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CORRELATION ANALYSIS OF THE INTERDEPENDENCE OF ECONOMY'S INNOVATION AND CREATIVITY INDICES

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Abstract. Creativity and the generation of innovative solutions are means of solving the problems of slow economic development and resistance to instability that have been observed in recent years. The key role of creativity of individuals and groups of workers as a defining feature of modern economic life is increasingly recognised. There is a consensus that people, as a source of creativity, are now a critical resource of the new era. In the new model of economic development, creativity, knowledge and free access to information are seen as powerful drivers of development and catalysts of globalisation. The *subject of the research* is to study the relationship between innovation and creativity in the economic sphere. In particular, the article examines how the creativity of various economic subjects affects the level of innovative indicators, which synthetically reflect the possibilities of achieving the goals of innovative development. The research *methodology* includes the use of global reports on innovation and creativity indices, as well as scientific sources on this topic. The study uses the methods of critical analysis of scientific papers and international rankings, comparison and correlation of interdependent indicators. The *purpose of the research* is to assess the relationship between creativity and the level of innovative indicators, which synthetically show the possibilities of achieving the goals of innovative development. Creativity of business entities and mechanisms for generating innovative solutions are determining factors of success of modern post-industrial societies. In most developed countries, long-term economic growth is supported by innovation and creativity of various economic entities. To create the research algorithm, the authors defined the chain of concepts "sustainable development – innovation – creativity". To assess and analyse creativity, the study uses methodological tools that can be applied in global and local contexts. The most well-known indices are the Global Innovation Index (GII), the Global Creativity Index (GCI), the City Creativity Index (CCI), and the Hong Kong Creativity Index (HKCI). The general correlation coefficients between the global innovation index and the creativity indices of some countries have been calculated. According to the results of the calculations, the correlation coefficients of creativity and innovation are very positive. They are closely related and belong to the group of significantly correlated indicators. This means that there is a very high correlation between innovation and creativity in the economies studied. *Conclusions*. The positive correlation between innovation and creativity indices confirms, in general and in specific terms, a close relationship between innovation and creativity in the economies of different countries. This may indicate that countries or regions with a higher level of economic development have higher rates of creativity and vice versa. The research demonstrates the importance of innovation for the development of creativity in the economy. Understanding this interaction can serve as a basis for designing strategies and policies aimed at promoting innovative development and the growth of creative potential. The economies of Poland, Bulgaria and Ukraine, which were studied in detail, are not innovative enough. The countries studied represent different levels of economic development and are in the phase of post-industrial development, which requires effective innovation policies and measures to support creativity. In order to increase the level of innovation and creativity, it is necessary to involve national governments and organisations (especially the European Union) that can contribute to this.

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The conclusions point to the need to develop comprehensive approaches to support innovation and creativity in the economies of the countries studied. This may include not only effective strategies to stimulate research and development, but also policies aimed at the cultural environment, education and other areas.

Keywords: innovation management, economic innovation, creativity, correlation analysis, global innovation index, creativity index, post-industrial society.

JEL Classification: M00, O10, O11, O31, O32

1. Introduction

Globalisation processes, the development of the world economy and the economic growth of enterprises are impossible without the implementation of innovative processes, which include the search for and active implementation of new goods, technologies, services and new management methods. The innovativeness of the economy is considered to be the ability and motivation of entrepreneurs to conduct scientific research that improves and develops production, to search for new solutions, ideas and concepts.

Analysis of scientific sources on innovative development at various levels allows defining the economic category of "innovative entrepreneurship" as a key element of the creativity management system that ensures its efficiency and commercialisation. These problems were actively studied in the works of the following scientists: Bazhal Yu., Bakushevych I. (Bazhal, Bakushevych, 2015), Florida R. (Florida, 2002), Florczykiewicz J. (Florczykiewicz, 2008), Havrysh O., Pylnova V., Piskovets O. (Havrysh, Pylnova and Piskovets, 2020), Maslow A. (Maslow, 1966), Simonton D. (Simonton, 2000), Svydruk I. (Svydruk, 2012), Yoffie D., Cusumano M. (Yoffie, Cusumano, 2015), and many others.

In these works, the main attention was paid to the management methods and the assessment of the importance of creativity as the main tool for ensuring high rates of innovative development of the economy of countries in the era of formation of a post-industrial society. In authors' opinion, the methods of assessing the level of creativity at the macro and micro levels, as well as the problems of commercialisation of scientific research and development in the context of implementation of an effective creative management system are insufficiently studied.

