Studia commercialia Bratislavensia

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Identification and comparison of the situation in the international tourist arrivals in the selected regions

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Abstract

Tourism is crucial for global economies, particularly as the primary revenue source for small developing countries, often constituting up to 90% of their total export earnings. However, the industry poses environmental challenges, including resource depletion and pollution issues. We focus on international tourist arrivals, recognizing that a destination's ability to attract tourists indicates overall support for tourism. Balancing economic benefits with sustainable practices is essential for fostering a resilient and responsible tourism industry. The main research objective is to identify the percentage increase in millions of international tourist arrivals in 2019 compared to 2015 and to identify the correlation between the variable "Arrivals in millions" and the variable "Tourism earns in billions. We used several calculations based on absolute change, absolute acceleration/slowdown, and % change using the base and change index. Additionally, we used Linear regression.

Introduction

Mass tourism has a devastating effect on many places on Earth. Many people would like to enjoy the integrity of virgin nature, but with their behaviour, they violate this virginity. Such places are in a difficult position because, on the one hand, the inhabitants are dependent on tourism; on the other hand, due to their vulnerability and sensitivity to climate change, these places are threatened by tourism. In coastal developing countries, where tourist destinations are massively built, the surroundings often suffer from high pollution from waste and wastewater; such places consume massive amounts of energy and drinking water. In the Mediterranean, during holiday periods, water consumption rises to an incredible 850 litres per inhabitant per day, and water shortage problems are emerging, which may worsen due to climate change. In many destinations, there are no or only weak standards for nature protection, and waste is not sorted, disposable packaging is used, wastewater is discharged into the sea, etc. Also, the method of travel itself has a significant influence on the amount of pollution. Tourism is deeply connected to and dependent on several essential resource flows, assets and commodity value chains in society – from agriculture to food to the built environment and transport sectors. Travel and tourism actors can act as powerful agents of circularity and benefit from the co-creation and capture of value within their respective value chains. It is essential to note that in 2020, the global tourism industry faced an unprecedented downturn, marking its most challenging year. International arrivals plummeted by a staggering 74%, a stark indication of the severe impact of the COVID-19 pandemic on the sector. (UNWTO, 2020). Tourism is responsible for a small

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proportion of waste generation within Europe, contributing to 6.7% of total waste generated in the broader services sector in the EU 27 (EEA, 2023). Nevertheless, the amount of solid waste tourism produces is large in absolute terms. Regarding world waste production, the UN (2023) estimates that tourism entities will produce 4.8 million tons, 14% of all solid waste, annually. At the same time, the UN emphasizes that the waste management sector plays an essential role in the triple planetary crisis, which includes climate change, loss of biodiversity and nature, and pollution. According to estimates, approximately 2.24 billion tons of municipal solid waste are produced yearly, with only 55% of this mass being processed correctly in controlled and managed facilities. This inefficient processing ratio points to the challenges associated with waste management and its environmental impact, which must be effectively addressed concerning global sustainability. The negative environmental impacts of tourism include the depletion of local resources and pollution and waste issues. Tourism burdens increasingly scarce natural resources. Author Dunne (2018) follows up on Lenzena et al.'s. study from 2018, emphasising that from 2009 to 2013, tourism at the global level contributed 8% to the total emissions of greenhouse gases. This finding shows the significant environmental impact of global tourism on climate change. 8% of the world's total greenhouse gas emissions are caused by tourism. Around 90% of these emissions come from transport. Author Lenzena et al. (2018) highlight that tourism contributes significantly to global gross domestic product and is projected to grow by 4% annually. For this reason, it is expected to overtake many other economic sectors. However, the negative impression is directed at the global carbon emissions that tourism produces. However, the data need to be sufficiently quantified. Environmentalists worldwide are concerned about the increasing waste and pollution generated by tourism operators. Tourism is one of the biggest culprits of beach pollution, contaminated with trash, plastic, oil and even pesticides. Visitors leave behind plastic cups, glass bottles and other waste. This destroys the ecosystem and affects marine life. Marine animals eventually ingest this waste, leading to serious health problems. Approximately 700 million marine species are at risk due to the ingestion or use of plastics. Some hotels use the oceans for waste disposal. This affects the ecosystem and disrupts life in the oceans. Wastewater contains dangerous chemicals that kill marine plants and animals, significantly affecting the ecosystem. Disposing of wastewater in the oceans even leads to severe oxygen depletion. Water's Lack of oxygen harms aquatic organisms (Rinkesh, 2023). According to the World Wide Fund for Nature (2020), cruise ships in the Caribbean produce 70,000 tons of wastewater each year. Cruise ships transport thousands of visitors annually, making massive waste dangerous to the environment. Noise pollution is exposure to high sound levels that affects humans and other living organisms. The booming travel industry is known to cause significant noise pollution. Tourist vehicles such as snowmobiles and jet skis entering and leaving natural areas create a lot of noise that disturbs the living organisms in the area. Tourism uses artificial lights such as streamers, billboards, and strobes, adversely affecting humans and animals. Light pollution seriously impacts endangered sea turtle species that use light as a navigation tool. Baby sea turtles come out at night when the temperature is cooler. In natural areas, visitors use the same path repeatedly, destroying the vegetation in the area. It causes damage and destroys biodiversity. The impacts of trampling on soil include accelerated erosion, increased water runoff, reduced air and water permeability, and loss of organic matter. Many tourism activities occur in fragile marine areas such as reefs, beaches, lagoons, and coastal regions. It threatens the biodiversity of these areas. With the growing number of visitors, the need for food, fresh water and energy consumption in accommodation facilities grows. Hotels turn to local resources and consume them excessively to meet these needs. This leads to a need for more natural resources and burdens the environment. Tourism contributes to the ozone hole by releasing ozone-depleting substances such as chlorofluorocarbons (CFCs), leading to ozone depletion

(Rinkesh, 2023). Authors Hallak and Schott (2011) draw attention to the statement that the negative indirect impact of tourism exceeds its direct positive impact, which is consistent with the complex nature of this industry and requires thorough professional analysis to understand the essence of this phenomenon. According to UNWTO (2021), tourism is an essential component of export diversification for world economies, with a solid ability to reduce trade deficits and offset weaker export earnings from other goods and services. It is important to note that tourism is the primary source of income for many small developing countries, representing up to 90% of total exports.

1   Methodology

Through a comprehensive examination of pertinent professional literature and scientific articles, our examination has yielded a set of key conclusions. These empirical insights have significantly informed the articulation of the research question:

1. Was there an increase in millions of international tourist arrivals in 2019 compared to 2015?

2. Is there a correlation between the variable "Arrivals in millions" and the variable "Tourism earns in billions"?

The main research objective is to identify the percentage increase in millions of international tourist arrivals in 2019 compared to 2015 and to identify the correlation between the variable "Arrivals in millions" and the variable "Tourism earns in billions. We focused on outbound tourism (international tourist arrivals) generated by regions such as Europe, Asia and the Pacific, the Americas, the Middle East, Africa, and Origin, which is unspecified. We want to point out the situation with international tourist arrivals. We worked with the following data based on the World Tourism Organization statistics from 2021, shown in Table 1.

Tab. 1 International tourist arrivals in millions by selected regions

Region	Europe	Asia and the Pacific	The Americas	The Middle East	Africa	Origin not specified
2015	581,8	293,6	200,2	39,7	36	51,9
2016	592,8	314,4	211,6	36,3	39,6	50,4
2017	636,6	337,6	227,3	36,8	42,5	51,7
2018	676	367,7	239,3	40,4	45,3	40
2019	702,7	381,7	244,7	43,8	47	40,2

Source: own processing based on World Tourism Organization, 2021, p 16

The research questions were verified using seven hypotheses shown in Table 2. The results were calculated and subsequently interpreted based on calculations using mathematical and statistical methods. We used Linear regression to identify the relationship between dependent and independent variables. We used calculation for an absolute change, such as an increase or a decrease, which refers to changes in values or quantities over time and measures the actual increase or decrease. In the context of economics, population, or

other variables, absolute growth can provide information about the overall magnitude of change regardless of relative percentage changes. We calculate absolute acceleration or slowdown, which refers to the total change in the rate of motion of an object, regardless of its direction. It measures how much an object's velocity changes over a specific period, expressed as the absolute value of the acceleration. The application of a base index was integral to our methodology, signifying changes in the value or quantity of a variable concerning a specified base period. We identified a change in the value or quantity of something relative to a specified base period, which is considered the base. This index provides a reference point for evaluating relative changes over time. The base period is usually chosen as a reference period with an index value equal to 100. If the base index reaches a value above 100, it means growth in the comparison period relative to the base, and conversely, a value below 100 indicates a decrease. Additionally, we incorporated the rate of increase, representing the coefficient of increase in percentage. It tells about the percentage by which the value of the monitored variable increased (decreased) at a time "t" compared to the value at a time "t-1".

