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South East European Journal of Economics and Business
Volume 16 (2) 2021, 101-113
**DOI:** 10.2478/jeb-2021-0017

# INFORMATION AND COMMUNICATION TECHNOLOGY DEVELOPMENT AND FOREIGN TRADE IN THE REGION OF SOUTH-EAST EUROPE

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***Abstract***

*This paper provides an analysis of the influence of Information and Communication Technology (ICT) infrastructure, usage and skills on the export and import of goods and services in the region of South-East Europe (SEE) by applying gravity models to bilateral trade flows through the panel data analysis. The results show that GDP per capita and Internet usage have a significant positive impact on import, and in addition, the digital infrastructure and digital skills have a positive, but small impact on export. Distance has a negative impact on trade. These countries faced relatively poor development and usage of the ICT sector, which indicates unexplored potential which could be used to improve international trade if exploited by businesses, government and households.*

**Keywords:** *Foreign trade, South-East Europe, ICT, gravity model*

**JEL classification:** *F10, F14, O30*

## 1. Introduction

The development of information and communication technology (ICT), i.e. usage of computers, smartphones, mobile banking, etc. has enabled the simplification of web shops and their wide availability to consumers. Due to the current economic situation in retail and foreign trade, the recommendation to avoid cash payments, the application of special hygienic measures in shopping malls, the opening up of new possibilities (web shops or online retailers) and development of existing shops (and multinational companies) on online platforms, there has been an increase in online orders for different products and services. The importance of digital trade (online purchase and sale) has been on the rise during the COVID-19 pandemic and the resulting lockdown of economies.

Digital trade covers cross-border trade in goods and services where some (ordered and/or delivered) transactions are provided digitally. There is no developed (unique) statistical and accounting approach to measure the value of digital trade. Digital trade can partially be explained by e-commerce, but this includes both trade on the domestic market and foreign trade, so there is no adequate measure of its cross-border value. The initial idea of this paper was to identify the development of digital trade in the region of South-East Europe (SEE) and its determinants but, since there is no specific database that covers this part of cross-border trade only, we will apply the

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measurement of the impact of different variables that describe ICT development on export and import flows in the SEE region. Specifically, the emphasis is on the research of the influence of particular variables that describe the presence (usage) of the Internet among households and businesses, ICT infrastructure and ICT skills on the values of export and import of goods and services.

The topic of the impact of different aspects of ICT development has been researched by many authors (e.g., Freund and Weinhold 2002; Freund and Weinhold 2004; Clarke and Wallsten 2006; Lin, Qin, and Xie 2015; Liu and Nath 2013; Barbero and Rodriguez-Crespo 2018; and Rodriguez-Crespo and Rocio 2019), where they covered different time periods, included different samples of countries, and implemented different variables of ICT development.

According to our knowledge, there is no specific research that has focused on the SEE region. This region covers Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia and Serbia[1]. This region is underdeveloped in terms of GDP p.c. compared to the EU, so it would be interesting to produce data about their digital readiness to promote trade and utilise its benefits.

We will perform two kinds of assessment of ICT development on trade of SEE countries: (1) theoretically - one part of the paper will be descriptive with an analysis and comparison of available data that describe the development of the digital society in SEE countries, creating the preconditions for the development of digital trade; (2) empirically - we will create gravity equations for bilateral export and import flows of SEE countries, covering the period 2000-2019 and including 6 SEE countries with 20 of their most important trade partners for export and for import.

The hypothesis is that variables which describe the digital society (ICT development) should have a positive impact on foreign trade performance. The problem in this specific region could lie in their lagging behind in economic and digital development in relation to the developed countries, resulting in a minor impact of ICT variables.

The paper is organised in four sections, where the second one comprises the review of literature about ICT impact on trade flows, and the third section comprises the comparison of data about the digital society development in the SEE region provided by international organisations that represent the preconditions (or limitations) for online trading, an explanation of the research methodology and the results of the econometric analysis. This is followed by the conclusion.

## 2. Literature review

In today's world of growing ICT development, bearing in mind the COVID-19 pandemic impact on (barriers to) freedom of movement and the application of different restrictions (especially in spring 2000, although many countries introduced the restrictions again in autumn 2021), online trading (e-commerce, digital trade) is blooming. Digital trade includes online purchases through the widespread use of Internet-enabled devices which provide consumers with direct access to online markets. López González and Jouanjean (2017) explain that digital trade encompasses digitally enabled transactions in trade of goods and services that can be digitally or physically delivered. The United States International Trade Commission (USITC 2014) defines digital trade as domestic commerce and international trade in which the Internet and Internet-based technologies play a particularly significant role in ordering, producing or delivering products and services. Such a definition includes commerce in most physical goods, such as goods ordered online and physical goods that have a digital counterpart.

Although there are no specific statistics for digital trade, and since it is a part of total (gross) export and import, it is impossible to examine its determinants only. The only way to do this is to include the specific ICT variables for every particular country (and for their trade partners) in the group of relevant preconditions (determinants) of export and import flows. As per the definition, the development of ICT infrastructure, usage and skills is necessary to conduct this type of trade. In view of the unavailability of data for digital trade that would bring added value to this analysis, here we will present the papers that have examined the impact of ICT on trade.