2. The Essence of the Relationship between Innovation and Creativity

Innovative entrepreneurship is an area of increased economic risk. Enterprises are discouraged from innovating by high innovation costs with no guarantee of quick returns, insufficient finance, lack of information and skilled human resources, fierce competition in many markets, uncertain demand for innovative goods or services, and the complexity of organising the process of constantly searching for new ideas to produce innovative goods or services.

The innovativeness of the economy is closely related to the level of development and provision of creative processes at both macro and micro levels. Creativity is seen as the ability to generate new concepts and ideas, generated or internalised by individuals or teams (Adair, 2009). From this perspective, creativity is the act of bringing something useful into the world that works and is not obvious; it is a combination of novelty, utility and surprise (Simonton, 2000; Florida, 2002). Creativity is also seen as the creative ability of an individual who recognises the need for self-actualisation (Maslow, 1966). Thus, creativity is considered a specific type of mental activity aimed at optimal development of personal potential modified by socio-cultural influences (Florczykiewicz, 2008). It should be noted that creativity is a dynamic process in the sense that all its elements and their arrangement are changeable (Kopciuch, 2020).

In order to create a research algorithm, it is necessary to define a chain of concepts that are grouped from the smallest to the largest. Thus, the model for studying the interdependence of the concepts of "sustainable development – innovation – creativity" is presented in Figure 1.

The usefulness of a particular creative activity is assessed from the point of view of four complementary criteria: individual, socio-cultural, temporal and moral perspectives (Kharkhurin, 2014).

Modern studies of creativity distinguish the following areas of its analysis (Szmidt, 2018):

1) Psychological (cognitive, personal, developmental);
2) pedagogical (socio-cultural, early childhood, art education, special pedagogy and resocialisation);
3) direction in the field of management and marketing;
4) direction of social geography and urbanism;
5) philosophical direction.

The use of certain grouping characteristics for the classification of creativity allows a more detailed analysis of each of its selected types in order to effectively perform the functions of planning, organising interaction, motivating and controlling innovative activity.

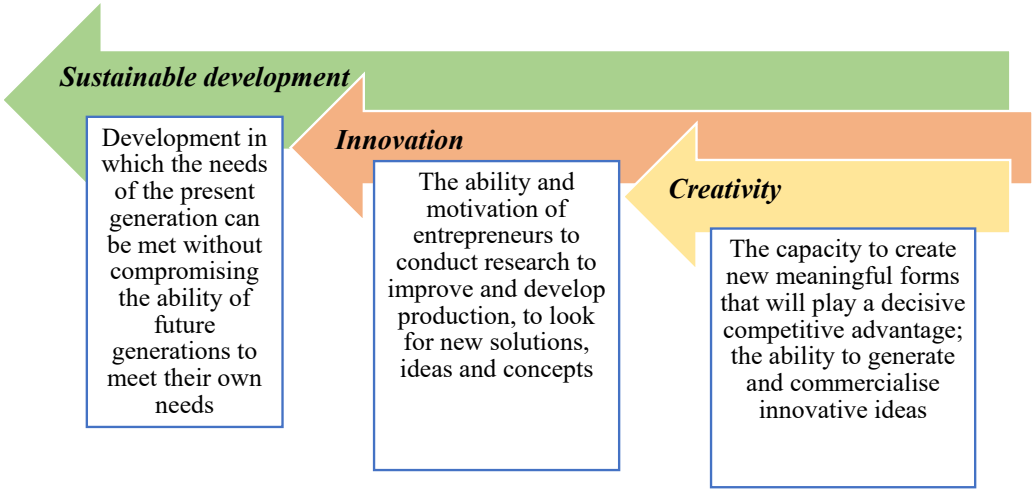

Figure 1. Model of interdependence of the concepts "Sustainable development – Innovation – Creativity"

Source: authors' own development

In the time dimension, innovations are the result and consequence of creativity processes (i.e., the use of creative effects in practice). Thus, the development of both individual enterprises and the economy as a whole depends on creativity and innovation, which stimulate change.

3. Assessment of Creativity Indices of Selected European Countries

Innovation and creativity can be analysed and evaluated on the basis of various criteria. The main criteria are novelty and value, in addition to the criteria of social usefulness, originality and relevance in the given historical period (Florczykiewicz, 2008).

There are methodological tools for assessing and analysing creativity that can be applied in global and local contexts. The most well-known indices are the Global Innovation Index (GII), the Global Creativity Index (GCI), the Cities Index (CCI), and the Hong Kong Creativity Index (HKCI).