Tab. 2 Hypotheses

$H1_0$	In 2019, there was no increase in international tourist arrivals in millions compared to 2015 in Europe.
H1	In 2019, there was an increase in international tourist arrivals in millions compared to 2015 in Europe.
$H2_0$	In 2019, there was no increase in international tourist arrivals in millions compared to 2015 in Asia and the Pacific.
H2	In 2019, there was an increase in international tourist arrivals in millions compared to 2015 in Asia and the Pacific.
$H3_0$	In 2019, there was no increase in international tourist arrivals in millions compared to 2015 in the Americas.
H3	In 2019, there was an increase in international tourist arrivals in millions compared to 2015 in the Americas.
$H4_0$	In 2019, there was no increase in international tourist arrivals in millions compared to 2015 in the Middle East.
H4	In 2019, there was an increase in international tourist arrivals in millions compared to 2015 in the Middle East.
$H5_0$	In 2019, there was no increase in international tourist arrivals in millions compared to 2015 in Africa.
H5	In 2019, there was an increase in international tourist arrivals in millions compared to 2015 in Africa.
$H6_0$	In 2019, there was no increase in international tourist arrivals in millions compared to 2015 in Origin, which is unspecified.
H6	In 2019, there was an increase in international tourist arrivals in millions compared to 2015 in Origin, which is unspecified.
$H7_0$	There is no correlation between the variable "Arrivals in millions" and the variable Tourism earns in billions".
H7	There is a correlation between the variable "Arrivals in millions" and the variable Tourism earns in billions".

Source: own processing

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2   Result and discussion

Tourism is pivotal in facilitating export diversification for economies worldwide, demonstrating a resilient capability to mitigate trade deficits and compensate for reduced export revenues from other sectors. It is imperative to underscore that tourism is the primary revenue source for many small developing countries, accounting for a significant percentage of their total export earnings, often reaching up to 90%. However, it is essential to note that the detrimental environmental consequences associated with tourism entail the depletion of local resources and the emergence of challenges related to pollution and waste management. Tourism significantly burdens finite natural resources, leading to their diminishment while concurrently amplifying concerns regarding pollution and the effective handling of waste (World Tourism Organization, 2021). For this reason, we focused on international tourist arrivals. If a destination can attract tourists, tourism is more supported. Thus, it can have both positive and negative effects. The graph 1 shows the export earnings by product category in 2019.

Graph 1 Export earnings by product category in 2019
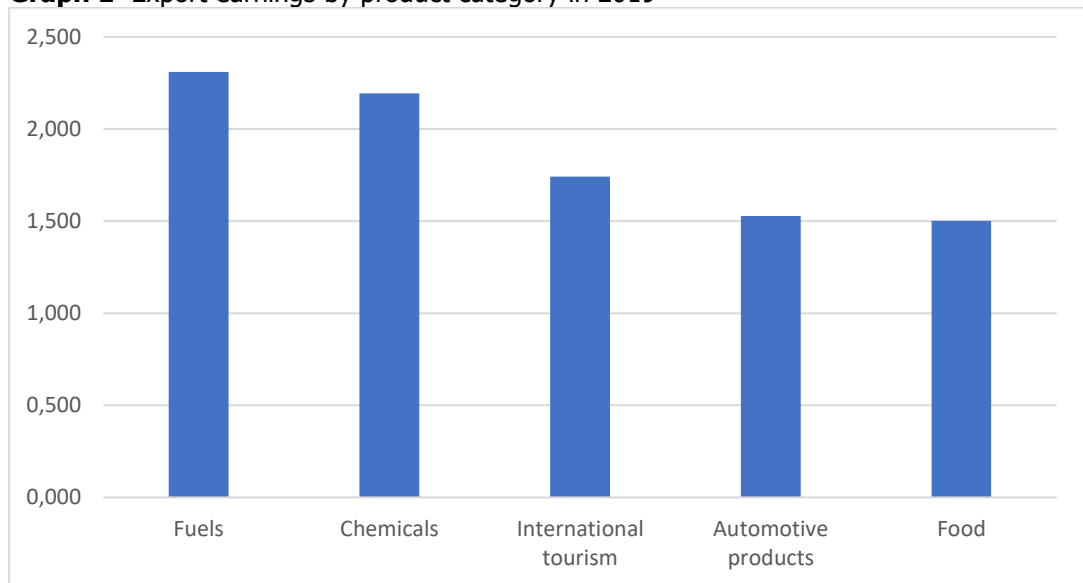
Source: own processing based on World Tourism Organization, 2021, p 16

The graph1 shows that the highest representation within the product category is fuels, with a value of up to 2.31 trillion in USD. However, international tourism reached third place in value of 1,74 billion USD.

2.1 % change compared to 2015 and rate of increase in selected regions

We present the findings based on the result showing absolute increase/decrease, absolute acceleration/slowdown, and % change using the base and change index. We focused on outbound tourism (international tourist arrivals) generated by regions such as Europe, Asia and the Pacific, the Americas, the Middle East, Africa, and Origin, which is unspecified.

Origin, which is not specified, is a specific group of countries that could not be allocated to a specific region of origin.
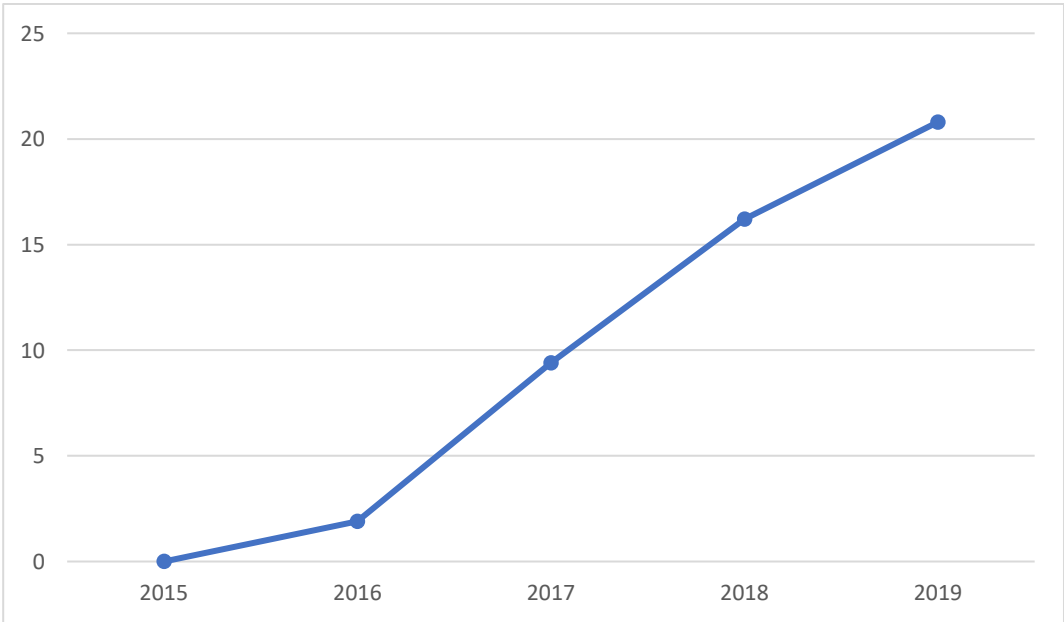
Tab. 3 Calculation for international tourist arrivals in Europe

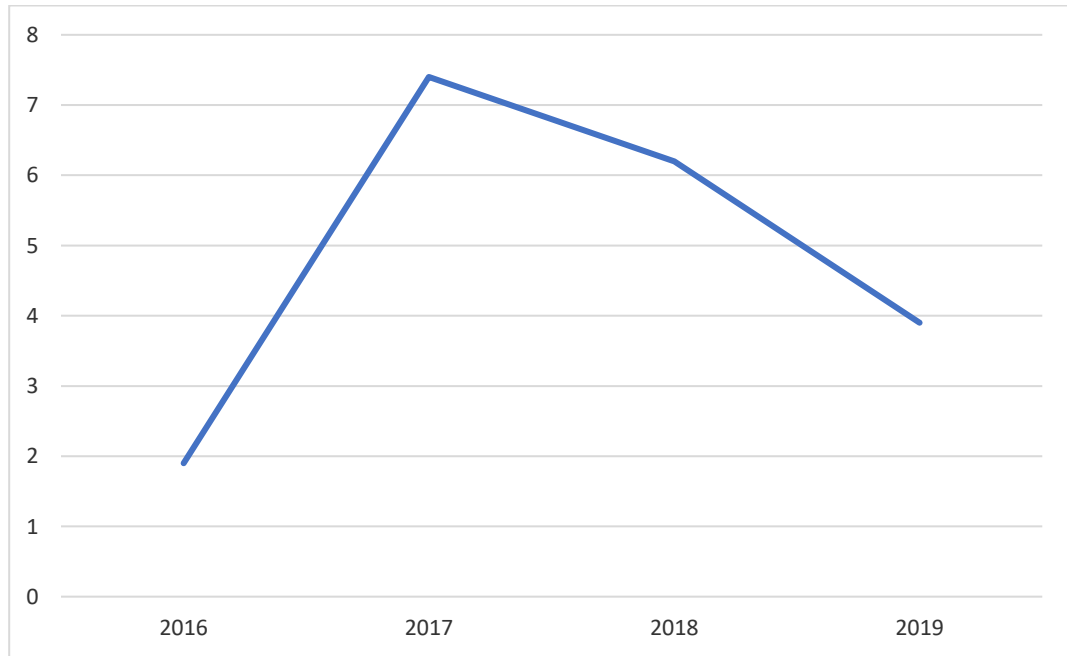| Year	Absolute change	Absolute acceleration/slowdown	% change compared to 2015	Rate of increase
2015				
2016	11		2%	2%
2017	**43,8**	-4,4	9%	**7%**
2018	39,4	-12,7	16%	6%
2019	26,7	-26,7	**21%**	4%

Source: own processing

The most significant increase in international tourist arrivals was recorded in 2017, with a value of 43.8 million. In 2018 and 2019, the values dropped to 39,4 and 26.7 million. Based on the result of the base index, we identify whether there was a decrease or an increase in international tourist arrivals expressed as a percentage compared to the year 2015 as the base year. Compared to 2015, the most significant increase in international tourist arrivals occurred in 2019, i.e., 21%. From the point of view of evaluating annual increases or decreases, we identify the most significant increase in international tourist arrivals in 2017 compared to 2016, i.e. 7%. All other values were approximately the same. % change compared to 2015 is shown in Graph 2, and Rate of increase is shown in Graph 3.

