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JEL: C10; L82; L86; R11

Marianna Kichurchak¹

**STRUCTURAL CHANGES IN THE INFORMATION AND
COMMUNICATION SECTOR IN THE CREATIVE ECONOMY
SYSTEM OF THE EU COUNTRIES: EXPERIENCE FOR UKRAINE**

One of the major factors to form a creative economy in the EU countries and Ukraine is the development of the information and communication sector (ICS). The purpose of the article is to evaluate the structural transformation peculiarities of the ICS in the EU countries in the conditions of forming and developing the creative economy and to determine the chief directions of adaptation of this experience to the social and economic situation in Ukraine. Scientific methods of induction, deduction, analysis, synthesis, statistical evaluation of variation, and multiple econometric modelling are used. The author has specified that the ICS contributes to the formation of the creative economy in Ukraine and the EU countries, based on a gradual increase in the share of this sector in output and employment in 2008–2020. The scientific and methodological approach to evaluating of structural changes in the ICS as a component of the creative economy has been formed including: a comparative analysis of the dynamics of output (% of GDP) and employment (% of total) in the ICS between the EU countries and Ukraine; determining the features of spatial differentiation based on calculating the scope of variation, sample variance and coefficient of variation for the main social and economic indicators of ICS; and identifying factors that affect output of the ICS (% of GDP) by means of the multiple regression analysis. In 2008–2020, the existence of different dynamics of the sector's impact on the development of creative economy in the EU countries is substantiated via the increase in the value of variation in terms of output (% of GDP) and employment (% of total). According to the results of multiple regression analysis, the author has found out the factors influencing the output of the ICS in the EU

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countries, which include the current social and economic situation in the country, and the amount of expenditures on R&D and on unemployment. Taking into account the experience of the EU countries, it is important for Ukraine to encourage economic activities in the ICS, which are based on structural reforms.

Keywords: *information and communication sector; creative economy; structural changes; analysis of variation; multiple regression analysis*

The development of the information and communication sector (ICS) is one of the important factors in the formation of the creative economy and transformation of the structure of the national economy. In view of this, it is advisable to analyze the main trends in the development of the I&C sector as a component of the creative economy of the EU countries in 2008-2020. The study of this experience will contribute to the development of a number of recommendations to enhance the development of the I&C sector in the Ukrainian economy.

The formation of the theoretical, methodological, scientific and applied foundations for the functioning of ICS in the creative economy system is controversial. Scientists have clarified the role of ICS in the development of creative industries in the region [1]. From the standpoint of maximizing the benefits and social value of the emergence of a new technological landscape, scientists determined the contribution of ICS to the development of creative industries [2]. Researchers examined the peculiarities of cooperation and implementation of innovative technologies in the information and communication creative industries of Germany [3]. Through the concept of a smart city, which is based on creative capital and the use of ICT, scientists determined the main factors of balanced economic development [4]. Based on a regional analysis, the existence of positive and interactive links between the creative class and the development of the EU's ICS was revealed [5]. For the long and short term, researchers found strong endogenous relationships between economic growth in OECD countries and the development of the ICS [6]. A holistic vision was formed and the main trends in the impact of the ICS on the formation of business models in the creative industries were identified [7]. Based on the study of socio-economic indicators of development in 160 countries, the peculiarities of the relationship between entrepreneurship, innovation and the creative economy were identified [8]. Researchers identified the existence of positive relationships between the ICS and market-oriented reforms in China's cultural and tourism industries [9].

