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Digital economy and its influence on competitiveness of countries and regions

La economía digital y su influencia en la competitividad de los países y regiones

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ABSTRACT:

The article defined digital economy from technological, industrial, process, and social perspectives. A SWOT analysis revealed the strengths, weaknesses, opportunities and threats associated with the digital economy. The article offered an author's interpretation of the concept of national competitiveness. Information about the digital infrastructure of Switzerland, Russia, and Azerbaijan were extrapolated via digital profiling based on the specially selected indicators. The competitive positions of the top 30 countries exporting telecommunications, computer and information (TCI) services were determined. The cluster analysis was based on data regarding the share of TCI services in the country's and global service exports. Strategies of competitive exporters (i.e., leaders, potential leaders, and non-interested actors) were identified. The article provides recommendations for countries that seek to strengthen their competitive position and improve digital competitiveness. The results show in particular that digital competitiveness of Countries could gain with several actions, like investments in digital industry, improve the digital literacy of the population, develop a digital culture, and improve the legal foundations of e-commerce and cybersecurity.
Keywords: new economy; digital technology; digital competitiveness; competitive advantages; computer and information services; service exports; cluster analysis.

RESUMEN:

El artículo definió la economía digital desde la perspectiva tecnológica, industrial, de procesos y social. Un análisis FODA reveló las fortalezas, debilidades, oportunidades y amenazas asociadas con la economía digital. El artículo ofreció una interpretación de un autor sobre el concepto de competitividad nacional. La información sobre la infraestructura digital de Suiza, Rusia y Azerbaiyán se ha extrapolado a través de perfiles digitales basados en indicadores especialmente seleccionados. Se determinaron las posiciones competitivas de los 30 principales países exportadores de servicios de telecomunicaciones, informática e información (TIC). El análisis de conglomerados se basó en datos relacionados con el peso de los servicios de TIC en las exportaciones de servicios del país y los servicios globales. Se identificaron estrategias competitivas de exportación (es decir, líderes, líderes potenciales y actores no interesados). El artículo proporciona recomendaciones para los países que buscan fortalecer su posición competitiva y mejorar la competitividad digital. Los resultados muestran, en particular, que la competitividad digital de los países podría beneficiarse de diversas acciones, tales como inversiones en la industria digital, mejorar la alfabetización digital de la población, desarrollar una cultura digital y mejorar los fundamentos legales del comercio electrónico y la ciberseguridad.
Palabras clave: nueva economía; tecnología digital; competitividad digital; ventajas competitivas; Servicios informáticos y de información; exportación de servicios; análisis de conglomerados.

1. Introduction

Digital transformations are inherent in and distinguish the economic system of modern-day countries. Computer and information technologies (CIT) are being incorporated in almost all areas of economic activity, which results in the emergence of the new forms of business, new professions, new markets, and the new legal relations between the government and the entities (e.g., taxation in a digital economy). In such conditions, countries digitally developed have significant competitive advantages over countries that do not invest enough in innovations.

Given the all-embracing nature of digitalization, this study is of particular interest to the international scientific community. The use of innovative digital solutions makes a difference in all spheres of social activity; from the production, sale and consumption of digital goods and services to the creation of an interactive digital environment for social communication, to the formation of a digital culture, to the emergence of e-democracy, etc.

The practical relevance of the study lies in the fact that it provided a list of indicators, which may be used in country's digital profiling (this refers to the strength of digital economy). Authors developed an approach towards evaluating country's competitive advantages in the international market. Additionally, the article offered a list of actions, with the aim of boosting digital competitiveness of countries that were classified as potentially leading exporters.

2. Literature review

According to several economists (Radu & Podașcă, 2013; Burma, 2016; Glushkova et al., 2019), digital technology is a product of the Fourth Industrial Revolution, which has set the economy to radical changes. Digital innovations contribute to the development of a new economic order, sometimes called digital economy, information economy, virtual economy, or network economy. These new structures open previously unknown opportunities for society, business, and the state.