The above indices differ in their categories, priorities, research objectives and context, as well as the set of input and output parameters used to create integrated indicators. Each of these indicators not only identifies the creative potential of specific research topics, but also assesses the contribution of creative activity to economic development. The global level of assessment includes three indices – Global Creativity Index, Creative Productivity Index, Global Innovation Index; the other two – Creative City Index and Hong Kong Creativity Index – are more local in nature.

This research focused on the creativity indicators of three countries: two members of the European Union – Poland and Bulgaria, and Ukraine, which is a candidate for accession to the European Union. The choice of these countries for research is based on similar historical conditions of development of their economies (so-called "socialist economies"), but different methods of systemic transformation and, accordingly, different results of such transformations. As a context for a detailed review, an analysis of the effectiveness of creative activity in various Member States of the European Union was carried out on the basis of the Global Creativity Index (Table 1).

The data in Table 1 show the ranking of some EU Member States among the 127 countries of the world included in the assessment. It shows that the five EU countries with the highest creativity indicators in 2017 were Luxembourg (1st place; 65.8 points), the United Kingdom (4th place; 60.5 points), the Netherlands (5th place; 59.0 points), Malta (6th place; 56.0 points) and Germany (7th place; 55.9 points). In 2021, among 132 countries in the world, Luxembourg ranked 3rd (54.4 points), the United Kingdom 4th (54.0 points), Sweden 5th (52.9 points), France 6th (52.6 points), and the Netherlands 7th (52.2 points). Croatia, Greece and Romania took the last places in the ranking of creativity among EU countries for 2017–2021.

In the process of studying the interdependence of creativity and innovation indices of the economies of different European countries, in addition to general trends, three countries were singled out – Poland, Bulgaria and Ukraine. The choice of these countries for further detailing the relationship between innovation and creativity is due to similar starting conditions of development and rather different development trajectories in the short term.

Tables 2-4 show the ten-year dynamics of the Global Innovation Index for Poland, Bulgaria and Ukraine.

In 2011, Poland was ranked 43rd in the global innovation rankings. In 10 years (2021), it moved to

Table 1

Dynamics of the creativity index of some European countries according to GII, 2017–2021

№	European countries	Year									
		2017		2018		2019		2020		2021	
		Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
		(1–100)	(1–127)	(1–100)	(1–141)	(1–100)	(1–141)	(1–100)	(1–131)	(1–100)	(1–132)
1	Austria	48.3	17	45.8	20	41.4	25	37.5	22	39.0	27
2	Belgium	47.1	19	42.7	27	38.5	33	35.0	32	53.1	36
3	Bulgaria	44.1	29	39.2	36	33.8	41	33.5	37	41.1	21
4	Croatia	37.9	43	37.6	43	*31.0*	*51*	*27.9*	*49*	*28.2*	*54*
5	Cyprus	38.2	41	42.3	28	41.1	28	36.1	25	41.3	20
6	Czech Republic	39.9	9	44.1	25	43.1	21	38.7	20	40.3	22
7	Denmark	53.5	9	51.7	9	48.6	11	48.3	10	47.7	13
8	Estonia	53.6	8	54.9	5	51.7	8	43.0	15	45.3	15
9	Finland	47.3	18	49.3	11	48.1	13	41.8	16	42.9	16
10	France	51.4	12	49.2	12	45.0	16	46.7	13	52.6	6
11	Greece	*35.5*	*51*	*32.2*	*51*	*30.1*	*53*	*23.8*	*59*	*22.9*	*69*
12	Spain	44.4	28	41.5	29	39.7	31	35.0	31	36.2	32
13	The Netherlands	**59.0**	**5**	**56.7**	**3**	**53.4**	**5**	51.7	6	52.2	7
14	Ireland	50.9	13	45.9	19	43.3	19	37.6	21	36.7	29
15	Lithuania	39.6	38	39.8	33	40.3	30	30.9	40	33.6	41
16	Luxembourg	**65.8**	**1**	**57.9**	**2**	**56.2**	**2**	**55.0**	**3**	**54.4**	**3**
17	Latvia	49.4	14	44.6	23	42.8	22	35.7	28	33.8	39
18	Malta	56.0	6	51.7	10	**55.0**	**4**	**53.5**	**4**	52.0	9
19	Germany	55.9	7	53.3	7	49.6	10	49.1	9	50.0	11
20	Poland	39.7	37	37.7	42	32.4	46	28.9	47	29.6	50
21	Portugal	46.7	21	43.4	26	39.4	32	35.3	29	39.3	26
22	Romania	*32.9*	*57*	*29.3*	*61*	*25.8*	*71*	*20.3*	*67*	*22.2*	*72*
23	Slovakia	40.8	35	38.1	41	37.1	36	31.3	39	33.0	43
24	Slovenia	46.4	23	46.7	16	42.1	24	30.7	41	34.3	38
25	Sweden	53.3	11	53.8	6	51.9	7	51.7	7	**52.9**	**5**
26	Ukraine (candidate for EU membership from 2022)	35.6	49	36.5	45	33.5	42	29.9	44	30.9	48
27	Hungary	37.9	42	36.6	44	34.6	38	29.4	46	30.9	47
28	The United Kingdom (the EU member until 2019)	**60.5**	**4**	**56.5**	**4**	52.2	6	**57.2**	**5**	**54.0**	**4**
29	Italy	42.9	33	38.9	38	36.8	37	35.9	27	35.8	34