Graph 2 % change compared to 2015 in Europe

Source: own processing
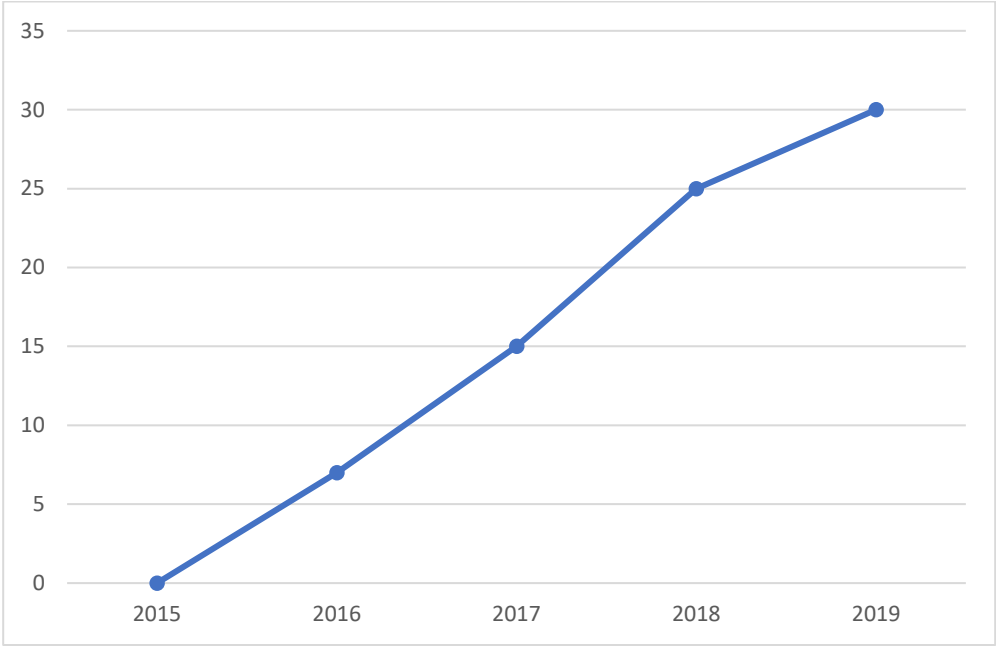
Graph 3 Rate of increase in Europe

Tab. 4 Calculation for international tourist arrivals in Asia and the Pacific

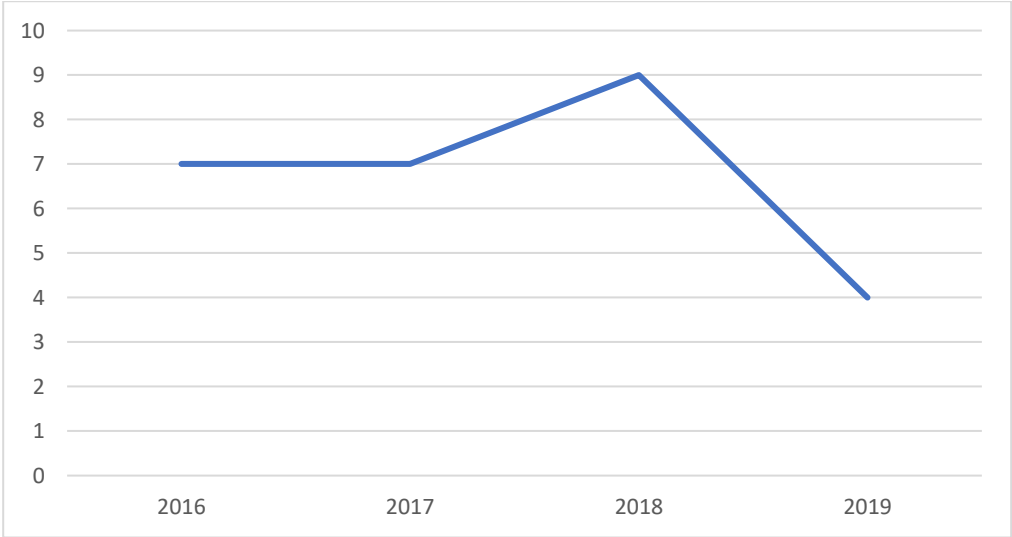| Year	Absolute change	Absolute acceleration/slowdown	% change compared to 2015	Rate of increase
2015				
2016	20,8		7%	7%
2017	23,2	2,4	15%	7%
2018	**30,1**	6,9	25%	**9**%
2019	14	-16,1	**30%**	4%

The most significant increase in international tourist arrivals was recorded in 2018, with a value of 30,1 million. Based on the result of the base index, we present the following findings. Compared to 2015, the most significant increase in international tourist arrivals occurred in 2019, i.e., 30%. From the point of view of evaluating annual increases or decreases, we identified the most significant increase in international tourist arrivals in 2018 compared to 2017, i.e. 9%. All other values were approximately the same. % change compared to 2015 is shown in Graph 4, and Rate of increase in Asia and the Pacific is shown in Graph 5.

Graph 4 % change compared to 2015 in Asia and the Pacific

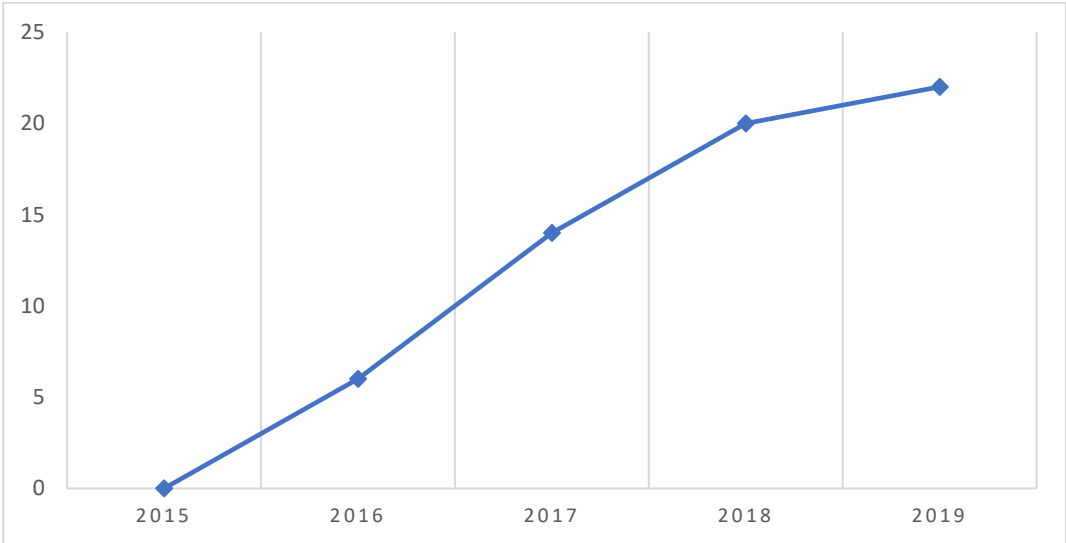**Graph 5** Rate of increase in Asia and the Pacific