The literature provides a diverse understanding of the essence of digital economy. Fayyaz (2019) states that markets based on digital technologies facilitate the trade of goods and services. No one will disagree with the fact that the trade of goods and services through e-commerce is a crucial component of digital economy but reducing digital economy to e-commerce narrows the understanding of its essence.

In contrast to the above, the World Bank (2016) characterizes digital economy as a system of economic, social and cultural relations that are based on digital technologies. This is a broad approach that embraces the whole spectrum of social relations. At that, the said definition refers to a more general meaning.

In our opinion, digital economy stands out with how goods and services are developed, produced, and sold (i.e. via digital technologies). Aguila, Padilla, Serarols & Veciana (2003) hold a similar view. Huckle, Bhattacharyaa, Whitea & Beloffa (2016), D'Souza & Williams (2017), and Barefoot, Curtis, Jolliff, Nicholson & Omohundro (2018) detail the diversity of digital technologies.

Zimmerman (2000), Alvedalen & Boschma (2017), Autio, Nambisan, Thomas & Wright (2018) focus on the fundamental changes in business organization, which take place during the period of digital transformation. Exploring digital economy from this point of view allows entrepreneurs to build their businesses by taking all advantages of digital technologies.

A variety of issues that surround the use of digital technologies in traditional sectors of industrial economy are tackled by Tuballa & Abundo (2016), Agrawal & Sen (2017), Pivoto, Waquil, Talamini, Spanhol, Corte & Mores (2018). The content of these works allows determining both the prospects for the creation of new markets and economic benefits of participation in them.

The transformation of social relations in the context of digital economy is discussed by Vermeulen et al. (2009), Redondo (2015) and Haiqing (2017). These studies allow identifying social risks that arise in connection with the emergence of new forms of economic activity. With this knowledge, measures for social protection in the new economic conditions can be developed.

The above works throw light on the certain aspects concerning the functioning of digital economy that together portray its essence. A narrow view of these works necessitates systematization of approaches towards the research on digital economy. In this way, the knowledge about it will be holistic.

The effect of digital economy on the competitiveness of countries and regions is insufficiently studied. Moreover, the very concept of country's competitiveness is not fully explored, as evidenced by the lack of consensus on factors impacting it. For instance, some scientists associate competitiveness with the economic efficiency. It is defined as the ability of a country to provide its population with a high quality of life (Siudek & Zawojska, 2014); a set of institutions, policies, and factors that determine the level of productivity of a country (Schwab & Sala-i-Martin, 2013; Rusu & Roman, 2018); an ability of a country to achieve sustained high rates of economic growth (Kharlamova & Vertelieva, 2013; Khyareh & Rostami, 2018).

As we see it, competitiveness refers to a set of characteristics of one object with respect to comparable benchmarks. A same attitude was held by Rusu & Roman (2018), who tied competitiveness to the favorable position of a country in international trade, and by Barker & Köhler (1998), who associated competitiveness with the ability of a country to produce goods and/or services that are in demand in the international market. However, these definitions take into account neither the quality of goods and services produced in the country (and this is when the product quality serves as a determinant of high

demand) nor the country's ability to ensure that goods are produced in the quantity enough to satisfy the internal and external demand.

The presented above indicates that the study on the relationship between digital economy and competitiveness needs to be continued.