By revealing the relationship between innovative development and the formation of creative economy, scientists identified the main prerequisites for its formation at the regional level, taking into account the EU experience [10]. Adamovych M. analyzed the main trends in the functioning of the creative economy and ICS as its component [11]. Based on the analysis of the economic potential of creative sector, I. Skavronska

developed a strategy for transforming Ukraine into a creative economy [12]. In the context of the ICS development, scientists identified the peculiarities of the impact of IT clusters on the economic and social development of Ukrainian regions [13], outlined theoretical and methodological approaches to understanding the impact of this sector on the reproduction of public goods [14], and assessed its impact on economic growth and development of other sectors [15]. Through the disclosure of the essence of creative economy, researchers identified its relationship with the digital economy and ICT development of [16]. Taking into account the achievements in the field of ICT, the main features and factors of the creative economy development in the developed countries are highlighted [17]. Given the existence of inter-branch connections, scientists analyzed the peculiarities of the impact of the ICS on the development of creative industries in the Ukrainian economy [18]. It was determined that the rapid development of the information and communication technologies sector in Ukraine is facilitated by the system of training specialists, current tax rates, and the post-crisis recovery of the world economy in 2009-2018 [19]. However, some parts of the general problem of analyzing structural changes in ICS in the context of the formation of the EU's creative economy in order to implement the relevant experience in Ukrainian business practice still need to be clarified.

The purpose of the article is to assess the peculiarities of the structural transformation of the ICS in the EU countries in the context of the formation and development of creative economy and to identify the main directions of adaptation of this experience to the socio-economic situation in Ukraine. This involves the use of the following scientific and methodological approaches: a comparative analysis of the dynamics of output by GDP and employment in this sector as a whole and its industries between the EU countries and Ukraine in 2008-2020; identification of the main trends in spatial differentiation based on the calculation of indicators of variation in output and employment for the EU countries; and identification of factors that affect output in this sector using the tools of regression and correlation analysis.

The scientific and methodological basis for the consideration of ICS in the system of creative economy includes: the theoretical approaches proposed by S. Davymuka and L. Fedulova in terms of their understanding of the "knowledge product" [10, p. 22] and analysis of trends in the development of creative industries in such areas as ICT and IT industry, media space, publishing [10, p. 290-307]; and the approaches of a team of scientists who noted that "the share of the creative sector in the economy is still quite low, although it tends to grow annually, mainly due to the IT industry" [16, p. 69- 70] and assessed the state of development of creative industries in the ICT sector [18, p. 206-213]. Statistical disaggregation of data that define the main social and economic indicators of ICS activities is in the process of formation. Given the completeness of indicators reflected by the SNA in the Eurostat database [20], this sector will be associated in this paper with economic activity "Information and communications".