Source: developed on the basis of the Global Innovation Index Reports 2017–2021.
bold underlined font – top-5 countries, *1* (*italics*) – 3 countries with the lowest indices

Table 2

Dynamics of the Global Innovation Index of Poland, 2011–2021

№	Components of the country's innovation potential	Year											
		2011		2013		2015		2017		2019		2021	
		Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
		(1–100)	(1–125)	(1–100)	(1–142)	(1–100)	(1–141)	(1–100)	(1–127)	(1–100)	(1–141)	(1–100)	(1–132)
		Input sub-index (innovation potential of the country)											
1	Institutions	76.4	37	74.4	35	75.3	34	75.6	33	73.6	37	73.2	38
2	Human capital and research	42.4	48	37.6	45	37.2	45	36.5	48	41.2	42	42.3	37
3	Infrastructure	30.4	52	38.0	47	45.5	47	53.3	41	53.8	38	50.1	41
4	Market sophistication	41.4	47	50.5	46	49.0	60	48.2	55	47.9	65	48.3	60
5	Business sophistication	23.7	66	38.6	40	35.2	66	37.4	42	38.4	38	34.2	38
Input rank		46.26	41	47.8	39	48.44	39	50.20	37	50.97	37	35.38	37

(End of Table 2)

№	Components of the country's innovation potential	Year											
		2011		2013		2015		2017		2019		2021	
		Score (1–100)	Rank (1–125)	Score (1–100)	Rank (1–142)	Score (1–100)	Rank (1–141)	Score (1–100)	Rank (1–127)	Score (1–100)	Rank (1–141)	Score (1–100)	Rank (1–132)
		Sub-index of results (realisation of innovation potential)											
6	Knowledge and technology outputs	23.7	66	29.0	55	28.3	56	27.9	44	30.9	39	30.6	36
7	Creative outputs	35.8	54	35.9	78	35.4	53	39.7	37	32.4	46	29.6	50
Output rank		29.74	55	32.4	64	31.87	56	33.78	41	31.66	41	40.44	42
Global Innovation Index		**38.02**	**43**	**40.1**	**49**	**40.2**	**46**	**42.0**	**38**	**41.31**	**39**	**39.9**	**40**

Source: developed on the basis of the Global Innovation Index Reports 2011–2021

Table 3

Dynamics of the Global Innovation Index of Bulgaria, 2011–2021

№	Components of the country's innovation potential	Year											
		2011		2013		2015		2017		2019		2021	
		Score (1–100)	Rank (1–125)	Score (1–100)	Rank (1–142)	Score (1–100)	Rank (1–141)	Score (1–100)	Rank (1–127)	Score (1–100)	Rank (1–141)	Score (1–100)	Rank (1–132)
		Input sub-index (innovation potential of the country)											
1	Institutions	74.5	40	68.0	51	69.7	45	67.1	52	68.3	48	69.8	47
2	Human capital and research	39.2	59	35.7	55	32.2	58	33.7	56	30.6	62	31.7	64
3	Infrastructure	28.9	59	40.0	43	43.3	53	51.9	48	53.7	39	51.7	36
4	Market sophistication	43.0	50	43.9	83	48.9	61	43.9	76	47.5	66	45.1	72
5	Business sophistication	35.4	65	32.2	65	36.4	60	41.4	32	40.3	34	32.6	42
Input rank		44.2	47	44.0	50	46.1	49	47.61	45	41.47	45	40.48	46
		Sub-index of results (realisation of innovation potential)											
6	Knowledge and technology outputs	27.2	50	35.0	36	35.4	37	32.0	35	31.4	37	36.0	27
7	Creative outputs	38.1	46	42.4	49	41.1	34	44.1	29	33.8	41	41.1	21
Output rank		32.6	43	38.7	38	38.2	35	38.08	32	37.39	38	25.30	27
Global Innovation Index		**38.42**	**42**	**41.33**	**41**	**42.16**	**39**	**42.84**	**36**	**38.40**	**40**	**42.4**	**35**

Source: developed on the basis of the Global Innovation Index Reports 2011–2021

40th place (Table 2). It is noteworthy that in 2021, Poland had better indicators of innovation costs than innovation results (Input/Output sub-indices). This means that Poland produces less innovation compared to the level of investment.