3. Problem statement

Traditionally, economic system competitiveness was based on obtaining competitive advantages in the markets, which allowed reducing the geopolitical dependence. Such competitive benefits mostly associated with the energy independence and availability of trading resources. However, these days among the basic types of competitive advantages, unique ones may also exist. Such a situation stabilizes the economic model of the country and makes it less dependent on the turbulent environment. Stable economic development, security in foreign trade, and the availability of resources for the implementation of the strategic goals are crucial in developing an independent political life of the state. These factors allow the country to protect its geopolitical non-aligned status, which ensures adhering to its interests in the international arena, protecting its development, and having no necessity to meet the other states' requirements Evaluating the competitiveness of countries with bloc affiliation is much more difficult since such an analysis will be multicomponent and include an assessment of relations between the state's dependence and other geopolitical entities. Bloc affiliated countries are supposed to have non-aligned status, already established competitive advantages in global markets and the least dependence potential. For this reason, the following European states are selected for analysis: the Russian Federation (economic independence based on energy and trade in raw materials); Switzerland (economic independence due to unique banking, representative services, and luxury trade); Azerbaijan (economic independence based on the presence of rich oil fields and trade in petroleum products). Even though these countries are similar in terms of their competitiveness strategy, they differ in the culturally and religiously. Consequently, the formation of their characteristics of competitiveness strengthening tactics in the context of digitalization will vary. The research was aimed at improving the interpretation of the digital economy and the countries. Based on the deeper understanding of the concept, a new approach towards identifying the competitive position of countries in the digital market was developed. The corresponding digital profiles were presented for each individual country under consideration. A list of actions aimed at boosting national competitiveness was compiled.

The research aimed to investigate the effect of digital economy on the competitiveness of countries and regions. To achieve this goal, the following tasks were completed:

- articulate the digital economy concept;
- conduct a SWOT analysis of digital economy;
- define national competitiveness;
- select indicators for digital profiling;
- create and compare digital profiles of Switzerland, Russia, and Azerbaijan;
- determine the competitive position of top 30 countries exporting telecommunications, computer and information services;
- identify competitive strategies of different countries in the international market;
- develop measures to strengthen the competitive position of countries under consideration and to increase their digital competitiveness.

4. Materials and methods

The concept of digital economy was articulated from several perspectives, with attention paid to technology, business, organizational issues, and the social aspect. Then, a SWOT analysis of the digital economy was carried out, according to Gürel & Tat (2017). This method was used to pinpoint *strengths* and *weaknesses* of digital economy; to describe *opportunities* that open up for individuals, business sector, and the government when digital technologies enter the game; and to identify *threats* associated with digitalization of the economy.

The national competitiveness notion that was offered here took into account a set of external factors impacting the production of goods and services, their quality, as well as the country's ability to satisfy domestic and external demand independently.

For comparative study, digital profiles were made for Switzerland, Russia, and Azerbaijan. Materials used to decide on digital profiling indicators were data provided by the International Telecommunication Unit and by the World Bank (these were indicators of financial inclusion from the Global Financial Inclusion Database).

The competitive positions of top 30 countries exporting telecommunications, computer and information services were determined by non-hierarchical k-means clustering. This approach was applied to process data regarding the share of TCI (telecommunications, computer and information) services in the country's and the global service exports.

An analytical method in data mining, cluster analysis was performed in accordance with Na, Xumin & Yong (2010) and Trebuňa & Halčinová (2013). This method is intended to group a set of objects into homogeneous groups or clusters. To map the competitive position of countries exporting TCI services, data from the International Trade Center were processed using the Statistica software.

The competitive strategies of TCI service exporters were explored in relation to leaders, countries seeking to become leaders in the export of TCI services, and countries that are not targeted at exporting such a service.

To conclude the research, measures to improve the competitive position and digital competitiveness of countries under study were developed.

The object of research is the production, sale, and consumption of goods and services with the use of digital technologies. The subject of research is the effect of these processes on the competitiveness of countries and regions.

5. Results

A factor that decisively affects whether one or another type of social relationship will be attributed to a digital domain is the production, sale and consumption of goods and services via digital technologies. Such an approach allows describing digital economy as a set of social relations that emerge in connection with the use of digital infrastructure.

The SWOP analysis results allow recognizing the following characteristics of digital economy.