Table 1

The dynamics of ICS output in EU countries, % of GDP

Country	Overall												including:											
	publishing activity				CVPTPPBA				telecommunications				CPCIS											
	2008	2018	2019	2020	2008	2018	2019	2020	2008	2018	2019	2020	2008	2018	2019	2020								
Belgium	3.5	4.1	4.2	4.4	0.4	0.3	0.3	...	0.4	0.5	0.5	...	1.5	1.2	1.2	1.2	1.3	2.1	2.3	2.5				
Bulgaria	3.4	5.0	5.7	6.1	0.3	0.2	0.2	0.2	0.5	0.5	0.6	0.4	1.9	1.5	1.5	1.6	0.7	2.9	3.4	3.9				
Czech Republic	3.7	4.1	4.4	4.8	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	1.5	1.1	1.1	1.1	1.4	2.1	2.3	2.7				
Denmark	4.8	4.6	4.9	5.1	0.8	0.6	0.7	...	0.6	0.7	0.7	...	1.5	1.0	1.2	...	1.9	2.3	2.4	...				
Germany	4.6	4.8	4.8	5.0	0.6	0.6	0.5	...	0.6	0.6	0.6	...	1.7	1.1	1.1	...	1.7	2.5	2.6	...				
Estonia	4.3	5.0	5.6	6.5	0.5	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.3	2.3	1.3	1.2	1.4	1.1	3.0	3.6	4.4			
Ireland	10.2	18.1	18.5	21.1	3.5	0.3	1.5	0.9	0.9	0.8	4.9	12.2	12.1	12.9			
Greece	3.7	3.5	3.6	4.0	0.5	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	2.3	2.1	2.1	2.3	0.3	0.8	0.8	0.9			
Spain	4.0	4.1	4.1	4.3	0.5	0.3	0.3	...	0.6	0.6	0.6	...	1.8	1.4	1.4	...	1.1	1.8	1.8	...				
France	5.0	5.1	5.2	5.6	0.7	0.7	0.7	...	0.7	0.7	0.7	...	1.7	1.3	1.3	1.5	1.8	2.4	2.5	2.8				
Croatia	4.2	4.3	4.4	...	0.8	0.3	0.3	...	0.5	0.6	0.6	...	2.3	1.7	1.6	...	0.6	1.7	1.8	...				
Italy	3.9	3.8	3.7	4.0	0.4	0.3	0.2	...	0.5	0.5	0.5	...	1.5	1.1	1.1	1.2	1.5	1.9	1.9	2.1				
Cyprus	4.1	8.8	10.5	11.6	0.2	2.2	2.9	...	0.5	0.3	0.3	...	1.8	1.7	1.6	...	1.6	4.6	5.7	...				
Larvia	3.5	4.5	4.6	4.6	0.4	0.2	0.2	...	0.3	0.3	0.3	...	1.9	1.7	1.6	...	0.9	2.3	2.5	...				
Lithuania	3.0	3.4	3.5	3.9	0.5	0.2	0.2	...	0.3	0.3	0.3	...	1.7	1.0	0.9	...	0.5	1.8	2.0	...				
Hungary	3.8	3.7	3.7	3.7	0.5	0.3	0.3	0.3	0.3	0.6	0.7	0.6	0.5	1.6	1.0	1.0	1.0	1.1	1.7	1.8	1.9			
Netherlands	4.5	5.4	5.6	5.7	0.6	0.4	0.4	0.4	0.4	0.4	0.9	1.0	0.9	1.5	1.0	0.9	0.9	2.1	3.1	3.3	3.5			
Austria	3.5	3.8	3.9	4.1	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	1.3	0.9	0.9	0.9	1.3	2.1	2.2	2.4			
Poland	3.7	3.7	3.8	4.0	0.6	0.3	0.3	...	0.6	0.5	0.5	...	1.8	1.1	1.0	...	0.7	1.8	1.9	...				
Portugal	4.1	3.6	3.8	4.4	0.4	0.2	0.2	...	0.5	0.5	0.5	...	2.3	1.5	1.5	...	0.9	1.4	1.6	...				
Romania	3.6	4.7	5.0	5.9	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.5	1.9	1.5	1.4	1.4	1.1	2.5	2.8	3.6			
Slovenia	3.9	3.8	3.9	4.1	0.5	0.3	0.3	0.3	0.4	0.5	0.5	0.5	0.4	1.8	1.3	1.3	1.3	1.1	1.7	1.9	2.1			
Slovakia	3.1	3.6	3.8	3.9	0.4	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	1.4	1.0	1.0	1.1	1.0	2.1	2.2	2.4			
Finland	4.3	5.5	5.5	5.8	0.9	1.3	1.2	1.3	1.3	1.4	1.3	1.4	1.3	1.0	1.0	1.0	1.0	1.8	2.8	2.9	3.2			
Sweden	6.9	7.5	7.8	...	1.8	1.5	1.5	...	0.6	0.6	0.6	...	1.6	1.5	1.4	...	2.9	4.0	4.3	...				
Iceland	4.3	5.1	5.0	5.5	0.5	0.2	0.2	0.2	0.2	0.9	0.5	0.5	0.6	1.7	1.4	1.3	1.4	1.2	2.9	3.0	3.2			
Norway	4.2	4.4	4.7	4.9	1.0	0.7	...	...	0.4	0.4	...	...	1.5	1.3	...	...	1.3	2.0	...	...		
United Kingdom	5.7	6.1	...	...	0.8	0.6	...	...	1.1	1.2	...	...	1.7	1.5	...	...	2.2	2.8	...	...		

* CVPTPPBA - cinema, video, production of television programs; program and broadcasting activities; CPCIS - computer programming, consulting and information services.
 Source: calculated on the basis of statistical data from the State Statistics Service of Ukraine: official web-site. URL: https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=educ_uoe_enr01&lang=en.