ICT development is an integral part of technological progress and it promotes changes both in the production processes and in all the related activities (in the real sector as well as in the services sectors). Technology development has a positive impact on growth, gross domestic product (GDP), trade, etc. The implementation of ICT reduces production costs, increases productivity, increases the demand for skilled workers (salaries will increase) and contributes to growth (Anderson and van Wincoop 2003; Liu and Nath 2013). There are several channels through which ICT impacts trade: ICT will reduce the fixed costs related to sales on the foreign market (such as market search, advertising, distribution network) as well as the uncertainties connected with the foreign market (delays), and ICT might facilitate trade. New technologies can reduce trade costs by impacting transportation

and storage costs reduction, by shortening the time for transport and by reducing the uncertainty of delivery times owing to better logistics. These costs have a major share in total trade costs; consequently, their reduction could have a considerable impact on trade flows. The impact of ICT on trade depends on the stage of ICT implementation and diffusion, trade specialisation and the level of economic development (Allen 2014). Internet use may reduce information asymmetries through the reduction of frictions associated with search costs between producers and consumers. It is more important in the case of differentiated goods (Akerman, Leuven, and Mogstad 2018). Additionally, Baldwin (2016) pointed out the importance of ICT usage in the production process that is dispersed (disaggregated) in many different countries through the complexity of global value chains (GVCs), where correct and timely information (and communication) reduces the organisational and information costs (friction). The World Trade Organisation (WTO 2018) also pointed out the most significant impacts of digital technologies on trade through: the reduction of trade costs, the change in the composition of trade by increasing the services component, changing the patterns of comparative advantage and affecting the complexity and length of global value chains. New technologies facilitate the search for products, help verify quality and reputation, and help match consumer preferences to products. The ICT term comprises several aspects, such as the development of ICT infrastructure, ICT usage and ICT skills. ICT infrastructure can be measured as fixed-telephone lines per 100 inhabitants, mobile-cellular telephone subscriptions per 100 inhabitants and international Internet bandwidth (bit/s) per Internet user. For ICT usage, the measurement can be made based on the percentage of individuals using the Internet or fixed (wired)-broadband Internet subscriptions per 100 inhabitants. Knowledge is crucial for a better exploitation of ICT, so the skills measurement includes data about educational levels, i.e. secondary gross enrolment ratio or tertiary gross enrolment ratio (Nath and Liu 2017).

The positive impact of the Internet on international trade development/rise has already been proven by Freund and Weinhold (2002); Freund and Weinhold (2004); Clarke and Wallsten (2006); Lin, Qin, and Xie (2015) and Liu and Nath (2013). The articles differ in terms of the period, the sample of countries included in the analysis and the variables they used in measuring ICT development. The simplest way to establish the influence of ICT on trade is by using data for Internet users (on 100 inhabitants). Freund and Weinhold (2002) found that Internet boosts US trade in services. They based their analysis, performed in 2000, on a sample of 31 countries. In another paper, Freund and Weinhold (2004) enlarged their analysis and, with a sample of 54 countries covering the period from 1995 to 1999, also found a positive effect of Internet use on trade. Clarke and Wallsten (2006) included 98 trading countries and used the data for 2001. They found a positive effect of Internet use on trade. Lin, Qin, and Xie (2015) analysed international trade flows within 200 countries during the period 1990–2006 and again found that Internet use had a positive effect on export.

Following these first examinations, the most recent articles have tried to include more variables in the analysis or to create some synthesised index that would include other measures of ICT (number of hosts, telephone subscriptions, education level, broadband Internet…). Portugal-Perez and Wilson (2012) established a weighted ICT-based index for a sample of 101 countries and found a positive effect of ICT infrastructure on exports, except that this effect is stronger in developing countries. Abeliansky and Hilbert (2017) compared the effect of ICT use and infrastructure on trade for 122 countries during 1995–2008. They concluded that ICT use is more important for developed countries, but ICT infrastructure is more important for developing countries.

Barbero and Rodriguez-Crespo (2018) analysed bilateral trade among 232 European regions in 2007 and 2010 and found a positive and robust effect of broadband on interregional trade. Additionally, Rodriguez-Crespo and Rocio (2019) found a significant and positive relationship between the Internet and bilateral exports for developed and developing countries. The impacts vary from 0.03 % to 0.13 %, where a greater effect of Internet use on bilateral trade flows is found in high-income countries. Nath and Liu (2017) explored not just the impact of Internet use on services trade, but they also created a comprehensive ICT development index (IDI) composed of seven different ICT variables. They found that ICT development has significant positive implications for the growth of international trade in seven (out of ten) service items, especially financial and other business services (with a positive impact on export and import). For some services, they found a positive impact only on the export or on the import side. They pointed out that ICT use has been found to be more important than access and skills for trade in a number of services.

In one earlier paper, Liu and Nath (2013) researched the impact of ICT (infrastructure, use, skills) variables on trade in emerging economies by applying a fixed effects model. They found that Internet subscriptions and Internet hosts have significant positive impacts on both export and import shares in

emerging economies, thus pointing out that ICT infrastructure or ICT capability *per se* are not important for fostering trade, but that trade depends on their use.