Strengths:

- innovations are incorporated in all spheres of business and social life (digital solutions save time and resources through rapid execution, thus, after a one-time precedent, the application of an innovative tool becomes an everyday practice);

- a range of new markets emerge (since time and effort to solve a standard problem are saved, unused resources are redistributed to other tasks and activities; this speeds up the production operating cycles and economic systems, contributing to the potential shift to new areas (unneeded at previous stages of the economic system development) and previously inaccessible geographical markets);

- growth in labor productivity (the gradual rejection from manual labor in areas where the process uniqueness is not necessary allows reducing the number of operational errors and allows releasing workers for creative activities; all this enables realizing the potential of employees and increasing the efficiency of their work);

- production and selling expenses reduce (inaccessible supply chains and geographic markets are becoming available; the production cost reducing can be involved into the process without human intervention; an increasing number of services and goods have no physical implementation, but only a virtual form, which significantly decreases operational risks for the manufacturer);

- goods and services become of better quality (more goods and services become available to the consumer, which encourages manufacturers instead of the old "cheap resource access" to form new competitive relations based on the quality of the offered goods and services).

Weaknesses:

- low trust in the digital environment (elder people do not perceive virtual goods and services as fully functional ones);

- increase in the share of part-time employment (technologies replace workers; thus, states are to develop employment models for substituted people to avoid ruining the balance of the social sphere);

- increase in the risk of incapacity for work due to undeveloped skills (education of a significant part of the employees on the market does not meet the requirements of digital infrastructure);

- decrease in personal security (private data, bank passwords, and other confidential information that can be used against a person may remain in a digital footprint that one leaves).

Opportunities:

- provide a broader range of goods (lower operating costs allow manufacturers to market a wider products assortment);

- create new professions (the transformation of the social relations stimulates the emergence of new demands, which can be responded by the new occupations);

- meet preferences of individual consumers (operational transformations, along with digitalization, can satisfy the needs of consumers more accurately);

- improve the standard of living (the economic transition due to digitalization, from "survival and use" to "creation and use" allows income redistributing at the level of the national system to improve the life quality).

Threats:

- growth of cybercrime (the public life transfer to cyberspace causes a similar crime transfer as a response to the social processes development);

- weak regulatory framework for digitalization (the regulatory framework can control life events only after they are firmly entrenched in public life; up until this period the participants in such events remain de facto unprotected);

- violation of consumer rights related to online trade (the consumer cannot check the quality of the purchased product until the purchase itself, while many groups of goods after the sale are not refundable);

- growth of technological unemployment (employers prefer the introduction of advanced technologies and costs reduction rather than working with staff).

Investing in digital solutions allows countries to gain competitive advantages and thus improve competitiveness, characterizing the level of country's development relative to other countries. In this study, competitiveness is a country's ability to produce high-quality, on-demand goods and services in the existing social, economic and political conditions, meeting the internal and external demand.

The effect of digital economy on national competitiveness was investigated on the example of Switzerland, Russia, and Azerbaijan. Table 1 presents digital profiling results that reflect the competitiveness of these countries (i.e., access to digital goods and services, the use of digital goods and services, and digital activity).

Table 1
Digital Profiles of the Following Countries: Switzerland, Russia, and Azerbaijan (data as of 2017)

Indicators	Switzerland	Russian Federation	Azerbaijan
Mobile-cellular telephone subscriptions per 100 inhabitants	135.6	163.3	106.3
International internet bandwidth per Internet user (Bit/s)	269221.7	51888.1	34255.1
Percentage of households with computer	89.3	74.3	64.3
Percentage of households with Internet access	86.8	74.8	77.4
Percentage of individuals using the Internet	89.4	76.4	78.2
Fixed (wired)-broadband subscriptions per 100 inhabitants	46.3	19.5	18.6
Active mobile-broadband subscriptions per 100 inhabitants	103.7	75.0	57.4
Made or received digital payments (% age 15+)	96.5	70.5	24.6
Used the internet to pay bills or to buy something online (% age 15+)	72.5	39.6	9.4
Used a mobile phone or the internet to access an account (% age 15+)	56.0	33.2	2.0

Data in Table 1 indicate that countries under consideration have different levels of access to digital infrastructure and the extent to which their citizens use it varies too.