Tab. 5 Calculation for international tourist arrivals in the Americas

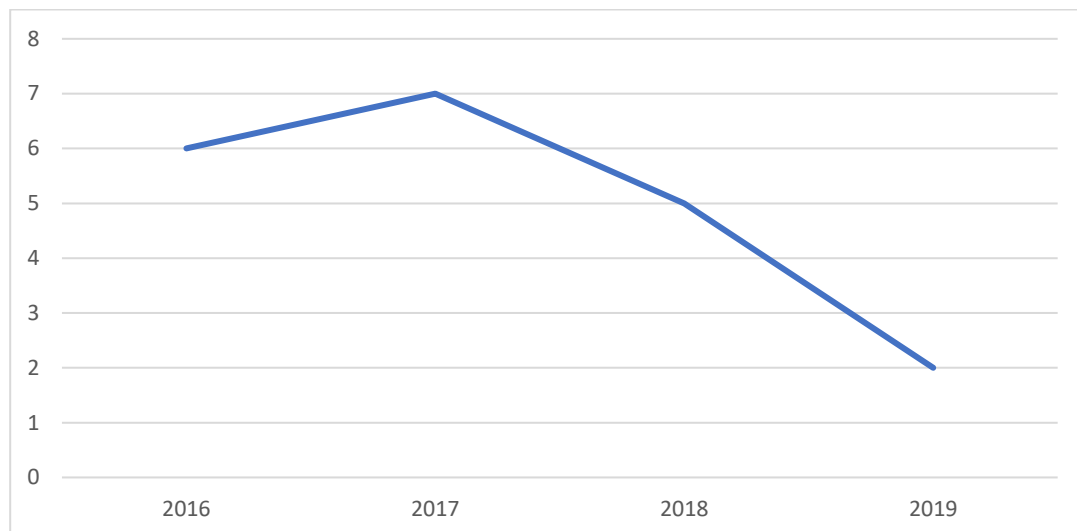| Year	Absolute change	Absolute acceleration/slowdown	% change compared to 2015	Rate of increase
2015				
2016	11,4		6%	6%
2017	**15,7**	4,3	14%	**7%**
2018	12	-3,7	20%	5%
2019	5,4	-6,6	**22%**	2%

The most significant increase in international tourist arrivals was recorded in 2017, with a value of 15,7 million. Based on the result of the base index, we present the following findings. Compared to 2015, the most significant increase in international tourist arrivals occurred in 2019, i.e., 22%. From the point of view of evaluating annual increases or decreases, we identified the most significant increase in international tourist arrivals in 2017 compared to 2016, i.e. 7%. All other values were approximately the same. % change compared to 2015 is shown in Graph 6, and Rate of increase is shown in Graph 7.

Graph 6 % change compared to 2015 in the Americas
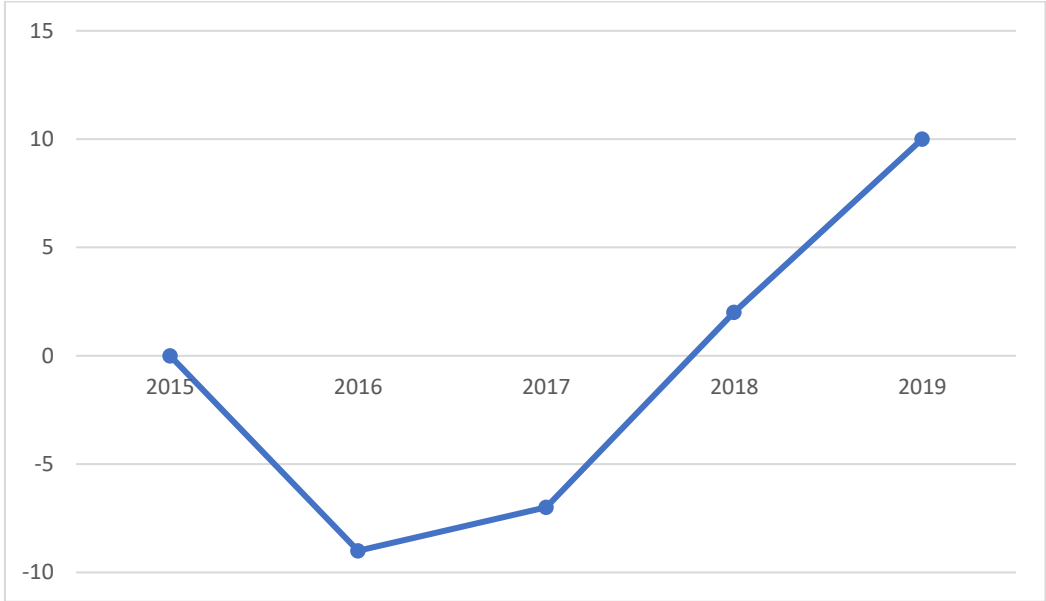
Graph 7 Rate of increase in Americas

Tab. 6 Calculation for international tourist arrivals in the Middle East

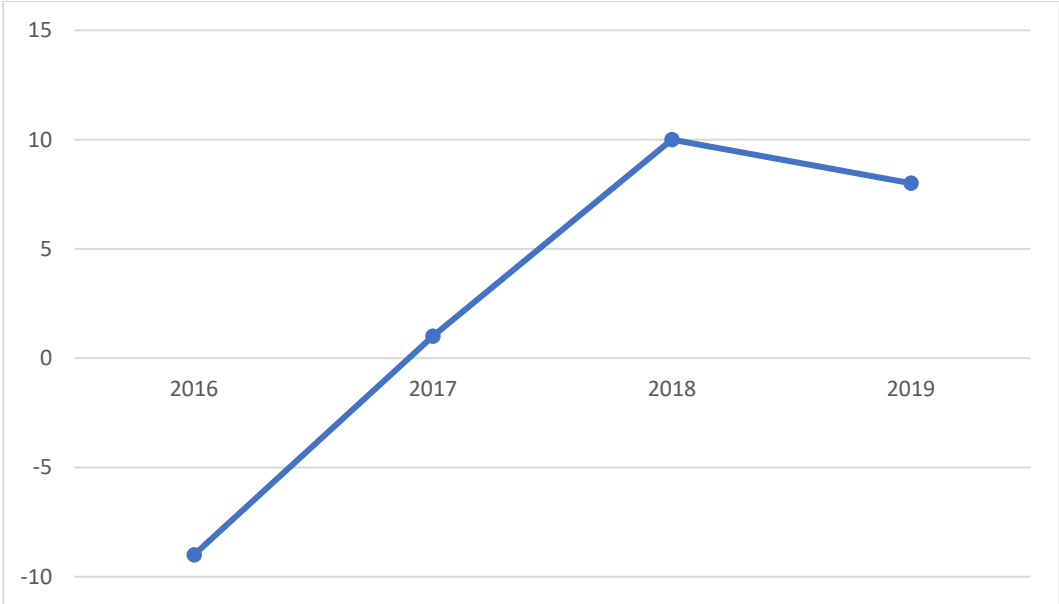| Year	Absolute change	Absolute acceleration/slowdown	% change compared to 2015	Rate of increase
2015				
2016	-3,4		-9%	-9%
2017	0,5	3,9	-7%	1%
2018	**3,6**	3,1	2%	**10%**
2019	3,4	-0,2	**10%**	8%

The most significant increase in international tourist arrivals was recorded in 2018, with a value of 3,6 million; in 2016, we identified the most significant decrease of -3,4 million. Based on the result of the base index, we present the following findings. Compared to 2015, the most significant increase in international tourist arrivals occurred in 2019, i.e., 10%. The most significant decrease in international tourist arrivals occurred in 2016, i.e., -9%. From the point of view of evaluating annual increases or decreases, we identified the most significant increase in international tourist arrivals in 2018 compared to 2017, i.e. 10%. However, other values are significantly higher or lower depending on the years. % change compared to 2015 is shown in Graph 8, and Rate of increase is shown in Graph 9.

Graph 8 % change compared to 2015 in the Middle East

Source: own processing

Graph 9 Rate of increase in the Middle East
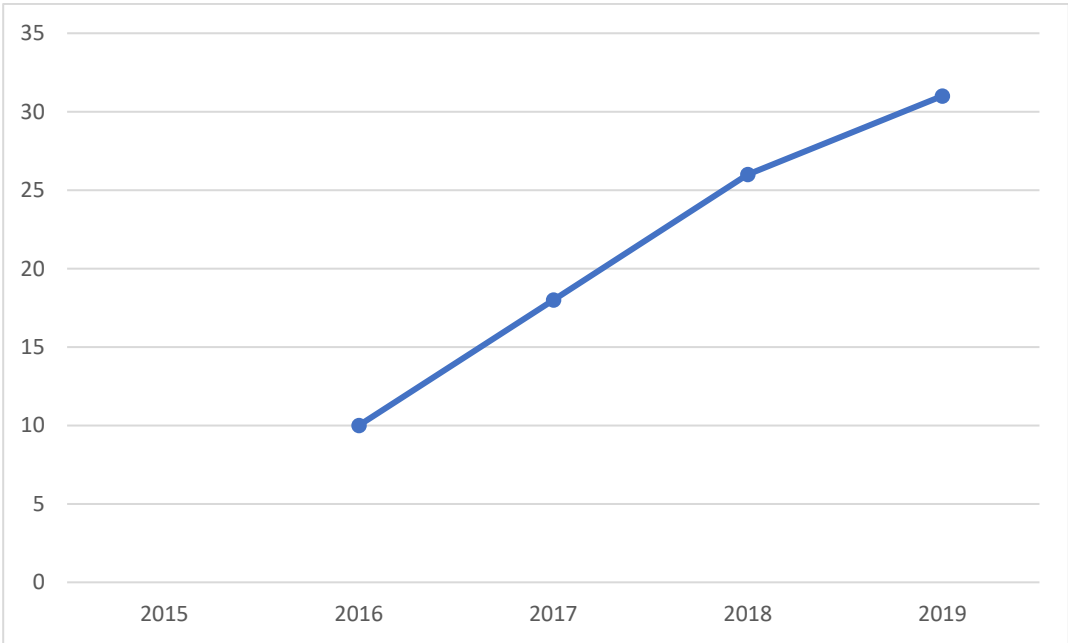

Source: own processing

Tab. 7 Calculation for international tourist arrivals in Africa

Year	Absolute change	Absolute acceleration/slowdown	% change compared to 2015	Rate of increase
2015				
2016	**3,6**		10%	10%
2017	2,9	-0,7	18%	7%
2018	2,8	-0,1	26%	7%
2019	1,7	-1,1	**31%**	4%

Source: own processing

The most significant increase in international tourist arrivals was recorded in 2016, with a value of 3,6 million. Based on the result of the base index, we present the following findings. Compared to 2015, the most significant increase in international tourist arrivals occurred in 2019, i.e., 31%. % change compared to 2015 is shown in Graph 10, and Rate of increase is shown in Graph 11.

