

GDP EFFECT ON B2C E-COMMERCE TURNOVER AND NUMBER OF EXPRESS SHIPMENTS IN SELECTED EUROPEAN POST-COMMUNIST COUNTRIES

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Resume

The impact of the e-economy has been observable in almost all the sectors of the national economies of the states in the last few years. The growing influence of this phenomenon is due to development of the Internet, which has already become a viable part of almost all the business activities including buying and selling. Therefore, it can be assumed that the area of e-commerce will have an increasing impact, not only on national economic development, but on the express mail market, as well. The content of the article is designed to provide a comprehensive view of the interdependence between the level of economic maturity (the GDP gross Domestic Product) per capita in the PPS (Purchase Power Standard) indicator), development of the e-commerce (indicator B2C (Business to Customer) e-commerce turnover) and the number of express deliveries. Identifying the influence between the aforementioned indicators, it will be possible to take certain measures to support the development of the e-commerce market.

Article info

Received 17 November 2020

Accepted 22 December 2020

Online 13 September 2021

Keywords:

e-commerce,
express deliveries,
GDP

Available online: <https://doi.org/10.26552/com.C.2021.4.A233-A240>

ISSN 1335-4205 (print version)

ISSN 2585-7878 (online version)

1 Introduction and literature review

Different indicators are used in macroeconomics to measure the economic performance of a state. One of the most important indicators is the gross domestic product per capita in purchasing power standard (GDP per capita in the PPS). The GDP per capita in PPS is, according to the most common definition also given by Eurostat, defined as the market value of all the manufactured goods and services produced in a given economy, in this case the economy of a given state, over a certain period of time, using the factors of production available in the territory of the selected economy, while independent of the ownership of those factors, calculated per capita [1]. Development of the GDP per capita in PPS then depends on many factors. Transport and technical infrastructure, civic equipment and public spaces are among the most important [2]. The quality of infrastructure, especially in terms of its scope, coverage density, throughput, safety and other specific factors, influences the possibility of using production factors and thus the performance of the state economy.

In recent years there has been a dramatic increase in development of the e-commerce, which also stimulates the need to develop the logistics industry [3]. The infrastructure that enables the development of the e-commerce phenomenon is undoubtedly the Internet communication network. Its coverage averages 82.49%

in the European countries [4]. The Internet enables both wholesale and retail businesses to reach a wider range of customers, move in the distribution network and optimize resources in overall. This means the necessary fulfillment of both, the supply, as well as the return, of the goods through the distribution chain, an important component of which are the postal and logistics service providers, who must adapt to this new market situation. The increasing volumes of goods to be delivered to customers were already highlighted by the European Commission in 2012, while pointing out the need to find new solutions in this area of business [5-6]. Some authors also write about the importance of focusing on stakeholders in the distribution chain [7]. The costliest component of this chain is the last mile where goods are delivered to the end customers [8]. At the same time, it is important to perceive the increasing customer demands, which no longer focus solely on the quality of the goods or their sellers, but increasingly these demands on the part of customers are directed to the postal providers as well [9]. The requirements relate to ensuring flexibility in time and place of delivery, the possibility of returning the delivered products with an option to make a complaint and/or to get a refund, finally, also, the variability of payment terms. Currently, the role of a customer is shifting [10]. A customer is now considered a co-creator of service innovation. At the same time, the customers demand shorter delivery time.

According to the authors, it is important, that the postal system looks for common features with other branches of the communications sector and identify possible interoperability [11].

The relationship between the turnover of the e-commerce and GDP per capita in PPS was investigated by many researchers [12]. The authors focused in particular on the legislative side of the matter, which prevents faster development of the e-commerce. They see problems not only in telecommunications infrastructure, but also in the adequacy of consumer rights protection [12]. Here it is worth mentioning that authors highlighted the Czech Republic and Ireland, as countries in which businesses have created the right conditions to connect online. During the research regarding the impact of the e-commerce on GDP, several obstacles were found influencing the development of the e-commerce. Therefore, the European countries were split up into several groups with similar characteristics [13]. Next author focused on three countries for which she examined the relationship of the e-commerce not only with GDP per capita in PPS, but also with the unemployment rate, as another indicator of economic development [14]. The increasing turnover of the e-commerce, which is growing by an average of 14.28% per year in the business to customer (B2C) model, puts enormous pressure on postal operators and the need for their rapid adaptation to increasing customer demands [4]. At this point, it should be noted that, there are other commonly used e-commerce models, among which the authors include business-to-business (B2B), customer-to-customer (C2C), customer-to-business (C2B) and the already mentioned B2C model, which this article deals with in particular [15]. Especially for the B2C sector in China, the last mile raises great concerns due to the rapid development of the e-commerce, with customers looking for delivery through express companies [16]. Some authors are looking into how to deliver a package the same day, using free public transport capacity [17]. Other authors go even further and propose a new concept of the city's railway transit system with stations equipped with freight platforms, which assumes a pre-known demand, but also works with customer's requests regarding delivery time [18]. Further research focuses on challenges and opportunities of urban logistics as a whole in order to prioritize allocation of resources to ensure quality of life of the population and meeting its needs [19]. Some other studies head in different direction and work with the option of returning the vehicle to a depot for new shipments before delivering already loaded shipments, even seeing possible improvements that can offer preventive returns to the depot [20]. These improvements include reduction in delivery times or more efficient use of a vehicle capacity.