Ozcan (2017) investigated the impact of four ICT indices on Turkey's bilateral trade flows by applying an extended panel gravity model and found that ICT has positive and significant impacts on both Turkish import and export volumes, while ICT has a quantitatively larger effect on imports than on exports. Wang and Li (2017) also researched the impact of ICT variables on export and import and found that a country's export in one industry increases by 10 percent if the country's ICT development index increases by 1 standard deviation (SD) and the industry's R&D intensity increases by 1 SD, and also that exports will increase by 25 percent in case of task complexity.

The region of South-East Europe has not been researched separately in the existing review of scientific articles (according to the author's information/knowledge).

## 3. Research

### 3.1. Measurement of some aspects of digitalisation (ICT) in the region of South-East Europe

Before conducting a quantitative analysis, it is important to examine the specific characteristics of ICT development in the SEE region.

The Organisation for Economic Co-operation and Development (OECD 2019) summarises the existing tools for measuring some aspects of digitalisation connected with trade performance and points out the following approaches:

- E-commerce Readiness is developed by the United Nations Conference on Trade and Development (UNCTAD), it is focused on Business to Consumer (B2C) online shopping transactions and measures an economy's preparedness to support online shopping, i.e. web presence, possibility to pay online and delivery reliability.
- The Networked Readiness Index was developed by the World Economic Forum (WEF) to measure the capacity of countries to leverage ICTs for increased competitiveness and wellbeing. It consists of subindexes: the enabling *environment,* a country's *readiness* in terms of, for example, infrastructure and skills, the *usage* of ICT and the economic and social *impacts*[2]. The new Network Readiness Index, developed by the Portulans Institute (2019), consists of four pillars: technology (access, content and future technology), people (individuals, businesses, government), governance (trust, regulation, inclusion) and impact (economy, quality of life, sustainable development goals contribution).
- The Global ICT Development Index was developed by the International Telecommunication Union (ITU). It aims to measure the information society by combining 11 indicators on ICT *access* (an indication of the available ICT infrastructure and individuals' access to basic ICTs), ICT *usage* (including intensity of use) and ICT *skills*.

Among these three approaches, the first one is the only approach that comprises the region of our interest, the SEE countries. The second one includes four South-East European countries: Serbia, North Macedonia, Albania and Bosnia and Herzegovina. In the observed group of 121 countries, Serbia reached a score of 53.65 and is ranked in the 52nd position, North Macedonia is ranked 65th with a score of 48.97, Albania is 75th with a score of 46.57 and Bosnia and Herzegovina is in the 81st position with a score of 42.72 (Portulans Institute 2020).

**Table 1. Indicators of Internet usage in South-East European countries**

| Countries | B2C e-commerce Rank 2019 | B2C e-commerce Index value | Share of individuals using the Internet (2018) in % | Share of individuals with an account (15+, 2017) in % | Secure Internet servers (normalized, 2018) | Internet shoppers as a share of Internet users (2018) in % | Internet shoppers as a share of population (2018) in % |
|---|---|---|---|---|---|---|---|
| Serbia | 45 | 76.2 | 73 | 71 | 77 | 46 | 34 |
| North Macedonia | 51 | 73 | 79 | 77 | 55 | 31 | 24 |
| Bosnia and Herzegovina | 63 | 61.5 | 70 | 59 | 67 | 25 | 18 |
| Albania | 75 | 54.4 | 72 | 40 | 56 | 9 | 7 |
| Montenegro | 77 | 54.2 | 72 | 68 | 55 | 16 | 12 |
| Kosovo | … | … | … | … | … | 25 | 22 |

Source: UNCTAD 2019a and UNCTAD 2019b.

The B2C e-commerce index is calculated for 152 countries and Table 1 shows the ranking, the scores and the main indicators included in that index. The best performer in that region is Serbia, while Kosovo is not included in the ranking. In an analysis of the complete data, we should emphasise that eight out of ten of the best performers in the world are in Europe. The first three countries are the Netherlands, Switzerland and Singapore, with scores of 96.4, 95.5 and 95.1, respectively. Looking at the shares of Internet shoppers in Internet users and in the total population, we can see that the numbers are quite small, while about half of the Internet users in Serbia also use the Internet for shopping, and only 9 % of Albania's Internet users use it for shopping.

All the above-mentioned approaches are focused on some preconditions for the development of digital trade transactions or on measuring the value of e-commerce.

### 3.2. Methodology and data

Regarding the literature review, the optimistic and comprehensive way to assess the impact of ICT development on foreign trade would be by including the variables which cover digital infrastructure (access), digital usage and digital skills, so our variables of interest are: fixed telephone lines per 100 inhabitants (as a measure of infrastructure), percentage of individuals using the Internet (as a measure of usage) and secondary and tertiary school enrolment ratio (as a measure of skills).

Due to the fact that the database for this investigation involves two dimensions: a cross-sectional and time-series (6 countries and a 20-year period), based on Hsiao (2003), Wooldrige (2002) and Verbeek (2008), the use of panel data is appropriate and also includes the advantage of mitigating the bias generated by heterogeneity across countries.

