėjimas įvertinti B2C elektroninę prekybą įvairiose valstybėse narėse platesniame ES kontekste. B2C e. prekybos indeksų vertės rodo, kad ES yra labai nevienalytė B2C elektroninės komercijos požiūriu. Jos įrodo, kad B2C elektroninės prekybos potencialas visoje ES vis dar yra neišnaudotas. Taip yra ne tik santykinai mažiau išsivysčiusiose šalyse, bet ir šalyse, kuriose ekonomika yra labai efektyvi.

REIKŠMINIAI ŽODŽIAI: B2C elektroninės prekybos matavimas, e. komercijos pasirengimas, e. prekybos intensyvumas, TOPSIS, Europos Sąjunga.