The liberalization of the postal market has taken place gradually by 2012 [21]. Full liberalization of the postal services was completed in all the states by the beginning of 2013 including the last 13 countries that

had an exemption. Countries such as the Czech Republic, Slovakia, Romania, under the EU Directive thus had longer time to remove the remaining barriers for the new logistics service providers and at the same time existing monopolists had time to implement the cost-cutting strategies and focus on parcel delivery and express parcel delivery, an area where the substantial competition had already flourished [21-22]. Year 2012 is also an important year for this sector, the operators entered the global monitoring system, which enabled improved shipments tracking. This system, which has gradually integrated all the countries, allowed for more than 20% increase in express shipment and proof of delivery timeliness in 90% of cases between 2014 and 2015 [23].

The objective of this article is to evaluate the existence of dependence of the economic development of the state, monitored by the macroeconomic indicator GDP per capita in PPS, on the year-over-year turnover of B2C e-commerce and the number of express mail shipped using the postal infrastructure. The regression and correlation analyses were used to achieve the objective of the article. The objective is divided into two sub-objectives that must be completed in order to achieve the main objective. The first step is to assess the existence of dependence of the GDP per capita in PPS in each state on the year-over-year turnover of the B2C e-commerce. The second sub-objective is to assess the existence of dependence of the GDP per capita in PPS in each state on the number of express items shipped.

2 Methodology

Data series are described in detail at the beginning of this section, followed by defined hypotheses the validity of which was tested using the selected mathematical and statistical methods, which are also described in detail.

2.1 Datasets

All the variables used, i.e. the GDP per capita in PPS, B2C e-commerce turnover and number of transported express shipments, were monitored in all the selected European countries between 2013 and 2017. Since some data was not available for some of the years or some of the states, only those states were chosen for which all the data for all the relevant years were available and subsequently tested to confirm or reject validity of hypotheses.

To compare the national economic performance through the GDP per capita, this variable was expressed in PPS (purchasing power standards), a common currency that eliminates differences between countries. The GDP data per capita in PPS was obtained from European Statistical Office documents [1]. „The value of the total output of goods and services produced by an economy, less intermediate consumption, plus net

taxes on products and imports. The GDP per capita is calculated as the ratio of GDP to the average population in a specific year“, [1].

Another variable used is turnover of the B2C e-commerce. The data was obtained from the Ecommerce Foundation, which works with 19 national associations and more than 75,000 companies, including SAP, Asendia Management SAS and MultiSafepay. The E-commerce Foundation analyzes the B2C e-commerce market and focuses, in particular, to negotiate the better conditions for development of the e-commerce with European Union legislators [1].

The last variable is the number of transported express shipments. Data on the number of express shipments transported was extracted from Universal Postal Union documents [23]. Universal Postal Union brings together information from all national regulatory authorities of the Member States. These regulatory authorities provide Universal Postal Union with data on number of express shipments transported.

2.2 Characteristics of tested hypotheses and used mathematical and statistical methods

With reference to the objective, set out in the introduction of this article, the following hypotheses were established:

H_{0_1} : Development of the GDP per capita in PPS indicator in a given state does not have a significant impact on development of the B2C e-commerce indicator in that state.

HA_1 : Development of the GDP per capita in PPS in a given state has a significant impact on the development of the B2C e-commerce indicator in that state.

H_{0_2} : Development of the GDP per capita in PPS indicator in a given state does not have a significant impact on development of the indicator of the number of express shipments transported in that state.