As for the digitally enabled transactions, where the important factor is ICT development, in both the host and home countries, we will create gravity equations for the bilateral export and import flows of SEE countries. The gravity model was initially introduced by Tinbergen (1962), and then many authors (Bergstrand 1985 and 1989; Krugman 1980; Anderson and van Wincoop 2003; Helpman, Melitz, and Rubinstein 2008; Afolabi, Abu Bakar, and Aziz 2016) contributed to its development and implementation.

The general formulation of the gravity equation is in the following multiplicative form:

$$X_{ij}= GS_iM_j\Phi_{ij} \quad (1),$$

where $X_{ij}$ is the export value from country *i* to country *j*, $M_j$ denotes all importer-specific factors that make up the total importers' demand (such as the importing country's GDP) and $S_i$ comprises exporter-specific factors (such as the exporters' GDP) that represent the total amount exporters are willing to supply. *G* is a variable that does not depend on *i* or *j*, such as the level of world liberalisation. Finally, $\Phi_{ij}$ represents the ease with which the exporter *i* can access the market *j* (that is, the inverse of bilateral trade costs).

The standard procedure for estimating a gravity equation is simply to take the natural logarithms of all variables and obtain a log-linear equation that can be estimated by ordinary least squares regression (clearly easier than non-linear estimation methods). This yields the estimation equation:

$$\ln X_{ij}= \ln G+\ln S_i+\ln M_j+\ln\Phi_{ij} \quad (2)$$

or more specifically (in line with Anderson and van Wincoop 2003) we can define the model:

$$\log E_{ij}=a_0+a_1\log Y_i+a_2\log Y_j+a_3\log POP_i+a_4\log POP_j+ a_5\log D_{ij}+a_nX_1\ldots n_{i,t}+\text{dummy}+u_{it};\ i=1\ldots N;\ j=1\ldots N;\ t=1\ldots T \text{ for export} \quad (3)$$

and

$$\log M_{ij}=a_0+a_1\log Y_i+a_2\log Y_j+a_3\log POP_i+a_4\log POP_j+ a_5\log D_{ij}+a_nX_1\ldots n_{i,t}+\text{dummy}+u_{it};\ i=1\ldots N;\ j=1\ldots N;\ t=1\ldots T \text{ for the import function} \quad (4),$$

where *i* represents export (import) country and *j* represents the trade partner, $E_{ij}$ is export of goods and services in EUR and $M_{ij}$ is import of goods and services in EUR and they are dependent variables. The econometric models will include independent variables: GDP (in million EUR, *gdp*), GDP p.c. (in EUR, *gdppc*), populations (in thousands, *pop*). Gravity models also include the distance between countries as a proxy of transport costs, i.e. transportation costs increase as distance increases which can discourage mutual trade. Even though the new technologies may decrease the relevance of geographical distance, the majority of world trade (and also the majority of trade in the SEE region) refers to merchandise trade where the distance is a relevant indicator for transport costs. Distance (D) is measured in kilometres as a distance between capital cities. The value of variables with absolute numbers (expressed in EUR) will be transformed into logarithmic values for easier explanation. $X_{ij}$ are a set of independent variables describing the ICT development that can impact export and import, and $u_{it}$ are called idiosyncratic errors (unobserved characteristics that influence bilateral trade). We will also include the exporter and importer country fixed effects to check

for the particular characteristics of each country. Additionally, time effects are included to check for the effects of cyclical changes on bilateral exports.

From the list of available (ICT) variables we have included the number of fixed telephone lines per 100 inhabitants to assess the *infrastructure (fixtellines),* percentage of individuals using the Internet for *Internet usage (intusage)* and secondary and tertiary gross enrolment ratio as variables for *skills (skillss, skillst)*. Some authors used the data on the number of web hosts as a measure of Internet connectedness and infrastructure (Freund and Weinhold, 2004) but this kind of data is not available for SEE countries. We will also include dummy variables in the analysis: (1) dummyRTA - describes the participation of countries in the same regional trade agreement (in the Central European Free Trade Agreement, CEFTA), (2) dummy border - describes two neighbouring countries, (3) dummy language - countries implement the same language, or the language of the trading partner is understandable (similar) to the national language. If the common characteristics (participation in the same integration, border, language) appear, the value of dummy variables is 1, in case of the opposite, the value is 0.

Panel data can be performed as static or dynamic analysis. In this analysis, we employed both of these: the results of the static analysis are presented in the Appendix, while the methodological approach and the results of the dynamic panel data are elaborated in detail. The dynamic panel data analysis is employed to overcome the limitations of the static panel analysis (endogeneity problems). Estimation with the dynamic model allows the dynamics of the underlying processes, which can be crucial in obtaining consistent estimates of the remaining parameters (Bond, 2002). Turning the lagged dependent variable, except that which alleviates rigidity in the adjustment, also reduces the problem of omitted variables. The dynamic model is defined in the following form:

$$Y_{it}=\delta Y_{it-1}+\lambda X_{it}+\varepsilon_{it} \quad (5)$$

$$\varepsilon_{it}=\eta_i+\gamma_t+u_{it}$$

$Y_{it}$ refers to the dependent variable (which is also included with time lags), $X_{it}$ is the vector of independent variables (presented in Table 2) for country $i$ at time $t$, and $\varepsilon_{it}$ is the error term that includes country- and time-specific attributes. Considering the other characteristics and advantages of the GMM estimators, the Blundell and Bond (1998) system GMM estimator is used in this research. To check the validity of the set of instruments used in the GMM estimation, we applied the Arellano and Bond autocorrelation test (Arellano and Bond 1991). Another specification test is the overidentification that may be caused by the number of instruments that exceeds the number of parameters to be estimated. The Sargan (1958) test of restrictions can be applied to check the validity of the set of instruments.