Within 10 years, Bulgaria moved from 42nd to 35th place in the global innovation ranking (Table 3). In 2001, Bulgarian analysts concluded that Bulgaria was seriously lagging behind developed countries in terms of the level of innovative infrastructure. The economic situation required urgent measures to ensure favourable conditions for innovative activities in high-tech industries such as chemistry, biotechnology, microelectronics, production of automation tools, etc. The country created venture capital funds, technology centres and parks, business incubators, human resources support for innovative activities and IT systems to accelerate the creation of innovative infrastructure. Ten years after Bulgaria's accession to the European Union, international rating agencies assess the country's financial situation as fairly stable (Kniazevych, 2018).

In 2011, Ukraine was ranked 60th in the innovation ranking. It made significant progress over the next 10 years. In 2021, it ranks 49th (Table 4). The strengths of the Ukrainian economy are related to the acquisition of knowledge (33rd place) and the quality of human capital (44th place). Its weaknesses are the institutional environment (91st), infrastructure (94th) and indicators of the development of the internal market (88th). This points to the need to increase the country's innovative capacity by improving the institutional environment and strengthening all elements of the national innovation system.

In 2022, after Russia's invasion of Ukraine, innovation performance has obviously deteriorated significantly. After all, 18% of Ukraine's territory is currently under occupation, much of the infrastructure

Table 4

Dynamics of Ukraine's Global Innovation Index, 2011–2021

№	Components of the country's innovation potential	Year											
		2011		2013		2015		2017		2019		2021	
		Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
		(1–100)	(1–125)	(1–100)	(1–142)	(1–100)	(1–141)	(1–100)	(1–127)	(1–100)	(1–141)	(1–100)	(1–132)
		Input sub-index (innovation potential of the country)											
1	Institutions	51.0	103	51.4	105	52.2	98	47.9	101	53.9	96	56.2	91
2	Human capital and research	44.3	40	37.9	44	40.4	36	39.6	41	35.6	51	38.2	44
3	Infrastructure	21.5	101	26.0	91	26.3	112	39.3	90	36.0	97	32.3	94
4	Market sophistication	39.6	64	44.0	82	43.9	89	43.2	81	43.3	90	42.3	88
5	Business sophistication	41.5	45	30.2	79	32.4	78	35.3	51	34.8	47	28.9	53
	Input rank	39.58	–	33.7	58	33.9	47	41.5	77	40.73	82	63.17	76
		Sub-index of results (realisation of innovation potential)											
6	Knowledge and technology outputs	29.9	40	32.0	45	36.4	34	32.8	32	34.6	28	32.3	33
7	Creative outputs	31.0	70	35.3	81	31.3	75	35.6	49	33.5	42	30.9	48
	Output rank	30.45	–	37.9	83	39.1	84	34.19	40	34.07	36	37.38	37
	Global Innovation Index	–	**60**	**36.1**	**63**	**36.5**	**64**	**37.6**	**50**	**37.4**	**47**	**35.6**	**49**

* The assessment took into account the fact that Ukraine belongs to the group of countries with lower than average per capita income.

Source: developed on the basis of the Global Innovation Index Reports 2011–2021

has been destroyed, and inflation is reaching 30%. In addition, significant migration and displacement of Ukrainian companies will have a further negative impact on the country's economy.

4. Correlation Analysis of the Interdependence of Innovation and Creativity in the Economies

Among the methods of economic analysis, correlation analysis plays a significant role. Correlation analysis is a method of studying the interdependence of features in a general population, which are random variables with a normal distribution. The main requirements for the application of correlation analysis are a sufficient number of observations, a set of factor and outcome indicators, as well as their quantitative measurement and reflection in information sources. The main tasks of correlation analysis are to determine the form of the relationship, measure the density (strength) of the relationship, and identify the influence of factors on the resulting characteristic (Starynets, 2017).

Probabilistic correlations are used to study the interdependence of mass socio-economic phenomena formed under the influence of various factors. In fact, multifactorial correlation analysis allows to estimate the degree of influence of each of the factor variables introduced into the model in a fixed position on the researched indicator at the average level of other factors. An important condition in this case is the absence of a functional connection between them, which determines the expediency of conducting a correlation analysis of the influence of factor variables, represented by the growth rates of intensification indicators on the resulting variable. This makes it possible to follow the elasticity of the studied indicator in accordance with the dynamic fluctuations of the factor variables (Hlubish, 2011).