HA_2 : Development of the GDP per capita in PPS indicator in a given state has a significant impact on development of the indicator of the number of express shipments transported in that state.

The validity of the presented hypotheses were verified for the Czech Republic, Bulgaria, Poland, Estonia and Romania.

2.3 Methods

To test validity of the hypotheses in relation to the

defined objective of this article, first, it will be necessary to test the normality of the data for each variable.

One of the tests to verify the normality of data is the Kolmogorov-Smirnov test (K-S test):

$$D_n = \sup |F_n(x) - F(x)|, \quad (1)$$

where:

F_n - the empirical distribution function for n independent and identically distributed ordered observations X_i ,

\sup_x - supremum of the set of distance.

The zero hypothesis assumes that the tested data series correspond to the selected theoretical distribution, i.e. the normal distribution. A zero hypothesis is rejected if the critical boundary (D_{\max}) of criterion D_n is exceeded. As a rule, zero hypothesis is rejected if the P-value < 0.05 . Therefore, if the P-value < 0.05 , it is unlikely that the data series follows the normal distribution.

After verifying the normality of the tested data and after the acceptance of zero hypothesis using the Kolmogorova-Smirnov test, the strength of the correlation of the monitored variable using the Pearson correlation coefficient was examined:

$$r = \frac{\sum (X - \bar{X})(Y - \bar{Y})}{\sqrt{\sum (X - \bar{X})^2 \sum (Y - \bar{Y})^2}}, \quad (2)$$

where:

\bar{X} Mean of X variable,

\bar{Y} Mean of Y variable.

The final determination of significance of correlation was established based on calculation of the P-value with significance level at 5%.

3 Results

Based on the methodology described above, the content of this section of the article is focused on presentation of results of the hypotheses validity testing, followed by the detailed examination of the monitored variables correlation.

3.1 Czech Republic

The Kolmogorov-Smirnov test was used to assess whether the monitored data series from Table 1 have the normal distribution. The test results for the Data Series of the Czech Republic are shown in Table 2.

Tests reveal that all the data series have a normal distribution. Table 3 shows the results of the Pearson correlation coefficient, resulting in a strong correlation

Table 1 The Czech Republic - data series, [1, 4, 22]

| year | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|--------|--------|--------|--------|--------|
| GDP per capita in PPS (per person in EUR) | 22400 | 23800 | 25300 | 25600 | 26900 |
| e-commerce B2C turnover (EUR bn) | 2210 | 2600 | 3150 | 3800 | 4470 |
| transported express shipments | 480077 | 488636 | 529281 | 563239 | 635237 |

Table 2 Czech Republic - Kolmogorov-Smirnov test for data

| data series | D_n | p-value | D_{max} | test result |
|---|--------|---------|-----------|-------------|
| GDP per capita in PPS (per person in EUR) | 0.2133 | 0.90999 | 0.565 | H0 accepted |
| e-commerce B2C turnover (EUR bn) | 0.1613 | 0.98133 | 0.565 | H0 accepted |
| transported express shipments | 0.3191 | 0.16461 | 0.565 | H0 accepted |

Table 3 Czech Republic - Pearson correlation coefficient

| data series | Pearson's r | p-value | 95% interval | test result |
|---|-------------|---------|------------------|--------------------------|
| GDP per capita in PPS and e-commerce B2C turnover | 0.9659 | 0.0075 | 0.5656 to 0.9978 | HA ₁ accepted |
| GDP per capita in PPS and express shipments | 0.9311 | 0.0215 | 0.2736 to 0.9956 | HA ₂ accepted |

between the GDP per capita in PPS and E-commerce B2C turnover, as well as between GDP per capita in PPS and the number of express shipments transported.

Bulgaria and Poland show the same results, which can be seen in the following sections of the article.

3.2 Bulgaria

The Kolmogorov-Smirnov test was used to assess whether the monitored data series from Table 4 had a normal distribution. The test results for Bulgaria's data series are shown in Table 5.

Testing shows that all the data series have a normal distribution. Table 6 shows the results of the Pearson correlation coefficient, revealing the strong dependence between the GDP per capita in PPS and E-commerce B2C turnover, as well as between the GDP per capita in PPS and the number of express shipments transported.

3.3 Poland

The Kolmogorov-Smirnov test was used to assess whether the monitored data series from Table 7 had a normal distribution. The test results for Poland's data series are shown in Table 8.