We expected positive impacts of GDP, population, GDP p.c., ICT variables, dummies on export and import, and negative impacts of distance. With the increasing GDP, we expect higher domestic demand (consumption on the domestic market) but also an increase in export. Through the marginal propensity to import, the increase in GDP will result in increased import, because the domestic production employs domestic resources as well as foreign input raw materials, intermediates, etc.). The level of development, measured by GDP p.c., is an indicator of purchasing power and the higher the GDP p.c., the higher will be the consumption of domestic and imported goods. Applying GDP per capita instead of the variables of GDP and population for both the export (import) country and its trading countries (that will count 4 variables), help us reduce the number of variables in the model because the focus is on ICT variables. Internet infrastructure is a precondition for Internet usage and, mainly in the past, it was related to telephone subscriptions, while today the Internet can be used without a telephone subscription. Internet usage is now a matter of literacy and, with an increased share of the population using the Internet, we can expect that a higher number of them will buy/sell online (through web shops). For the large-scale utilisation of Internet possibilities, and the development of web sites (hosts), skills and proficiency, which are connected with the level of education, are important. With the higher ratio of secondary and tertiary attainment, we can expect a higher impact of skills on international trade.

The source of the data are the World Development Indicators from the World Bank database[3], the Vienna Institute for International Economic Studies (WIIW) database and Eurostat.

The correlation matrix shows that the highest correlation is observed between GDP p.c. and Internet usage, skills (tertiary and secondary education attainment) and Internet usage (higher than 80%) and because of this we have created several models with the inclusion of a different set (combination) of independent variables.

The analysis was carried out from 2000 to 2019. We faced the problem of data (un)availability of some relevant variables, where the data is scarce and covers just a part of the analysed period. For example, data about secondary and tertiary enrolment rates are not available for the entire period, so the number of observations is smaller for the models that include

**Table 2. Variables, data sources and expected impact of independent variables**

| Variable | Description | Data source | Expected impact |
|---|---|---|---|
| *Dependent variables* | | | |
| Export | Export of goods and services (in EUR) | WIIW | |
| Import | Import of goods and services (in EUR) | WIIW | |
| *Independent variables* | | | |
| GDP | Gross domestic product of exporter (importer) *i* and of partner country *j* (in current EUR) | World Development Indicators, Eurostat | + |
| GDP per capita | Gross domestic product per capita of exporter (importer) *i* and of partner country *j* (in EUR) | World Development Indicators, Eurostat | + |
| Population | Number of inhabitants of exporter (importer) *i* and of partner country *j* in thousands | World Development Indicators, Eurostat | + |
| Distance | Distance between capital cities of exporter (importer) and partner country (in km) | Distance calculator, https://www.distance.to/ | - |
| Fixed telephone lines | Fixed telephone subscriptions refer to the sum of active number of analogue fixed telephone lines, voice-over-IP (VoIP) subscriptions, fixed wireless local loop (WLL) subscriptions, ISDN voice-channel equivalents and fixed public payphones; per 100 people | World Development Indicators | + |
| Internet usage | Internet users are individuals who have used the Internet (from any location) in the last 3 months. The Internet can be used via a computer, mobile phone, personal digital assistant, games machine, digital TV etc.; % of individuals | Eurostat, World Development Indicators | + |
| Secondary gross enrolment ratio | the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown, in % | World Development Indicators | + |
| Tertiary gross enrolment ratio | the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown, in % | World Development Indicators | + |
| Dummy RTA | Participation in regional trade agreement, value 1 for participation and 0 for non-participation | World Trade Organization | + |
| Dummy border | Value 1 for exporter (importer) and trade partner that have a common border | | + |
| Dummy language | Value 1 for the implementation of similar (understandable) language between exporter (importer) and partner country | | + |

Source: World Development Indicators, https://databank.worldbank.org/source/world-development-indicators (September 20, 2020), Eurostat, https://ec.europa.eu/eurostat (September 20, 2020), WIIW (2021).

such variables, and for Kosovo, these data are not available at all.

### 3.3. Impact of ICT development on foreign trade in SEE countries- empirical analysis

We carried out the dynamic analysis, for both export of goods and services and import of goods and services.