The structural transformation of the ICS in the EU countries has a multi-vector direction, as some types of economic activity showed a tendency to increase its share in output, while others showed stability. A common feature of the EU countries is that in 2008-2020, the share of ICS output gradually increased, most intensively in Ireland, Cyprus, Estonia, and Bulgaria. The main factors were the favorable economic conditions for the development of this sector in the EU, the expansion of the use of ICT to improve the business ecosystem, and improved infrastructure for providing services to this sector.

In the EU countries, the share of output of computer programming, consulting, and information services grew most dynamically. The rapid development of this ICS in European countries is associated with the improvement of information exchange processes, the need to provide access to information resources and interaction on various network platforms, and the increased use of software products in production processes. In 2020, the COVID-19 pandemic and the shift to remote work were among the major factors that strengthened the industry's position in the EU. Positive structural changes in the production of ICS products contribute to the formation of the creative economy in the EU countries through the introduction of the latest technologies, and the development of modern information exchange and knowledge transfer systems (Table 1).

Similar trends in the development of the ICS are recorded in Ukraine (Table 2), with the sector's contribution to GDP increasing by 1.5 times by 2020. Growth of 3.3 times was recorded in such areas as computer programming, consulting, and information services. Due to the annexation of the Crimean Peninsula and the temporary occupation of certain territories of Donetsk and Luhansk regions, priorities in publishing, film, television and radio production, and telecommunications development changed. In 2014-2020, Ukraine's economy saw a decrease in the value of output in terms of GDP in publishing and an increase in film, video, broadcasting, and telecommunications.

Table 2

Output of ICS in Ukrainian economy, % of GDP

Years	Overall	Including:			
		publishing activity	CVPTPPBA*	telecommunications	CPCIS**
2013	6.17	0.50	0.72	2.99	1.97
2014	6.57	0.42	0.70	2.89	2.56
2015	6.63	0.36	0.56	2.45	3.27
2016	7.20	0.37	0.63	2.18	4.02
2017	7.34	0.33	0.73	1.87	4.40
2018	7.69	0.33	0.65	1.80	4.91
2019	8.43	0.32	0.77	1.78	5.56
2020	9.37	0.31	0.68	1.88	6.50

* CVPTPPBA - cinema, video, production of television programs; program and broadcasting activities.

** CPCIS - computer programming, consulting and information services

Source: calculated on the basis of statistical data from the State Statistics Service of Ukraine. URL:

<http://www.ukrstat.gov.ua/>

Table 3

Employment dynamics in the EU ICS, % of the total

Country	Overall												including*											
	publishing activity						CVPTPPBA						telecommunications						CPCIS					
	2008	2018	2019	2020	2008	2018	2019	2020	2008	2018	2019	2020	2008	2018	2019	2020	2008	2018	2019	2020				
Belgium	2.31	2.57	2.65	2.67	0.25	0.22	0.20	0.20	0.31	0.27	0.28	0.27	0.63	0.49	0.47	0.44	1.12	1.59	1.70	1.76				
Bulgaria	1.72	2.83	3.04	3.30	0.32	0.20	0.21	0.17	0.37	0.25	0.26	0.27	0.67	0.61	0.62	0.63	0.35	1.77	1.95	2.23				
Czech Republic	2.44	2.92	3.04	3.26	0.40	0.33	0.33	0.36	0.24	0.20	0.19	0.20	0.44	0.42	0.43	0.44	1.36	1.97	2.08	2.26				
Denmark	3.36	3.58	3.63	3.72	0.78	0.71	0.70	0.70	0.44	0.54	0.53	0.54	0.58	0.44	0.47	0.47	1.56	1.89	1.93	1.98				
Germany	2.95	2.96	3.04	3.11	0.59	0.40	0.38	...	0.30	0.29	0.29	...	0.48	0.24	0.24	...	1.58	2.03	2.13	...				
Estonia	2.35	4.77	4.60	4.92	0.59	0.46	0.41	0.50	0.23	0.48	0.46	0.42	0.43	0.73	0.72	0.76	1.10	3.10	3.02	3.24				
Ireland	3.38	3.93	3.99	4.35	0.25	0.49	0.53	0.55	0.32	0.40	0.45	0.43	1.00	0.48	0.47	0.52	1.81	2.56	2.54	2.86				
Greece	1.85	2.16	2.20	2.19	0.37	0.32	0.32	0.28	0.43	0.43	0.43	0.46	0.61	0.67	0.67	0.66	0.44	0.74	0.78	0.79				
Spain	2.15	2.58	2.60	2.77	0.42	0.25	0.25	...	0.36	0.35	0.37	...	0.35	0.37	0.35	...	1.03	1.62	1.63	...				
France	2.90	3.16	3.18	3.23	0.48	0.40	0.42	...	0.33	0.33	0.34	...	0.52	0.38	0.38	...	1.57	2.05	2.04	...				
Croatia	2.29	3.52	3.36	3.34	0.23	0.36	0.34	0.34	0.31	0.47	0.45	0.45	0.87	1.34	1.28	1.27	0.88	1.36	1.29	1.29				
Italy	2.38	2.44	2.47	2.51	0.21	0.16	0.16	...	0.23	0.21	0.21	...	0.46	0.34	0.34	0.33	1.48	1.73	1.75	1.81				
Cyprus	2.28	2.96	3.19	3.26	0.30	0.32	0.32	0.32	0.61	0.43	0.42	0.40	0.81	0.85	0.88	0.91	0.57	1.36	1.56	1.63				
Latvia	2.10	3.94	3.98	4.19	0.54	0.32	0.30	...	0.14	0.21	0.22	...	0.58	0.67	0.65	...	0.84	2.73	2.80	...				
Lithuania	1.71	2.34	2.67	2.87	0.51	0.33	0.33	...	0.14	0.16	0.19	...	0.49	0.37	0.32	...	0.56	1.48	1.82	...				
Hungary	2.57	3.17	3.32	3.51	0.55	0.36	0.37	0.38	0.34	0.39	0.40	0.30	0.55	0.46	0.46	0.37	1.13	1.96	2.10	2.45				
Netherlands	3.01	3.26	3.33	3.45	0.40	0.26	0.25	0.24	0.31	0.34	0.34	0.35	0.43	0.31	0.29	0.28	1.86	2.35	2.44	2.58				
Austria	2.40	2.76	2.87	2.99	0.31	0.32	0.33	0.33	0.30	0.31	0.31	0.31	0.47	0.34	0.32	0.32	1.32	1.79	1.91	2.03				
Poland	1.89	2.55	2.68	2.78	0.31	0.27	0.32	...	0.26	0.28	0.24	...	0.64	0.49	0.46	...	0.68	1.52	1.66	...				
Portugal	1.33	2.10	2.25	2.42	0.26	0.18	0.18	...	0.22	0.22	0.22	...	0.27	0.31	0.29	...	0.59	1.38	1.56	...				
Romania	1.23	2.11	2.02	2.21	0.22	0.18	0.15	...	0.23	0.17	0.18	...	0.43	0.77	0.65	...	0.35	0.98	1.03	...				
Slovenia	2.38	3.05	3.08	3.21	0.38	0.26	0.25	0.24	0.38	0.49	0.49	0.49	0.51	0.47	0.46	0.47	1.11	1.82	1.88	2.01				
Slovakia	2.27	2.93	2.99	3.12	0.47	0.35	0.35	0.33	0.21	0.18	0.19	0.18	0.42	0.50	0.50	0.50	1.16	1.90	1.95	2.12				
Finland	3.72	4.18	4.21	4.40	0.73	0.64	0.62	0.64	0.38	0.37	0.36	0.35	0.60	0.47	0.48	0.48	2.02	2.70	2.76	2.92				
Sweden	4.08	4.04	4.13	4.29	0.86	0.67	0.70	...	0.46	0.47	0.47	...	0.53	0.43	0.41	...	2.26	2.47	2.55	...				
Iceland	4.35	4.10	4.00	4.15	0.84	0.44	0.30	0.31	0.89	0.69	0.69	0.67	0.95	0.69	0.64	0.62	1.67	2.32	2.37	2.54				
Norway	3.27	3.44	3.56	3.55	0.89	0.72	0.71	...	0.39	0.43	0.42	...	0.51	0.43	0.42	...	1.48	1.86	2.01	...				
United Kingdom	3.78	4.27	4.31	...	0.60	0.48	0.49	...	0.50	0.61	0.65	...	0.69	0.66	0.64	...	1.99	2.53	2.53	...				