Switzerland is a country with the highest level of digital development. It occupied a leading position by focusing on IT education and digital R&D. However, raising funds for digitalization remains a challenging task.

As well as Switzerland, Russia offers good IT education services but lags behind Switzerland when it comes to the protection of intellectual property rights and research legislation. According to the BSA Software Manufacturers Association, the rate of unlicensed software use in Russia grew to 64 percent in 2015 (BSA reports, 2019). This gain resulted from the economic downturn, which caused the prices for imported software products to grow. Together with a decrease in the disposable personal income of software users, these tendencies bred ground for the use of illegal software products. This study confirms the existence of intellectual property rights protection issues.

In Russia, the first-order problem that hinders the development of digital economy is the poor digital infrastructure. According to the *Russian Digital Economy Program*, the country needs to achieve the following benchmarks to enhance digital economy:

- 97 percent of households with access to 100 Mbps broadband;
- 5G coverage with stable connection and higher in all large cities (1 million people or more) (Resolution No. 1632-r on Digital Economy Program Implementation, 2017).

In recent years, Azerbaijan has pursued a liberal foreign economic policy (Gulaliyev et al., 2017). This enabled the Azerbaijani government to prioritize digital economy. At that, the country joined the EU4Digital project, funded by the European Union. Within its framework, TCIs are expected to play an important role in economic diversification. Currently, the government is putting efforts to increasing the

access to digital infrastructure for households and to improve digital literacy, assuming that this will contribute to the development of e-commerce.

Digital competitiveness refers to the competitive position of digital product and service exporters. Table 2 shows data on the competitive position of Switzerland, Russia, and Azerbaijan as the exporters of telecommunications, computer and information services, relative to other countries.

Table 2
Inputs for the Cluster Analysis of Competitiveness (data as of 2018)

Exporters	Exports of telecommunications, computer and information services, US Dollar thousand	Total service exports, US Dollar thousand	Telecommunications, computer and information services, % of country's service exports	Telecommunications, computer and information services, % of world's service exports
Ireland	101130494	205731803	49.2	17.0
India	58248442	205108133	28.4	9.8
China	47057609	266841238	17.6	7.9
USA	43959919	828428111	5.3	7.4
Germany	40770579	331155736	12.3	6.8
United Kingdom	28103406	376157024	7.5	4.7
Netherlands	27181077	242488584	11.2	4.6
France	20723274	291494233	7.1	3.5
Sweden	15006481	73134527	20.5	2.5
Israel	14402779	49929432	28.8	2.4
Spain	14392001	149166612	9.6	2.4
Belgium	13972573	123404745	11.3	2.3
Singapore	13207555	184015297	7.2	2.2
Switzerland	12441397	124274714	10.0	2.1
Italy	9532688	121589042	7.8	1.6
Canada	9020156	92881017	9.7	1.5
Finland	8171966	32704428	25.0	1.4
Poland	7850134	69246118	11.3	1.3
Austria	7320354	74143741	9.9	1.2
UAE	6725664	71831178	9.4	1.1
Philippines	5939975	37468748	15.9	1.0
Romania	5517603	26610671	20.7	0.9
Russian Federation	5260359	64858519	8.1	0.9

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Denmark	4911450	69557638	7.1	0.8
Korea, Republic of	4832571	96600613	5.0	0.8
Japan	4566489	192006366	2.4	0.8
Czech Republic	4237907	29927451	14.2	0.7
Luxembourg	3872933	113138788	3.4	0.6
Taipei, Chinese	3764000	50289958	7.5	0.6
Azerbaijan	78995	4690704	1.7	0.0

Countries in the competitiveness ranking were grouped in three clusters:

Cluster I. Leading Exporters. Among the countries under consideration, only one can be can be classified as a leading exporter; Ireland, exporting 49.2 percent of telecommunications, computer and information services that account for 17.0 percent of global TCI exports.