We created several models with the combination of selected, relevant variables. We first focused on finding out and assessing the importance of the variables of ICT infrastructure, skills and usage on exports and imports. Our intention was not to create a comprehensive (complete) export or import function, because we were aware there are also other variables such as productivity, level of wages, institutional (regulatory) variables, real effective exchange rates, terms of trade etc., such a model should include. We will follow the described gravity model with the inclusion of variables that explain the trade flows between two partners, and we will upgrade the basic model

with ICT variables. The results of gravity models are reported in Table 3. We included one lag for the predetermined variable and two lags for the endogenous variables. The diagnostic test of the models reported at the end of the table was in favour of the hypothesis of proper identification: m1 statistics, which measures the first-order autocorrelation, is negative and significant; and m2 statistics, which measures the second-order autocorrelation, is not significant. Moreover, the null hypothesis of the Sargan test could not be rejected. This means that the instruments used are not correlated with the errors and can be used in the model. The diagnostic tests reported are satisfactory; thus, we can conclude that the estimated model is correctly specified. We decided to provide here three models for the export function and three for the import function by including the variables that proved to be the most significant in a static analysis and the variables of importance for this analysis (ICT variables).

The results of the dynamic panel data analysis indicate the importance of the level of development (GDP p.c.) of both export and import countries, lagged value of import (or export) and Internet usage in importer (exporter) i.e. analysed country as relevant determinants of bilateral trade flows. The introduction of lagged values of import (or export) changes the strength of the influence of the other included variables (in comparison with static panel data analysis) in a way that dominant impact comes from the lagged dependent variable, and the impact of other variables weakens. ICT development highlighted the relevance of Internet usage in both exporter (importer) countries and their trading partners. The impact of Internet usage is small and is in line with the Rodriguez-Crespo,

**Table 3. Impact of ICT development on import and export (GMM; standard errors in brackets)**

| | Dependent variable log.import | | | Dependent variable log.export | | |
|---|---|---|---|---|---|---|
| Independent variables | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
| l.logimport | 0.997 (0.008) *** | 0.931 (0.009) *** | 0.952 (0.009) *** | | | |
| l.logexport | | | | 0.910 (0.013) *** | 0.894 (0.015) *** | 0.914 (0.016) *** |
| Loggdppci | 0.087 (0.004) ** | 0.518 (0.091) *** | 0.078 (0.038) *** | 0.156 (0.104) ** | 0.123 (0.078) * | 0.021 (0.015) * |
| loggdppcj | 0.014 (0.011) * | 0.163 (0.052) *** | 0.028 (0.013) * | 0.018 (0.043) | 0.102 (0.051) * | 0.032 (0.045) |
| intusagei | 0.007 (0.005) * | | | 0.022 (0.002) * | | |
| intusagej | 0.001 (0.001) | | | 0.010 (0.002) | | |
| fixtellinesi | | 0.000 (0.001) | | | 0.008 (0.003)* | |
| fixtellinesj | | -0.001 (0.002) | | | 0.008 (0.003)* | |
| skillssi | | | 0.001 (0.001) | | | 0.005 (0.003)* |
| skillssj | | | 0.002 (0.001) | | | 0.00 (0.007) |
| logD | -0.214 (0.002)* | -0.482 (0.083)*** | -0.300 (0.018)** | -0.627 (0.033)** | -0.562 (0.033)** | -0.822 (0.044)* |
| observations | 1682 | 1749 | 1270 | 1514 | 1586 | 959 |
| Groups | 120 | 119 | 98 | 115 | 119 | 100 |
| AR(1) p-value | -16.57 (0.000) | -11.67 (0.000) | -13.97 (0.000) | -15.22 (0.000) | -14.70 (0.000) | -8.84 (0.000) |
| AR(2) p-value | 1.86 (0.062) | 0.34 (0.737) | 0.93 (0.352) | 2.42 (0.115) | 2.40 (0.016) | 1.04 (0.298) |
| Sargan-Hansen test p-value | 0.148 | 0.143 | 0.129 | 0.135 | 0.143 | 0.115 |

Source: own calculations.

et al. (2019) findings, who found a lower impact of Internet usage on both export and import for low and middle-income countries in comparison with developed countries. They also found a smaller impact on import vs. export flows. The ICT infrastructure and the level of education are not significant for explanation of import but have a small significance in the explanation of export flows. The non-significance (or very small influence) of variables on digital skills can be explained by concluding that Internet usage is the most important and it is not necessarily related to the level of education for online purchasing (surely the level of education is important for some more complex functions, but the process of online buying/selling is very simple and user-friendly). Furthermore, exporters (companies) usually pay professionals to create their websites (hosts) and the software for web shops, so the exporters are just users and not the creators of those kinds of websites. The relevance of infrastructure (measured here with the number of telephone lines) is limited, because the number of telephone subscriptions is decreasing and no longer connected with the use of the Internet (even in the past, in the 2000s, it was connected). So, the results are as expected and in accordance with the theory. The impact of distance is negative and significant in explanation of bilateral export and import flows of SEE countries.

The results are consistent with the results of the static panel data analysis which also indicate that all three included dummy variables also have a positive impact on exports.

## 4. Conclusion

The present situation, characterised by the spreading of the COVID-19 pandemic which started at the beginning of spring 2020, has resulted in the imposition of some restrictions on the freedom of movement. In the situation of "working at home", "online schools" etc., the importance of the usage and possibilities of ICT technology has surged. This paper focuses on the connection between ICT development and foreign trade performance in the region of South-East Europe.

The issue is quite new, with limited scientific (background) research (covering this specific region), which is no surprise, because, to obtain data on a range of ICT variables, it would be useful to compare and connect with the foreign trade flows, which means facing numerous limitations in data availability.