One of the advantages of this method is the possibility of determining the influence of a number of factors not only on one indicator characterising the studied phenomenon, but on several indicators at the same time. Canonical correlation analysis makes it possible to simultaneously examine the relationships between the indicators of both sets and determine the closest ones, i.e., those with the highest correlation coefficient. On the basis of the results obtained, it is possible to identify the main and secondary factors of influence, and if the latter have weak connections between the canonical quantities, they can be discarded. Thus, the study of the economic process is not overloaded with unnecessary factors (Dziubanovska, 2017).

The Creativity Index is a component of the Global Innovation Index. The level of the Creativity Index is shown in Tables 2-4 (row 7). In the 2021 ranking, according to the creativity index, Bulgaria is ranked 21st, Ukraine is ranked 48th and Poland is ranked 50th.

The creativity index is based on three main assessment criteria (see Tables 5-7): Intangible assets; Creative goods and services; and Online creativity.

Table 5
Detailed analysis of the dynamics of Poland's creativity assessment criteria according to GII, 2017–2021

№	Components of the country's creative potential	Year									
		2017		2018		2019		2020		2021	
		Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
		(1–100)	(1–127)	(1–100)	(1–141)	(1–100)	(1–141)	(1–100)	(1–131)	(1–100)	(1–132)
I.	**Intangible assets**	**45.9**	**54**	**46.2**	**50**	**42.6**	**58**	**26.7**	**69**	**29.5**	**73**
1.1.	Trademarks by origin/billion USD PPP GDP	45.0	55	47.1	57	38.2	67	34.2	72	32.0	73
1.2.	Value of global brands, top 5,000, % of GDP	–	–	–	–	–	–	38.4	39	33.8	42
1.3.	Industrial designs by origin / billion USD PPP GDP	61.0	59	63.4	52	60.8	60	–	–	–	–
1.4.	ICT and the creation of an organisational model	54.0	62	53.4	65	51.9	73	51.9	74	51.9	74
II.	**Creative goods and services**	**34.1**	**22**	**36.7**	**25**	**27.2**	**37**	**31.8**	**22**	**29.4**	**26**
2.1.	Exports of cultural and creative services, % of total trade	1.0	16	1.1	13	1.1	25	1.1	23	1.2	24
2.2.	National feature films/million pop. 15–69	1.5	69	1.5	69	1.8	69	1.8	72	1.8	71
2.3.	Entertainment and media market/ thousand pop. 15–69	11.1	34	11.1	32	11.5	33	12.6	34	12.1	34
2.4.	Print and other media, % of production	1.1	57	1.2	45	1.2	54	1.1	48	1.2	37
2.5.	7.2.5 Exports of creative goods, % of total trade	5.5	9	5.0	9	4.4	12	4.8	12	4.5	12
III.	**Online creativity**	**32.7**	**35**	**21.6**	**34**	**17.4**	**38**	**30.5**	**35**	**30.1**	**35**
3.1.	Generic top-level domains (TLDs)/ thousand pop. 15–69	7.1	46	6.9	46	6.9	46	7.0	46	7.1	46
3.2.	TLDs with country code / thousand pop. 15–69	27.9	22	25.8	24	25.7	23	26.8	25	26.9	26
3.3.	Wikipedia edits/ million pop. 15–69	6.2	31	34.3	36	34.3	36	74.5	32	68.5	42
3.4.	Mobile app creation/ billion USD PPP GDP	35.8	39	30.4	31	13.8	34	15.1	32	15.5	32
Creative outputs		**39.7**	**37**	**37.7**	**42**	**32.4**	**46**	**28.9**	**47**	**29.6**	**50**
Global Innovation Index		***42.0***	***38***	***41.67***	***39***	***41.31***	***39***	***39.95***	***38***	***39.9***	***40***

Source: developed on the basis of the Global Innovation Index Reports 2017–2021

Table 6
Detailed analysis of the dynamics of the criteria for assessing Bulgaria's creativity according to GII, 2017–2021