Cluster II. Seeking to Become Leading Exporters. This cluster includes six countries: Israel, India, China, Romania, Finland and Sweden, with the average exports 23.5 and 4.1 percent, respectively.

Cluster III. Not Targeted at Exporting TCI. Twenty-three countries belong to this cluster: the US, Germany, the UK, Netherlands, France, Spain, Belgium, Singapore, Switzerland, Italy, Canada, Poland, Austria, the United Arab Emirates, Philippines, Russia, Denmark, Korea, Japan, Czech Republic, Luxembourg, Taipei, and Azerbaijan. The average exports are 8.5 and 2.1 percent, respectively (Figure 1).

Figure 1
Clusters of Competitive TCI Exporters
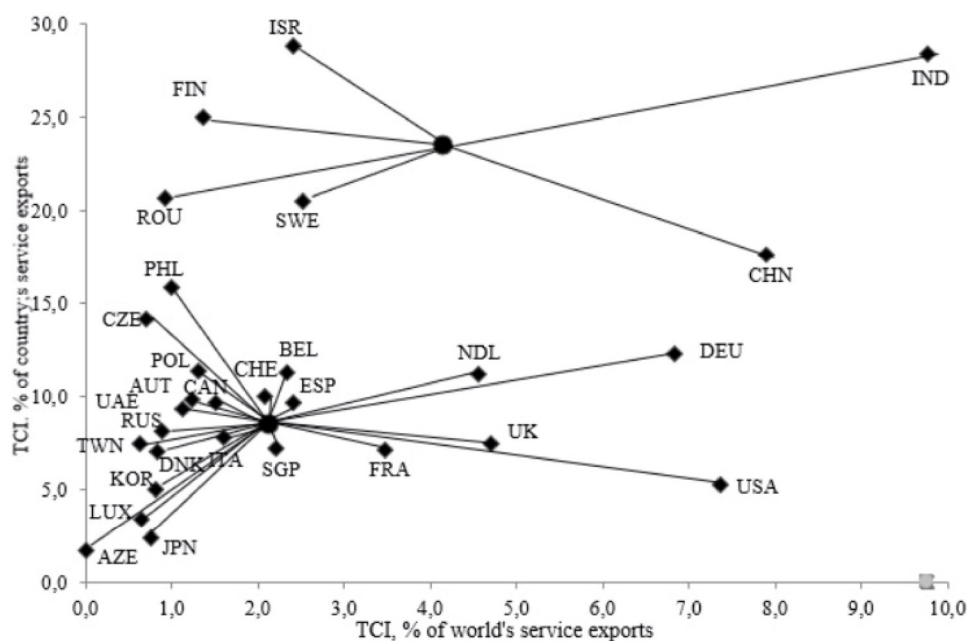
Countries seeking to become leaders in the export of telecommunications, computer and information services need to undertake the following actions:

- attract investment for retrofitting and upgradation;
- grant funding for national research centers, support startups with venture capital funds, encourage public-private partnerships to implement innovation projects;
- develop a digital environment (i.e., telecommunication systems, cloud servers, data centers, user identification and authentication systems);
- improve digital literacy of the population by producing specialists with digital skills;
- build a digital culture in society;
- lay groundwork for the legal regulation of economic activities in a digital space, for cybersecurity, and for the protection of personal data and intellectual property on the Internet.

The use of these recommendations will enable the development of digital economy. Consequently, countries will be able to gain additional competitive advantages and strengthen their competitive positions in the international digital goods and services market.

6. Discussion

The article defines digital economy as a set of social relations, which arise in connection with the production, sale and consumption of digital goods and services. Same was stated by Aguila, Padilla, Serarols & Veciana (2003). However, the proposed approach differs from that offered by D'Souza & Williams (2017), Autio, Nambisan, Thomas & Wright (2018), Barefoot, Curtis, Jolliff, Nicholson & Omohundro (2018), Pivoto, Waquil, Talamini, Spanhol, Corte & Mores (2018), and Rusu & Roman (2018). These authors examined digital economy from various points of view: opportunities for using digital technologies; directions in technology-driven economic development; and socio-economic transformations that follow digitalization.