Graph 10 % change compared to 2015 in Africa

Source: own processing

Graph 11 Rate of increase in Africa

Tab. 8 Calculation for international tourist arrivals in Origin, which is not specified

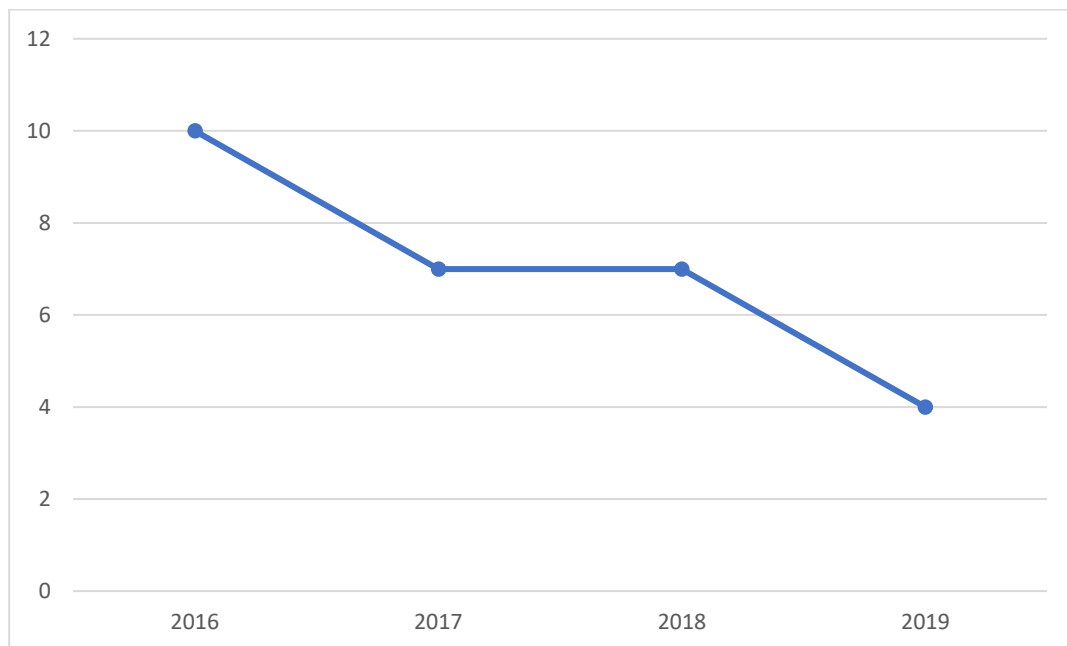| Year	Absolute change	Absolute acceleration /slowdown	% change compared to 2015	Rate of increase
2015				
2016	-1,5		-3%	-3%
2017	**1,3**	2,8	0%	**3%**
2018	-11,7	-13	-23%	-23%
2019	0,2	11,9	**-23%**	1%

The most significant increase in international tourist arrivals was recorded in 2017, with a value of 1,3 million. However, in 2018, we identified the most significant decrease of -11,7 million. Based on the result of the base index, we present the following findings. Compared to 2015, the most significant decrease in international tourist arrivals occurred in 2018 and 2019, i.e., -23%. From the point of view of evaluating annual increases or decreases, we identified the most significant increase in international tourist arrivals in 2017 compared to 2016, i.e. 3%. % change compared to 2015 is shown in Graph 12, and Rate of increase is shown in Graph 13.

Graph 12 % change compared to 2015 in Origin, which is not specified
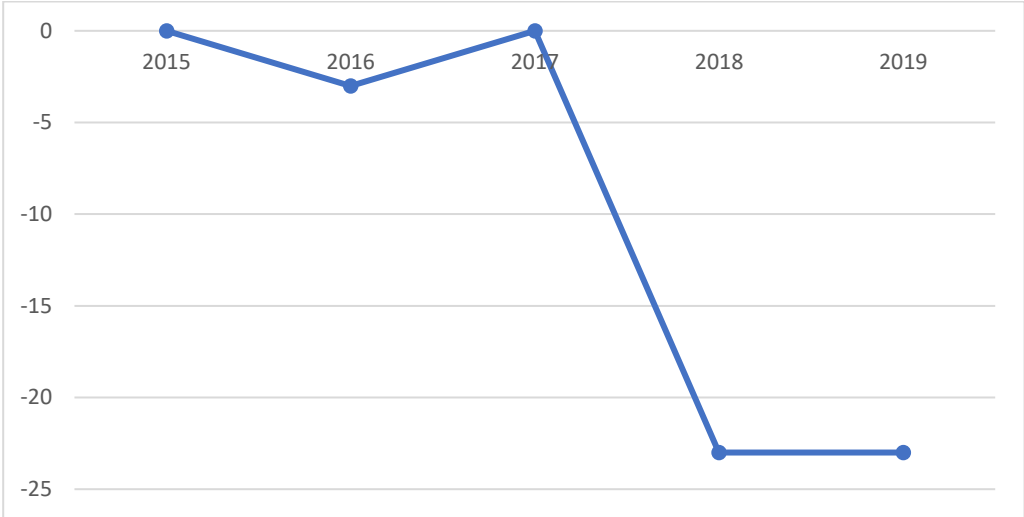
Source: own processing

Graph 13 Rate of increase in Origin, which is not specified
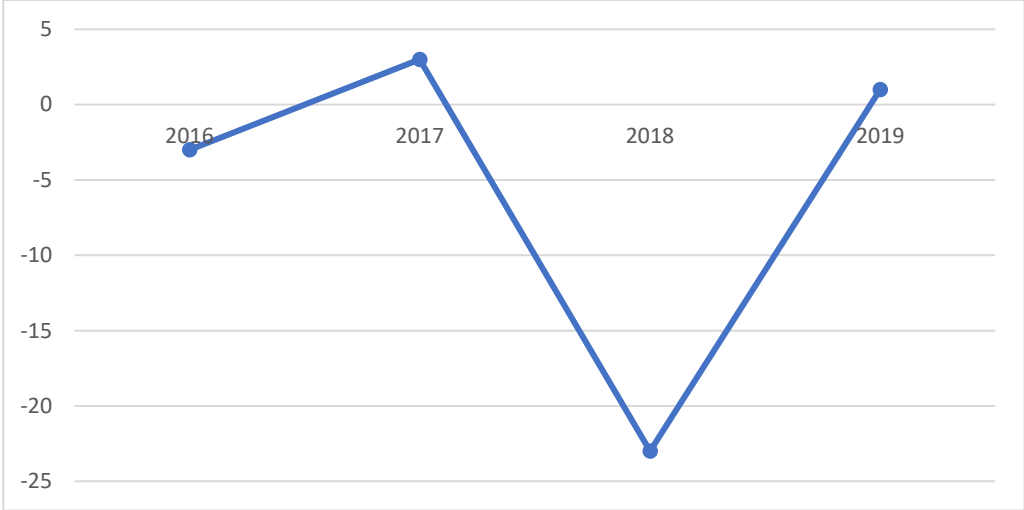
Source: own processing

2.2 Result based on linear regression

This table shows the model's results, including the constant, for each independent variable. The coefficient indicates the expected change in the dependent variable „Arrivals in millions" for each one-unit increase in the respective independent variable. In the context of constant, it means that when Tourism earners in billion, is zero, the dependent variable "Arrivals in millions" is expected to be around 51,31. The p-value is 0,00; indicating that the

value is statistically significant. If the value of the variable „Tourism earners in billion" changes by one unit, the value of the variable Arrivals in million changes by 0.15 units. The p-value is 0,30; indicating that this coefficient is not statistically significant. We cannot confidently say that the variable „Tourism earners in billions" impacts the dependent variable. The result is shown in Table 9.