Within this framework, we have performed an analysis which resulted in some important findings - only ICT usage has an impact on imports of the SEE region countries, while the ICT skills (measured by secondary or tertiary attainment ratios) and ICT infrastructure (number of telephone lines) are not significant variables for the import. The findings are in line with Liu and Nath (2013), Rodriguez-Crespo and Rocio (2019) and are within our expectations. The dynamic analysis highlights a high importance of the lagged values of import for the explanation of import flows, while additionally, for the export - the level of ICT infrastructure and secondary skills (in observed SEE countries) also became important (together with lagged values of export).

The data covers a twenty-year period, and the findings should be useful indicators for different sectors to increase their online visibility. It is related to government services and goods and services provided by companies. Another concern refers to the creation of a simple and barrier-free framework for the development of e-commerce within countries, but also in performing cross-border trade activities. The technological advances are an essential enabler of international trade expansion but, to exploit the opportunities they offer, it is just as important to ensure adequate capacity to manage the changes at play (WTO, 2018).

The obtained results should be a guide to invest more in: ICT modern infrastructure (high-speed Internet, 5G network), promoting usage of the Internet at the upgraded level (not just for reading and finding some information), i.e., improving the digital skills or digital literacy which is partially connected with the level of education, but there are also many life-long learning courses for improving skills. It is also connected with online payments (e-banking, m-banking), confidence (security, consumer protection) in buying and selling online. On the other hand, the entrepreneurial sector should invest in its presence on the Internet and in creating offers of its products and services online i.e., creating their digital business strategies. It has been widely recognised that web sales (shops) can be an inevitable tool to survive these difficult periods of doing business in the periods of an unusual crisis, but this sales tool can also be an instrument for providing own goods and services to consumers located worldwide. So, to be present and active on the Internet (e.g. have one's own website, to have a web-shop, to be present on social media, etc.) is an imperative for being successful now and in the future. Importers (buyers) on the Internet must be protected in different ways (personal data, payment, delivery (quality) of ordered articles/services), which are regulatory (government) issues.

Governments have recognised the benefits of digital technologies and they are promoting their use to facilitate trade by reducing delays in the clearance of goods at borders, thereby lowering associated costs.

They should also address concerns relating to consumer protection, cybersecurity, data privacy and competition that arise from digital trade transactions.

This analysis is, in a way, pioneering (or perhaps even ambitious) and therefore somewhat limited, mainly in terms of the (un)availability of data about ICT indicators in all SEE countries as well as educational attainment in particular countries. Availability of data would enable the inclusion of a wider set of ICT variables (about the infrastructure, usage and skills) in the models and produce more reliable and complete results. Moreover, a more intensive implementation of ICT would result in a change of the trade patterns, which is not the focus of this paper, because the performance in ICT development of the SEE region is lagging behind the EU Member States, which can be an obstacle to their foreign trade activities and changes that have started to happen in developed countries.

The approach, the applied methodology and the findings can pave the way for further analysis that will overcome the designated limitations, and which can be focused on specific countries, sectors and/or trade partners.

## Endnotes

1 Geographically there should be included also Croatia, Greece, Romania and Bulgaria, but they are EU members and because of this they were excluded from the analysis.

2 The last edition was published in 2016.

3 The values of GDP, GDP per capita for countries outside the EU are converted from USD to EUR using the average annual USD/EUR exchange rates available at the ECB, https://sdw.ecb.europa.eu/browse.do?node=9691296.

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## Acknowledgements

The research was supported by the grant project "The determinants and challenges of competitiveness" by the Faculty of Economics and Tourism "Dr. Mijo Mirković", Juraj Dobrila University of Pula, Croatia. Any opinions, findings, and conclusions or recommendations expressed in this article are those of the author(s) and do not necessarily reflect the views of the Faculty of Economics and Tourism "Dr. Mijo Mirković", Pula.

# APPENDIX

**Table 4. Impact of ICT development on export (dependent variable log.export of goods and services, standard errors in brackets; static panel data analysis)**