Testing shows that all the data series have normal distribution. Table 9 shows the results of the Pearson correlation coefficient, resulting in a strong dependence between the GDP per capita in PPS and E-commerce B2C turnover, as well as between the GDP per capita in PPS and the number of express shipments transported.

3.4 Estonia

The Kolmogorov-Smirnov test was used to assess whether the monitored data series from Table 10 have

Table 4 Bulgaria - data series, [1, 4, 22]

| year | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---------|---------|---------|---------|---------|
| GDP per capita in PPS (per person in EUR) | 12 200 | 12 900 | 13 700 | 14 200 | 14 800 |
| e-commerce B2C turnover (EUR bn) | 199.43 | 250 | 330 | 419.4 | 488.6 |
| transported express shipments | 1002409 | 1109686 | 1236146 | 1318089 | 1289516 |

Table 5 Bulgaria - Kolmogorov-Smirnov test

| data series | D_n | p-value | D_{max} | test result |
|---|--------|---------|-----------|-------------|
| GDP per capita in PPS (per person in EUR) | 0.154 | 0.99622 | 0.565 | H0 accepted |
| e-commerce B2C turnover (EUR bn) | 0.1695 | 0.7887 | 0.565 | H0 accepted |
| transported express shipments | 0.233 | 0.16191 | 0.565 | H0 accepted |

Table 6 Bulgaria - Pearson correlation coefficient

| data series | Pearson's r | p-value | 95% interval | test result |
|---|-------------|---------|------------------|--------------------------|
| GDP per capita in PPS and e-commerce B2C turnover | 0.9896 | 0.0013 | 0.8459 to 0.9993 | HA ₁ accepted |
| GDP per capita in PPS and express shipments | 0.9526 | 0.0123 | 0.4404 to 0.9970 | HA ₂ accepted |

Table 7 Data series in Poland, [1, 4, 22]

| year | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|-----------|-----------|-----------|-----------|-----------|
| GDP per capita in PPS (per person in EUR) | 17900 | 18600 | 19900 | 19900 | 20900 |
| e-commerce B2C turnover (EUR bn) | 1930 | 3450 | 4960 | 6280 | 8380 |
| transported express shipments | 136396000 | 194464000 | 214159000 | 264070000 | 307751000 |

Table 8 Poland - Kolmogorov-Smirnov test

| data series | D _n | p-value | D _{max} | test result |
|---|----------------|---------|------------------|-------------|
| GDP per capita in PPS (per person in EUR) | 0.2509 | 0.78607 | 0.565 | H0 accepted |
| e-commerce B2C turnover (EUR bn) | 0.1328 | 0.99781 | 0.565 | H0 accepted |
| transported express shipments | 0.1557 | 0.2197 | 0.565 | H0 accepted |

Table 9 Poland - Pearson correlation coefficient

| data series | Pearson's r | p-value | 95% interval | test result |
|---|-------------|---------|------------------|--------------------------|
| GDP per capita in PPS and e-commerce B2C turnover | 0.9742 | 0.0049 | 0.6544 to 0.9984 | HA ₁ accepted |
| GDP per capita in PPS and express shipments | 0.949 | 0.0137 | 0.4100 to 0.9967 | HA ₂ accepted |

normal distribution. The test results of data series collected in Estonia are shown in Table 11.

Testing shows that all the data series have a normal distribution. Table 12 shows the Pearson correlation coefficients, revealing strong dependence between the GDP per capita in PPS and E-commerce B2C turnover, but the dependence between the GDP per capita in PPS and the number of express shipments transported is refuted. The Pearson coefficient even reaches negative values.

3.5 Romania

The Kolmogorov-Smirnov test was used to assess whether the monitored data series from Table 13 have normal distribution. The test results for the Romania data series are shown in Table 14.

Testing shows that all the data series have normal distribution. Table 15 shows the Pearson correlation coefficients, revealing strong dependence between the GDP per capita in PPS and E-commerce B2C turnover,

Table 10 Estonia - Data series, [1, 4, 22]

| year | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---------|--------|--------|---------|---------|
| GDP per capita in PPS (per person in EUR) | 20200 | 21300 | 22000 | 22500 | 23600 |
| e-commerce B2C turnover (EUR bn) | 101 | 119 | 159 | 175 | 204 |
| transported express shipments | 1341503 | 909900 | 910000 | 1079846 | 1228902 |