Tab. 9 Result based on linear regression

	Coefficient	P-value
Constant	51,31	0,00
Tourism earners in billion	0,15	0,42

Source: own processing

Conclusion

Based on the results, we can answer the questions:

Was there an increase in million of international tourist arrivals in 2019 compared to 2015? The answer is YES for regions Europe, Asia and the Pacific, the Americas, and the Middle East. Due to the results, we do not reject $H1_0$, $H2_0$, $H3_0$, $H4_0$, and $H5_0$. However, we identified a decrease (-23%) compared to 2015 in Origin, which is unspecified. We reject $H6_0$.

Is there a correlation between the variable "Arrivals in millions" and the variable "Tourism earns in billions"? The answer is NO. We did not identify the correlation between the variables due to the result, which is statistically insignificant. We cannot confidently say that the variable „Tourism earners in billions" impacts the dependent variable. We reject $H7_0$.

Tab. 10 Conclusion

Hypotheses	Decision
$H1_0$	DO NOT REJECT
$H2_0$	DO NOT REJECT
$H3_0$	DO NOT REJECT
$H4_0$	DO NOT REJECT
$H5_0$	DO NOT REJECT
$H6_0$	REJECT
$H7_0$	REJECT

Source: own processing

Acknowledgement

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Assessment of the state of digital transformation in the Ukrainian economy[1]

Yuliia Yehorova[2]

Abstract

In the current phase of global development, digitalization affects all areas of countries' economic and social life and has a direct impact on their competitiveness. The article provides an assessment of the state of digital transformation in the Ukrainian economy from the point of view of network readiness and innovation. Two international indices were used as a basis for information: the Network Readiness Index (NRI) and the Global Innovation Index (GII). Research methods included analysis, synthesis, comparison, induction, and deduction. Based on the results of the work, the position of Ukraine in world rankings of network readiness and innovation was determined, a comparison was made with the countries of the European Union, and the main problem areas that should be paid attention to reduce the digital gap between them were identified.

Introduction

One of the most noticeable trends of the last decade is the transition to the next stage of globalization - digital transformation. In this regard, measuring the level of development of the digital economy of a particular country and the degree of its digital transformation becomes a key task for research.

A quantitative assessment of the Ukrainian economy, considering the specific features of its readiness for digital transformation, at this stage is fraught with difficulties since the necessary forms of statistical reporting are at the stage of development or improvement. In such conditions, international ratings are becoming an increasingly important source of information about the potential and dynamics of a country's development.

1   Methodology

The purpose of the article is to assess the level of digital transformation of the Ukrainian economy from the point of view of network readiness and innovation. To achieve this goal, two international indices were used as an information base: the Network Readiness Index

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(NRI) to assess the effectiveness of the processes of integrating people with information and communication technologies and the Global Innovation Index (GII) to characterize innovative activities.

Analysis of the main indicators of network readiness and innovation for 2019–2022 made it possible to identify positive and problematic areas of digital transformation of the Ukrainian economy. The positioning of Ukraine and the countries of the European Union according to NRI and GII made it possible to assess the current level of digitalization and the size of the digital divide. The work used methods of analysis, synthesis, comparison, induction, and deduction.

2   Results and Discussion

Digital transformation is defined as the emergence of qualitative, revolutionary changes, which consist not only of individual digital transformations but also in a fundamental change in the structure of the economy, in the transfer of centers of added value creation to the sphere of building digital resources and end-to-end digital processes (World Bank Group, 2018).

According to the International Telecommunication Union (2018), the essence of digital transformation lies in the application of innovative developments based on information and telecommunication technologies to solve various problems. The Organization for Economic Co-operation and Development (2019) defines this process as the use of data and digital technologies to create new or existing activities.

The process of digital transformation, as described by the European Commission (2019), represents significant changes in all sectors of the economy and society, brought about by the widespread adoption of digital technologies in various aspects of human life.

According to the United Nations Conference on Trade and Development (2019), digital products and services are having an impact on traditional sectors of the economy, which means the need to introduce new realities and transform traditional approaches in business and society.

The International Telecommunications Union (2019) views digital transformation as a continuous process of multimodal adoption of digital technologies that fundamentally change the processes of creation, planning, design, deployment, and operation of public and private sector services, making them personalized, paperless, and cashless, freeing physical presence based on the consensus of the parties.

From the above definitions, the concept of "digital transformation" is very multifaceted and can be interpreted extremely broadly.

The issue of the digital transformation of the national economy is the subject of research by Ukrainian scientists. Cherep et al. (2022) believe that in the context of digital transformation in Ukraine, the main strategic task for business entities is the introduction of innovative information technologies that will ensure competitiveness in the domestic and foreign markets.

According to Kotelevec (2022), ensuring digital development requires high-quality Internet coverage, the training of specialists in information and communication technologies, modern digital infrastructure, and digital services.

Among the current research in this direction, it is worth noting the international ranking of the national economies of the countries in the world in terms of digitalization and innovation. A comparative analysis of assessments of the development of the information society of countries around the world according to individual ICT indices was carried out in the work of Shumaeva (2014). Systematization, generalization, and analysis of modern methodological approaches to assessing the level of digital transformation of the economy based on well-known indices are presented in the article by Chesnokova (2020).

3 Rating assessment of the digital transformation of the Ukrainian economy based on the Network Readiness Index

The most common method for assessing the digital transformation of the economy is the creation of rating indices, which provide a basis for measuring and comparing the progress of different countries and regions of the world. They are also important research tools to understand the current state of digitalization and identify areas for improvement. Specific indices and their components may vary, and new indices may emerge as the digital landscape continues to evolve.

Since the digital transformation process is based on information and communication technologies (ICT), it is advisable to use the Network Readiness Index (NRI) to rate the Ukrainian economy. The index is an assessment of a country's or region's ability to harness the power of ICTs to improve economic and social productivity. The NRI calculation methodology, updated in 2019, involves measuring (considering) four groups of factors: technology, people, management, and impact (The Network Readiness Index report, 2019). The "Technology" group of factors includes access (the basic level of information and communication technologies in countries, including communication infrastructure and accessibility); content (the type of digital technology chosen for the development of IT projects, the creation of mobile applications that can be deployed on site); technologies of the future (readiness of countries for the future network economy and new technological trends - artificial intelligence, Internet of things, etc.). The level and availability of technology in a country only matter if people and organizations have the access, resources, and skills to use it. Accordingly, the group of indicators "People" involves assessing the use of ICT at three levels: individuals, enterprises, and government. The third group of factors, "Governance," includes indicators of trust (the security of people and firms in the context of the network economy, current perceptions of security and privacy), regulation (the degree of government participation in the network economy), inclusion (the digital divide within countries based on gender inequality, disability, socio-economic status, etc.). Since, in modern conditions, the key goal is to increase the welfare of society, the fourth group of factors, "Impact" includes economic factors (economic effect of participation in the network economy), quality of life (social impact of participation in the network economy), and the contribution of the network economy to the achievement of sustainable development goals (health, education, and the environment).

Graph 1 shows a slight positive trend in the network readiness index of the Ukrainian economy. The overall NRI score has increased from 48.92 in 2019 to 55.71 in 2022. The increase in the technology indicator from 43.01 points in 2019 to 50.52 points in 2022 is largely due to the development of technological infrastructure and the strengthening of positions in the elements "Computer software spending" and "FTTH/Internet subscriptions

building Internet subscriptions" (9th place in the ranking of 131 countries in 2022). A noticeable increase in indicators of the use of digital technologies by the population, enterprises, and government from 42.05 points in 2019 to 54.43 in 2022 is primarily associated with the level of literacy of the adult population (1st place in the NRI ranking in 2022) and higher education (18th place in the ranking). A slight improvement in the governance score from 58.32 points in 2019 to 60.81 points in 2022 indicates a strengthening of the regulatory framework in the digital economy. Ukraine took first place in the 2022 NRI ranking for the "e-commerce legislation" indicator. The decrease in the impact of digital technologies in 2022 to 57.08 points compared to 60.4 points is mainly due to the deterioration of their contribution to achieving the sustainable development goals, namely the factor of use and access to environmental types of energy (113th place in the 2022 ranking out of 131 countries).