In our interpretation, the country's competitiveness refers to the ability of a country to produce high-quality, on-demand goods and services in the existing social, economic and political conditions, meeting the internal and external demand. This definition differs from that to which other authors adhere (Kharlamova & Vertelieva, 2013; Schwab & Sala-i-Martin, 2013; Siudek & Zawojska, 2014; Khyareh & Rostami, 2018; Rusu & Roman, 2018). It takes into account an array of external factors that influence the production of digital goods and services, their quality, and the fulfillment capacity.

The country's digital profile in this study embraced a range of specific quantitative characteristics. Among which:

- mobile-cellular telephone subscriptions per 100 inhabitants;
- fixed (wired)-broadband subscriptions per 100 inhabitants;
- active mobile-broadband subscriptions per 100 inhabitants;
- international internet bandwidth per Internet user (Bit/s);
- percentage of households with Internet access;
- percentage of households with computer;
- percentage of individuals using the Internet;
- making digital payments;
- using the Internet to pay bills or buy something online;
- using a mobile phone or the internet to access an account.

Based on data from the International Telecommunication Unit and the World Bank reports, the digital profiles of Switzerland, Russia, and Azerbaijan were made. Note that quantitative indicators in the country's digital profile successfully correlated with techniques used by the United Nations to rank countries on e-government development. Indirectly, this corroborates the research idea.

This study was first to use the non-hierarchical clustering method for mapping the competitive landscape in the TCI service export market. Findings reveled that Ireland is a leading TCI service exporter. Israel, India, China, Romania, Finland, and Sweden seek to put efforts to occupy a leading position too. Although some of these account for a high percent of the country's and global service exports, they still lag behind the leader and then significantly. Other countries in this cluster contribute little to the global service exports but the share of TCI services in their exports remains high. The vast majority of countries under consideration seem to be not interested in exporting telecommunications, computer and information services. These countries either had a considerable share of TCI services in the global service market but chose to focus on other export services, or had a low share of TCI services in the global service market and did not make efforts to shift priorities from other services to TCI.

Recommendations for the enhancement of digital economy development allow strengthening the country's competitive position but do not involve regional and international cooperation in digital projects.

7. Conclusion

Digital economy is defined as a set of social relations, which arise in connection with the production, sale and consumption of digital goods and services or with the use of digital infrastructure.

The *strengths* of digital economy are the incorporation of innovations; the emergence of new markets; growth in labor productivity; reduction of production and selling expenses; the production of higher-quality goods and services. The *weaknesses* include the low trust in digital environment; increase in the share of part-time employment; increase in the risk of incapacity for work due to (mental) illnesses; and decrease in social security.

Digital economy opens up new opportunities for consumers (i.e., a broader range of goods; new jobs; preferences of individual consumers are met; higher standard of living) but also carries threats (i.e. growth of cybercrime; weak regulatory framework for digitalization; violation of consumer rights related to online trade; growth of technological unemployment).

Investing in digitalization allows countries to boost national competitiveness, which characterizes the country's ability to produce high-quality, on-demand goods and services in the existing social, economic and political conditions, meeting the internal and external demand.

Countries under consideration were grouped in three clusters: leading exporters of telecommunications, computer and information services; countries seeking such a leadership; and non-interested actors. Those seeking to occupy a leading position in the TCI service market were recommended to undertake a range

of certain actions: investment in digital industry, improve digital literacy of the population, develop a digital culture, and improve the legal foundations of e-commerce and cybersecurity.

The practical relevance of the research lies in the fact that is offers an approach for determining the competitive position of countries in terms of telecommunications, computer and information service exports. This approach is based on the k-means clustering technique. Recommendations for boosting the country's digital competitiveness concluded the research.

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