Table 11 Estonia - Kolmogorov-Smirnov test

| data series | D _n | p-value | D _{max} | test result |
|---|----------------|---------|------------------|-------------|
| GDP per capita in PPS (per person in EUR) | 0.125 | 0.99982 | 0.565 | H0 accepted |
| e-commerce B2C turnover (EUR bn) | 0.1826 | 0.94702 | 0.565 | H0 accepted |
| transported express shipments | 0.2311 | 0.45197 | 0.565 | H0 accepted |

Table 12 Pearson correlation coefficient for Estonia

| data series | Pearson's r | p-value | 95% interval | test result |
|---|-------------|---------|-------------------|--------------------------|
| GDP per capita in PPS and e-commerce B2C turnover | 0.9833 | 0.0026 | 0.7624 to 0.9989 | HA ₁ accepted |
| GDP per capita in PPS and express shipments | -0.1101 | 0.8601 | -0.9046 to 0.8553 | H0 ₂ accepted |

Table 13 Romania - Data series, [1, 4, 22]

| year | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---------|---------|---------|----------|---------|
| GDP per capita in PPS (per person in EUR) | 14500 | 15200 | 16300 | 17400 | 18800 |
| e-commerce B2C turnover (EUR bn) | 1040 | 1200 | 1490 | 2050 | 2800 |
| transported express shipments | 4211266 | 3472404 | 3515399 | 38746320 | 4489918 |

Table 14 Romania - Kolmogorov- Smirnov test

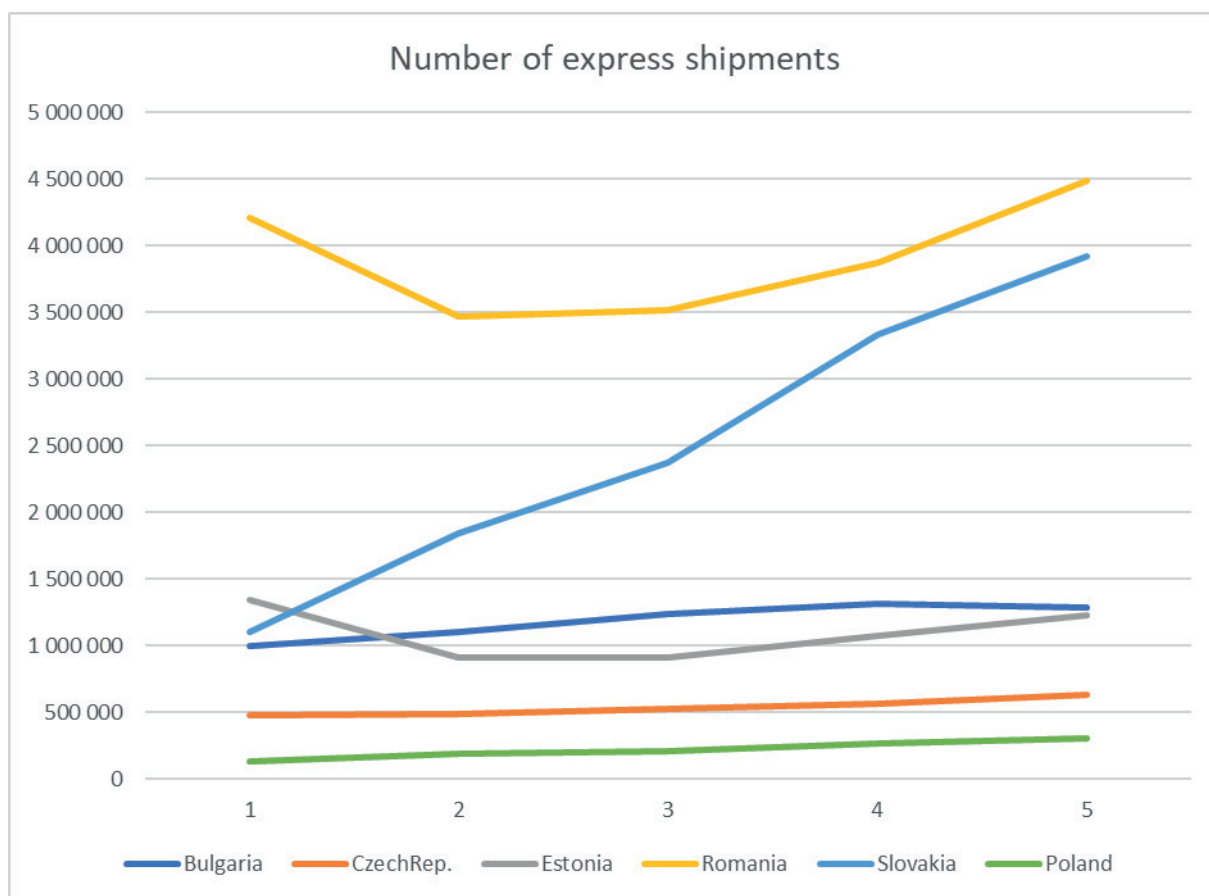
| data series | D _n | p-value | D _{max} | test result |
|---|----------------|---------|------------------|-------------|
| GDP per capita in PPS (per person in EUR) | 0.2918 | 0.8544 | 0.565 | H0 accepted |
| e-commerce B2C turnover (EUR bn) | 0.1859 | 0.9689 | 0.565 | H0 accepted |
| transported express shipments | 0.2568 | 0.5375 | 0.565 | H0 accepted |