Graph 1 Indicators of network readiness of the Ukrainian economy by main groups, 2019-2022
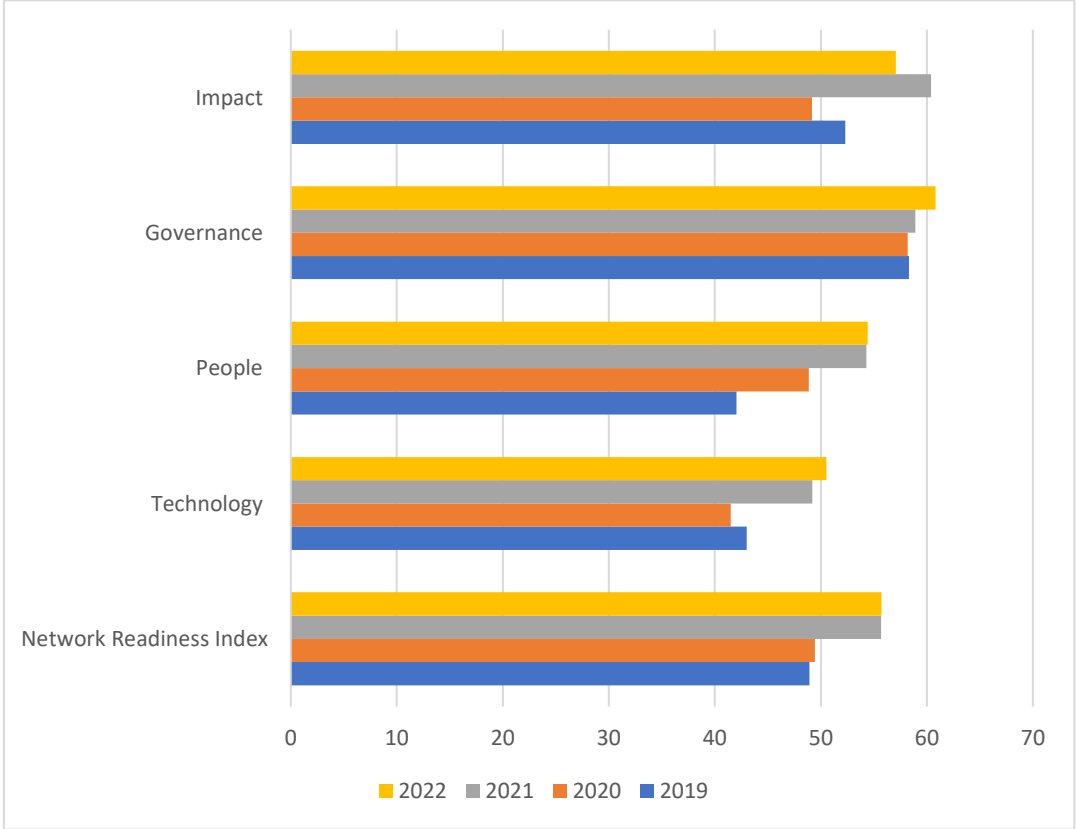
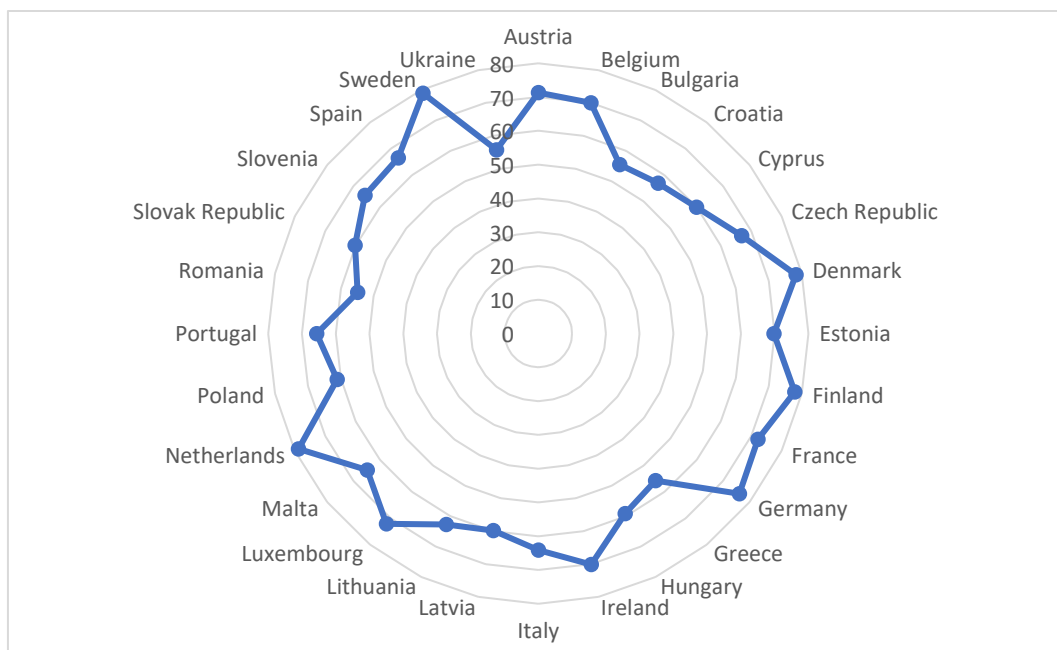Source: own processing based on data of the Network Readiness Index Report 2019, 2020, 2021,2022

In the context of European integration processes and Ukraine's accession to the Digital Europe program, it is advisable to compare the level of its digitalization with the countries of the European Union. The European Commission calculates the Digital Economy and Society Index (DESI), which provides information on countries that are members of the European Union on a wide range of parameters: from connectivity methods, digital skills, to the

digitalization of business and public services (European Commission. Digital Scoreboard, 2022).

However, the Cabinet of Ministers of Ukraine has only recently approved the list of DESI indicators and the procedure for the collection and exchange of data based on the EU methodology (EU4DigitalUA, 2022). In this context, the Network Readiness Index is also used to compare the positions of Ukraine and the countries of the European Union, which allows not only to assess the readiness of a country to participate in the information world, but also to characterize the size of the digital divide between them.

Graph 2 visualizes Ukraine's current position in relation to EU countries in accordance with the Network Readiness Index. In general, according to this rating indicator, Ukraine lags most EU countries, but with an NRI value of 55.71 points, it is slightly ahead of Bulgaria (55.51 points) and Romania (54.89 points). It should be noted that the level of income in Ukraine is below average, while most countries in the European Union have a high level of income. The fact that the value of NRI in these countries is growing very closely suggests that there is significant potential for achieving higher levels of development.

Graph 2 Positioning of Ukraine and the countries of the European Union according to the Network Readiness Index, 2022
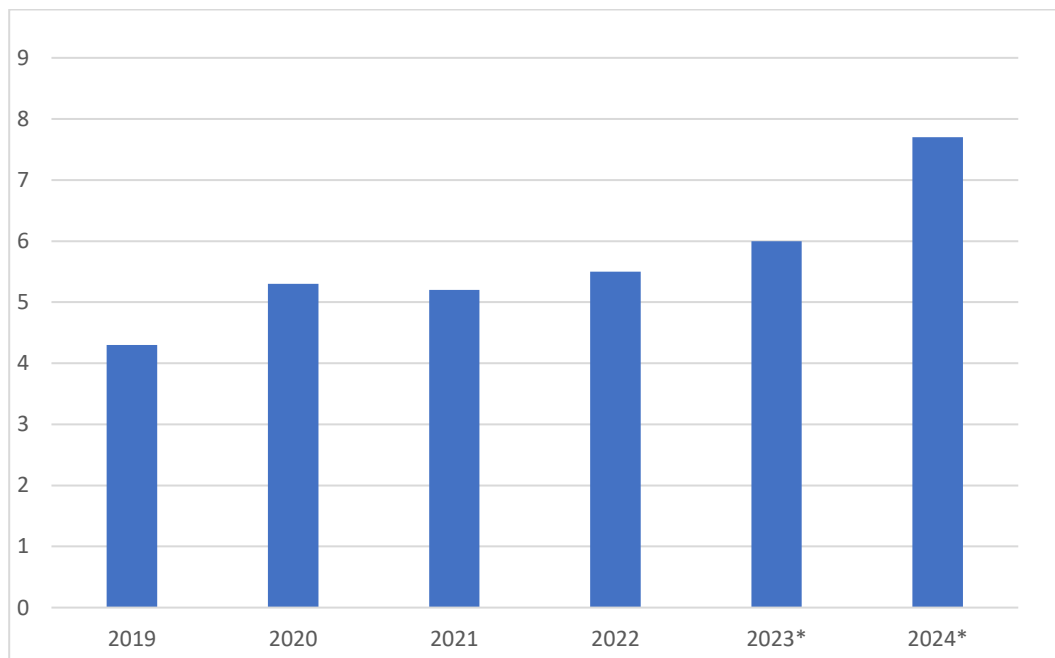

Source: own processing based on data of the Network Readiness Index Report, 2022, pp. 32-33.

According to some studies, the share of the digital economy in Ukraine's GDP will gradually increase. In 2019, it was 4.3%, and the following year it increased to 5.3% (Graph 3).