№	Components of the country's creative potential	Year									
		2017		2018		2019		2020		2021	
		Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
		(1–100)	(1–127)	(1–100)	(1–141)	(1–100)	(1–141)	(1–100)	(1–131)	(1–100)	(1–132)
I.	**Intangible assets**	**59.4**	**16**	**54.7**	**25**	**49.9**	**37**	**43.8**	**21**	**57.9**	**7**
1.1.	Trademarks by origin/billion USD PPP GDP	113.6	8	111.4	8	98.6	12	91.1	16	84.8	18
1.2.	Value of global brands, top 5,000, % of GDP	10.8	12	8.5	13	8.1	15	–	–	–	–
1.3.	Industrial designs by origin / billion USD PPP GDP	62.0	56	61.0	57	58.0	75	5.8	23	8.5	13
1.4.	ICT and the creation of an organisational model	58.6	44	55.5	56	53.7	64	53.7	64	53.7	64
II.	**Creative goods and services**	**26.5**	**41**	**29.7**	**42**	**19.3**	**57**	**19.8**	**55**	**21.7**	**46**
2.1.	Exports of cultural and creative services, % of total trade	1.1	13	1.3	9	1.4	19	1.4	14	1.7	13

(End of Table 6)

№	Components of the country's creative potential	Year									
		2017		2018		2019		2020		2021	
		Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
		(1–100)	(1–127)	(1–100)	(1–141)	(1–100)	(1–141)	(1–100)	(1–131)	(1–100)	(1–132)
2.2.	National feature films/million pop. 15–69	4.8	39	4.8	39	4.8	44	4.7	45	4.7	45
2.3.	Entertainment and media market/ thousand pop. 15–69	–	–	–	–	–	–	–	–	–	–
2.4.	Print and other media, % of production	1.3	38	1.2	49	1.2	48	1.1	46	1.1	43
2.5.	7.2.5 Exports of creative goods, % of total trade	1.0	43	0.9	48	0.8	49	1.0	44	1.0	42
III.	**Online creativity**	**31.2**	**38**	**17.8**	**41**	**16.0**	**40**	**26.5**	**41**	**26.8**	**43**
3.1.	Generic top-level domains (TLDs)/ thousand pop. 15–69	22.7	26	22.7	25	22.9	25	23.4	24	23.7	24
3.2.	TLDs with country code / thousand pop. 15–69	2.0	65	2.0	67	3.3	59	3.7	59	3.8	59
3.3.	Wikipedia edits/ million pop. 15–69	6.5	26	46.2	30	46.2	30	74.3	33	69.5	39
3.4.	Mobile app creation/ billion USD PPP GDP	36.8	36	15.5	49	7.0	45	6.1	52	7.3	53
Creative outputs		**44.1**	**29**	**39.2**	**36**	**33.8**	**41**	**33.5**	**37**	**41.1**	**21**
Global Innovation Index		***42.84***	***36***	***42.65***	***37***	***40.35***	***40***	***39.98***	***37***	***42.4***	***35***

Source: developed on the basis of the Global Innovation Index Reports 2017–2021

Table 7

Detailed analysis of the dynamics of the criteria for assessing Ukraine's creativity according to the GII, 2017–2021

№	Components of the country's creative potential	Year									
		2017		2018		2019		2020		2021	
		Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
		(1–100)	(1–127)	(1–100)	(1–141)	(1–100)	(1–141)	(1–100)	(1–131)	(1–100)	(1–132)
I.	**Intangible assets**	**53.7**	**26**	**58.6**	**13**	**55.8**	**17**	**42.8**	**23**	**45.0**	**29**
1.1.	Trademarks by origin/billion USD PPP GDP	106.8	12	130.0	5	128.6	6	131.1	5	96.8	10
1.2.	Value of global brands, top 5,000, % of GDP	12.6	11	15.3	7	13.4	8	1.3	79	3.1	74
1.3.	Industrial designs by origin / billion USD PPP GDP	47.0	112	49.6	106	49.1	109	13.5	8	8.3	15
1.4.	ICT and the creation of an organisational model	52.2	66	54.3	57	55.6	58	55.6	58	55.6	58
II.	**Creative goods and services**	**9.3**	**92**	**11.9**	**86**	**8.8**	**91**	**6.6**	**95**	**7.0**	**93**
2.1.	Exports of cultural and creative services, % of total trade	0.1	53	0.1	58	0.4	58	0.5	48	0.5	47
2.2.	National feature films/million pop. 15–69	0.1	102	0.1	101	0.6	94	0.6	99	0.6	97
2.3.	Entertainment and media market/ thousand pop. 15–69	–	–	–	–	–	–	–	–	–	–
2.4.	Print and other media, % of production	1.0	66	0.9	63	1.0	62	0.8	70	0.8	68
2.5.	7.2.5 Exports of creative goods, % of total trade	0.4	63	0.4	61	0.2	82	0.2	80	0.2	78
III.	**Online creativity**	**25.8**	**47**	**16.9**	**43**	**13.6**	**43**	**27.3**	**39**	**26.4**	**45**
3.1.	Generic top-level domains (TLDs)/ thousand pop. 15–69	4.4	59	4.3	57	4.5	57	4.5	56	4.5	55
3.2.	TLDs with country code / thousand pop. 15–69	5.1	50	4.9	50	4.7	51	5.1	54	5.1	55