Table 15 Romania - Pearson correlation coefficient

| data series | Pearson's r | p-value | 95% interval | test result |
|---|-------------|---------|-------------------|--------------------------|
| GDP per capita in PPS and e-commerce B2C turnover | 0.9854 | 0.0021 | 0.7892 to 0.9991 | HA ₁ accepted |
| GDP per capita in PPS and express shipments | 0.4454 | 0.4522 | -0.7198 to 0.9532 | H0 ₂ accepted |

Table 16 GDP per capita in PPS 2018, 2019, [1]

| GDP | Bulgaria | Czech Republic | Estonia | Romania | Poland |
|------|----------|----------------|---------|---------|--------|
| 2018 | 15 500 | 27 900 | 24 700 | 19 800 | 21 400 |
| 2019 | 16 500 | 28 900 | 26 100 | 21 700 | 22 700 |

**Figure 1** Number of express shipments [23]

but rejects the dependence between the GDP per capita in PPS and the number of express shipments transported.

4 Discussion and conclusion

The analysis of dependence between the GDP per capita in PPS and B2C e-commerce turnover, respectively between the GDP per capita in PPS and the number of express shipments transported, was established through the value of the correlation coefficient, respectively, the Pearson coefficient of serial correlation was used. Prior to the correlation analysis itself, the Kolmogorov-Smirnov data normality test was performed, which confirmed that the examined statistical selection had a normal probability distribution. Therefore, the Pearson coefficient of serial correlation could be used to determine the link between data series. The resulting values of the Pearson coefficient of serial correlation, verified by the significance testing, imply the existence of a strong dependence between all the variables for the Czech Republic, Bulgaria and Poland.

Dependency was not confirmed only between the GDP per capita in PPS and the number of express mail shipped in Estonia and Romania. This may be because, as can be seen in Figure 1, the data series of express shipments has an increasing trend for Estonia and Romania, same as other countries included in the studies, except for the year 2013. As the postal market was to be fully liberalized from 2013 on and this period marked a difficult transition for many countries, it is possible that the responsible authorities in Estonia and Romania did not proceed the same way as other countries when reporting the number of express mail transported, even though Estonia fully opened its market in 2009 [5]. The data series of express shipments was also obtained for Slovakia. Figure number 1 shows that Slovakia achieves higher value of number of express shipments than countries

of similar size. However, the data series of E-commerce B2C turnover was not obtained for Slovakia, due to this fact Slovakia could not be included in the final group of analyzed countries.

A certain limit to this article is the unavailability of the data needed for other European countries, which is due to the inconsistent practice of European states in obtaining data based on which the comprehensive studies mapping the issue across the continent of Europe are carried out.

Based on the results presented in this article, it can be concluded that majority of tested hypotheses confirmed the impact of the GDP per capita in PPS on development of the B2C e-commerce turnover indicator during the considered time period as well as the impact of the GDP per capita in PPS on the number of express shipments transported during the same time period. Based on this fact, it is possible to ascertain that through the monitoring of the macroeconomic indicator GDP per capita in PPS, the prediction of the development of B2C e-commerce and the number of express shipments transported can be carried out.

Table 16 shows the GDP per capita in PPS in the group of analyzed countries in 2018 and 2019. In all the analyzed countries, there is a year-on-year increase in the value of the GDP per PPS in 2018 and 2019. Based on this fact and with reference to results of this article, it is possible to predict the growth of E-commerce B2C turnover in 2018 and 2019 as well.

The conclusions of the article opened space for further research to seek why the validity of the two sub-hypotheses had not been confirmed in Estonia and Romania.

Acknowledgements

The article was supported by student grant - SGS_2020_010.

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