| Independent variables | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 8 | Model 7 | Model 8 |
|---|---|---|---|---|---|---|---|---|---|
| Loggdppci | | 2.100 (0.261)*** | 1.656 (0.528)* | 2.574 (0.268)*** | 1.470 (0.242)*** | 1.502 (0.713) | 2.433 (0.929)** | 1.646 (0.692)* | 2.191 (0.982)** |
| loggdppcj | | 0.428 (0.082)*** | 0.935 (0.144)*** | 0.105 (0.112) | 0.521 (0.065)*** | 0.391 (0.122)* | 1.193 (0.212)** | 0.855 (0.113)*** | 0.688 (0.314)** |
| intusagei | | | 0.029 (0.004)*** | | | | 0.038 (0.005)*** | 0.035 (0.007)*** | 0.039 (0.005)*** |
| intusagej | | | 0.003 (0.143)*** | | | | 0.005 (0.001)** | 0.031 (0.010)* | -0.041 (0.017) |
| fixtellinesi | | | | -0.017 (0.011) | | | 0.028 (0.024) | 0.037 (0.019) | 0.020 (0.023) |
| fixtellinesj | | | | 0.025 (0.008)* | | | 0.032 (0.012)* | 0.021 (0.013) | 0.031 (0.017) |
| skillssi | | | | | 0.017 (0.008)* | | 0.003 (0.004) | 0.002 (0.004) | -0.000 (0.004) |
| skillssj | | | | | -0.0064 (0.002) | | 0.001 (0.002) | -0.002 (0.005) | -0.012 (0.005) |
| skillsti | | | | | | 0.021 (0.023) | | | |
| skillstj | | | | | | -0.005 (0.008) | | | |
| Loggdpi | 1.944 (0.253)*** | | | | | | | | |
| Loggdpj | 0.337 (0.092)*** | | | | | | | | |
| logpopi | -4.86 (2.764) | | | | | | | | |
| logpopj | 0.141 (0.155) | | | | | | | | |
| logD | -1.496 (0.131)*** | -0.781 (0.144)*** | -0.778 (0.143)*** | -0.673 (0.149)** | -0.625 (0.166)** | -0.571 (0.173)** | -0.516 (0.166)* | | |
| dummyRTA | | | | | | | 1.532 (0.195)*** | | |
| dummyborder | | | | | | | | 1.841 (0.346)** | |
| dummylan-guage | | | | | | | | | 1.242 (0.217)*** |
| Time fixed effects | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| R-squared | 0.413 | 0.330 | 0.350 | 0.311 | 0.319 | 0.235 | 0.438 | 0.460 | 0.361 |
| F test | 515.64 (0.000) | 90.57 (0.000) | 17490 (0.000) | 108.54 (0.000) | 158.26 (0.000) | 89.25 (0.000) | 115,78 (0.000) | 187.23 (0.000) | 189.35 (0.000) |
| Number of observation | 2128 | 2126 | 1693 | 1756 | 1251 | 1363 | 1103 | 1103 | 1103 |

All models include constant variable. Standard errors are in parenthesis. ***P statistically significant at 1%. **P statistically significant at 5%. *P statistically significant at 10%.

Source: author's calculations.

**Table 5. Impact of ICT development on import (dependent variable log.import of goods and services, standard errors in brackets; static panel data analysis)**

| Independent variables | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 | Model 9 |
|---|---|---|---|---|---|---|---|---|---|
| Loggdppci | | 1.366 (0.100)*** | 1.963 (0.588)* | 1.683 (0.157)*** | 1.565 (0.203)*** | 0.637 (0.098)* | 2.297 (0.737)* | 2.620 (0.581)** | 2.417 (0.435)*** |
| loggdppcj | | 0.021 (0.044) | 0.533 (0.117)*** | 0.397 (0.112)* | 0.058 (0.054) | 0.039 (0.005)* | 0.253 (0.161) | 0.324 (0.195) | 0.339 (0.156)* |
| intusagei | | | 0.014 (0.006)* | | | | 0.020 (0.007)* | 0.021 (0.004)*** | 0.019 (0.004)** |
| intusagej | | | -0.034 (0.006) | | | | 0.040 (0.007)* | 0.041 (0.010)* | 0.036 (0.006)** |
| fixtellinesi | | | | -0.020 (0.009) | | | -0.009 (0.015) | -0.005 (0.009) | 0.001 (0.008) |
| fixtellinesj | | | | 0.030 (0.006)** | | | 0.033 (0.007)** | 0.032 (0.006)** | 0.029 (0.007)** |
| skillssi | | | | | -0.005 (0.004) | | | -0.009 (0.003) | -0.008 (0.002) |
| skillssj | | | | | 0.003 (0.003) | | | 0.004 (0.002) | 0.008 (0.002)* |
| skillsti | | | | | | 0.017 (0.030) | | | |
| skillstj | | | | | | -0.004 (0.003) | | | |
| Loggdpi | 1.363 (0.082)*** | | | | | | | | |
| Loggdpj | 0.014 (0.035) | | | | | | | | |
| logpopi | -0.814 (1.220) | | | | | | | | |
| logpopj | 0.516 (0.101)*** | | | | | | | | |
| logD | -0.885 (0.157)*** | -0.100 (0.050) | -0.137 (0.040)** | -0.048 (0.042)* | -0.118 (0.057) | 0.017 (0.070) | -0.051 (0.044) | | |
| dummyRTA | | | | | | | 0.361 (0.106)* | | |
| dummyborder | | | | | | | | | 0.770 (0.331)* |
| dummylan-guage | | | | | | | | 0.635 (0.351) | |
| R-squared | 0.345 | 0.189 | 0.249 | 0.201 | 0.223 | 0.272 | 0.340 | 0.373 | 0.417 |
| Time fixed effects | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| F test | 496.48 (0.000) | 102.71 (0.000) | 312.13 (0.000) | 6569.40 (0.000) | 1083.26 (0.000) | 1977,34 (0.000) | 2344,28 (0.000) | 2133,56 (0.000) | 2098,45 (0.000) |
| Number of observation | 2191 | 2188 | 1740 | 1806 | 1377 | 1377 | 1631 | 1167 | 1167 |

All models include constant variable. Standard errors are in parenthesis. ***P statistically significant at 1%. **P statistically significant at 5%. *P statistically significant at 10%.

Source: author's calculations.