(End of Table 7)

№	Components of the country's creative potential	Year									
		2017		2018		2019		2020		2021	
		Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
		(1–100)	(1–127)	(1–100)	(1–141)	(1–100)	(1–141)	(1–100)	(1–131)	(1–100)	(1–132)
3.3.	Wikipedia edits/ million pop. 15–69	6.1	39	31.1	38	31.1	38	67.7	43	65.0	44
3.4.	Mobile app creation/ billion USD PPP GDP	34.9	41	37.3	19	24.3	19	33.8	15	29.1	17
Creative outputs		**35.6**	**49**	**36.5**	**45**	**33.5**	**42**	**29.9**	**44**	**30.9**	**48**
Global Innovation Index		***37.6***	***50***	***38.52***	***43***	***37.4***	***47***	***36.32***	***45***	***36.5***	***49***

Source: developed on the basis of the Global Innovation Index Reports 2017–2021

Based on the detailed dynamics of the global innovation index (Tables 2-4) and the creativity index (Tables 5-7), the level of their relationship in 2021 was investigated using the correlation method. The purpose of this calculation was to identify and measure the strength of the relationship between innovation and creativity.

The statistical information was structured by the countries studied, then a correlation analysis was conducted and the overall correlation coefficients were calculated using the Microsoft Excel analytical package (Formula 1).

$$Correl(X,Y) = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2 \sum(y-\bar{y})^2}} \quad (1)$$

Correl (X,Y) is the correlation coefficient;

$\bar{x}, \bar{y}$ are sample averages of datasets.

X is a mathematical array of data on the ratings of countries by the Creativity Index for 2017–2021 (Tables 5-7, penultimate row);

Y is a mathematical array of data on the rankings of countries by the Innovation Index for 2017–2021 (Tables 5-7, last row).

Table 8 shows the correlation coefficients between the Global Innovation Index and the Creativity Index.

Table 8

Results of calculating correlation coefficients

	Correlation coefficients	
	Creativity Index and Global Innovation Index	
Poland	+0.618	High positive correlation
Bulgaria	+0.881	
Ukraine	+0.624	

Source: authors' own development

According to the results of the calculations, the correlation coefficients between creativity and innovation are very positive. They are closely related and belong to the group of significantly correlated indicators. This means that there is a very high correlation between innovation and creativity in the economies studied. The economies of Poland, Bulgaria and Ukraine cannot be considered innovative or creative in comparison with other countries of the European Union. Unfortunately, this is not a positive conclusion and indicates the need for radical changes in the innovation policies of these countries.

5. Conclusions

The article investigates the relationship between innovation and creativity indices in the national economies of some European countries. Several key conclusions can be drawn from the analysis:

1. There is a positive correlation between innovation and creativity indices. The results of the study confirm, in general and specific terms, the close relationship between innovation and creativity of national economies of different countries. This may indicate that countries or regions with a higher level of economic development have higher creativity scores, and vice versa.

2. Innovation is important for the development of creativity. An important factor in economic development is the effective use of innovations, which play a crucial role in solving economic, environmental and social problems. Creativity, the generation of innovative ideas, innovative enterprises and infrastructure are becoming key concepts in today's post-industrial society. The study proved the importance of innovation for the development of creativity in the economy. Understanding this relationship can serve as a basis for developing strategies and policies aimed at promoting innovation and creativity.

3. There is a need for a comprehensive approach. The economies of Poland, Bulgaria and Ukraine, which have been studied in detail, are unfortunately not innovative enough. The countries studied represent different levels of economic development and are at the stage of post-industrial development, which requires effective innovation policies and efficient measures to support creativity. Increasing the level of innovation and creativity requires the involvement of national governments and organisations (primarily the European Union) that can contribute to this. The findings suggest the need to develop

comprehensive approaches to supporting innovation and creativity in the economies of the countries studied. This may include not only effective strategies to stimulate research and development, but also policies aimed at the cultural environment, education and other areas.

4. There is a need for further research. Despite these findings, research on such a complex topic remains at an early stage. Further research could focus on deeper aspects of the interaction between innovation and creativity, taking into account contextual differences between different economic sectors and countries. In addition, special attention should be paid to the issue of categorical changes in the studied indicators after the outbreak of a full-scale war in Ukraine.

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