Graph 3 Share of the digital economy in Ukraine's GDP, %

Notes: *forecast

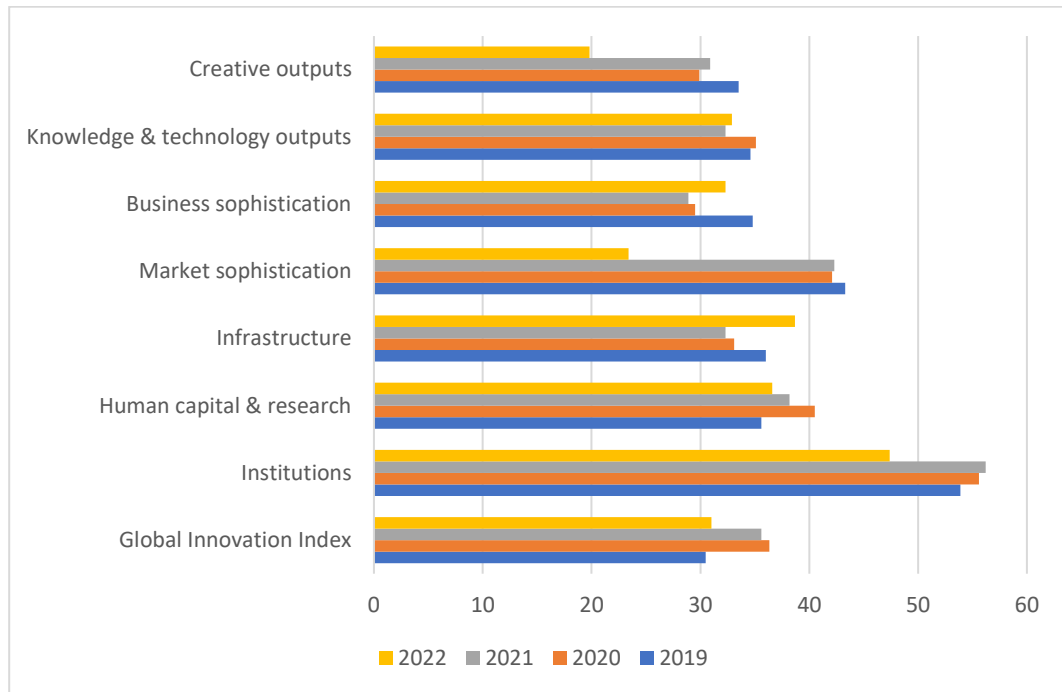Source: own processing based on data of the Draft Ukraine Recovery Plan, 2022

In 2022, the growth of the digital economy in Ukraine slowed down somewhat due to the outbreak of hostilities. However, according to available forecasts, it will be 6% in 2023 and up to 7.7% in 2024.

4   Innovative development of Ukraine under modern conditions

The process of digital transformation of the economy is closely related to the creation and implementation of innovations. To analyze innovative development, integral assessments - indices - are often used. Ukraine is represented in most of them, but the most recognized is the Global Innovation Index (GII).

The Global Innovation Index uses 82 indicators distributed across seven groups (The Global Innovation Index report, 2019). These groups in turn form two sub-indices: "innovation input" and "innovation output". The "innovation input" sub-index comprises five criteria that cover elements of the national economy that support innovation activity. The "innovation output" sub-index contains only two criteria and characterizes the result of innovation activity. The overall value of the Global Innovation Index is the average of the sub-indices for input and output. The evaluation scale ranges from a minimum value (weakness) of 0 points to a maximum value (strength) of 100 points.

Graph 4 Indicators of innovation in the Ukrainian economy by main groups of factors, 2019-2022

At the beginning of the analysed period, there was a tendency for the total GII score to increase from 30.47 points in 2019 to 36.32 points in 2020. In 2021, however, it fell to 35.6 points, and in 2022 it stood at 31 points (Figure 4). Human capital and research as well as knowledge and scientific research results have always been considered the basis for Ukraine's innovative competitiveness. Compared to 2022, however, it has worsened its position in the "People and human capital" category, slipping from 44th place (38.2 points) to 49th place (36.6 points), largely due to a decline in spending on education as a percentage of GDP (23rd place in the 2021 ranking, 27th place in 2022).

Negative trends are observed in all innovative areas, except for "Infrastructure" (94th place in the rating with a value of 32.3 points in 2021, 82nd place with 38.7 points in 2022) and "Business sophistication" (53rd place in the rating with a value of 28.9 points in 2021, 48th place with 32.3 points - in 2022). The most problematic areas in 2022 are "Institutions" – 97th place in the GII ranking and "Market sophistication" – 102nd place.

In general, according to the Global Innovation Index Report (2022), Ukraine ranks 57th out of 131 countries in the world. Since the study is geographically limited to the countries of the European Union, we will compare Ukraine's positions in the Global Innovation Index with these countries.

Graph 5 Positioning of Ukraine and the countries of the European Union according to the Global Innovation Index, 2022
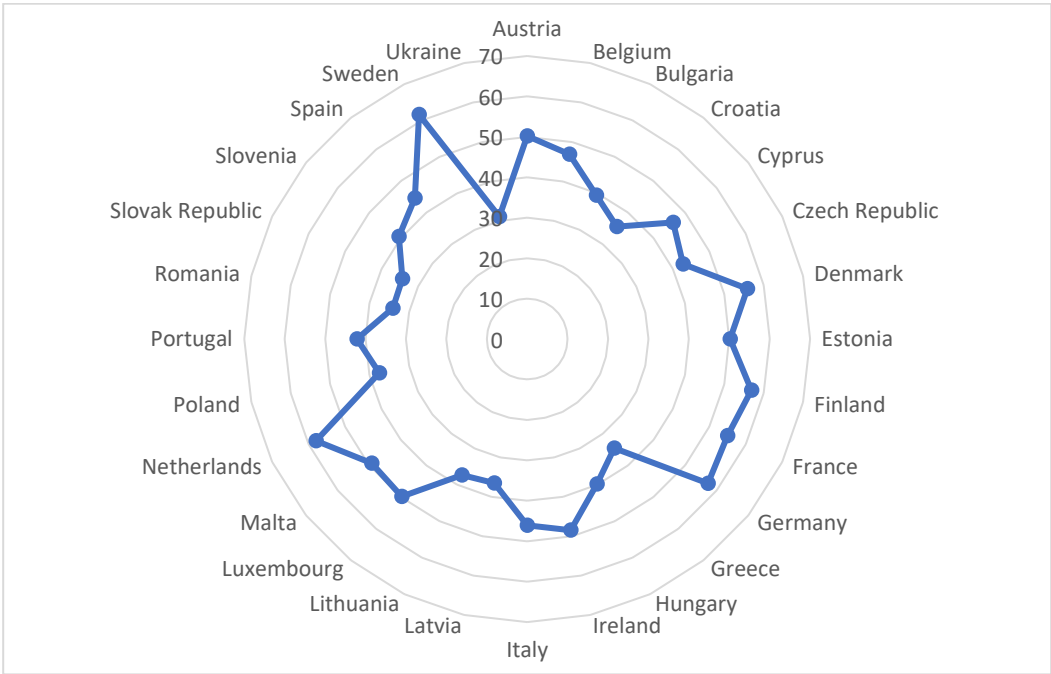
Source: own processing based on data of the Global Innovation Index Report, 2022, p.19.

Graph 5 shows a visualization of the position of Ukraine and the EU countries in accordance with the Global Innovation Index. The highest positions in the ranking are occupied by Sweden (61.6 points), the Netherlands (58 points), Germany (57.2 points), Finland (56.9 points) and Denmark (55.9 points). Ukraine ranks last with thirty-one points behind countries such as Greece (34.5), the Slovak Republic (34.3) and Romania (34.1), highlighting the need to develop strategies to improve innovation performance.

Conclusion

The aims of the work were achieved. Today, there is a comprehensive apparatus for assessing the degree of digital transformation of the economy using various international composite indices. As part of the assessment of the digital transformation of the Ukrainian economy, the Network Readiness Index (NRI) was chosen, which allows us to track the effectiveness of the processes of integration of people and technology, and the Global Innovation Index (GII) to characterize innovative development. The choice of indices depends on the purpose and objectives of the study and the availability of data.

The results of the work show that from 2019 to 2022 Ukraine showed a slightly positive dynamic in the index of network readiness. The increase in indicators occurred in three out of four main groups: "Technology", "People" and "Governance", which indicates a favorable environment for the development of digitalization. Given the rapid development of the Internet of Things, artificial intelligence, robotics and additive manufacturing, the growth of the "technology" factor deserves particular attention. Despite the improvement in most NRI

indicators, weak positions were identified in the impact of information and communication technologies on the achievement of sustainable development goals.

The digital transformation of European Union countries is based on high levels of network readiness, innovation, technology, and other factors. A comparative analysis of Ukraine's ranking in terms of network readiness with EU countries showed that it is slightly ahead of Bulgaria and Romania in 2022, indicating that there is significant potential for achieving a higher level of digital development.

As a result of the positioning of Ukraine and the countries of the European Union on the Global Innovation Index, it was found that in 2022 it occupies the lowest place, but the gap with countries such as Greece, the Slovak Republic and Romania is only about three points. An assessment of the level of innovative development of the Ukrainian economy showed a downward trend in most indicators, except for "Infrastructure" and "Business sophistication". At the same time, the most problematic areas in 2022 were "Institutions" – 97th place in the GII ranking and "Market sophistication" – 102nd place.

In general, the digital transformation in the Ukrainian economy is continuing despite martial law. Work is underway to provide institutional support for innovative developments and create conditions for management innovations. Ukraine's participation in the Digital Europe program can play an important role in accelerating economic recovery and digital transformation.

The results of the research provide an overview of the current state of the Ukrainian economy in the last decades of digital technologies and innovative development and also indicate potential areas where more balanced results can be achieved in all dimensions. The perspectives for the current research may include digital transformation at the external level, from the industry perspective, as well as identification of external and internal factors influencing it.

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