* CVPTPPBA - cinema, video, production of television programs; program and broadcasting activities; CPCIS - computer programming, consulting and information services.

 Source: calculated on the basis of statistical data from the State Statistics Service of Ukraine: [official web-site](https://appsso.eurostat.ec.europa.eu/nu/show.do?dataset=educ_uae_cnr01&lang=en). URL:

https://appsso.eurostat.ec.europa.eu/nu/show.do?dataset=educ_uae_cnr01&lang=en.

The intensification of economic activity in the ICS in these years contributed to strengthening the position of the creative economy in Ukraine, which is in line with the general trends of its development in the EU. The use of the EU experience for the ICS as a component of Ukraine's creative economy is based on the fact that it is involved in the production of high value-added products, the development of the information society, the formation of information and marketing infrastructure and information services in education, culture and the healthcare system. In our country, one of the important measures to stimulate the development of the ICS was the Order of the Cabinet of Ministers of Ukraine "On Approval of Economic Activities Belonging to Creative Industries" [22], the Decree of the President of Ukraine "On Measures to Create Favorable Conditions for the Development of the IT Industry in Ukraine" [23], the Law of Ukraine "On Stimulating the Development of the Digital Economy in Ukraine" [24], etc.

The strengthening of the position of the ICS had an impact on structural changes in employment in EU countries (Table 3). In 2008-2020, these countries recorded an increase in the share of people employed in the ICS, while in individual subsectors both growth and decline were recorded. In 2008-2020, the share of employment in telecommunications showed a downward trend in most EU countries, with positive dynamics in Estonia, Cyprus, and Croatia. During these years, changes in employment in the ICS were associated with improved production technologies, increased labor productivity, modernization of communication networks, the emergence of alternative ways to meet the demand for creative content, and the transformation of consumer preferences in the EU. In 2008-2020, the share of people employed in computer programming, consulting, and information services in the EU increased due to the growing demand for software services for various economic activities, the emergence of new business model formats, the development of markets for remote services in education, healthcare, and security, and the formation of a virtual financial market. In these years, structural changes in employment in the ICS had a positive impact on the development of creative economy in these countries through the diversification of types and forms of employment, creation of new jobs, and attraction of highly skilled workers.

In 2010-2020, the share of people employed in Ukraine's ICS increased by 1.6 times (Table 4). In terms of employment structure, this sector is on par with countries such as the UK, Estonia, Latvia, Ireland, Iceland, and Finland. Similarly to the EU countries, Ukraine's publishing and telecommunications sectors recorded a decrease in the share of employees - by 1.8 and 2.0 times, respectively. In our country, the main reasons for this were reduced demand for reading books due to the use of alternative ways of processing information, technological innovations, and the development of the mobile communications market. Positive structural changes in the employment sector are observed in film, video, and television program production, and broadcasting due to the displacement of the aggressor country's products from the Ukrainian film, television, and radio space and changed priorities of state policy in this area.

Table 4
Employment in ICS in Ukrainian economy, % of total

Years	Overall	including:			
		publishing activity	CVTPPBA*	telecommunications	CPCIS**
2010	2.59	0.45	0.33	1.14	0.67
2011	2.70	0.46	0.36	1.11	0.76
2012	2.75	0.39	0.31	1.04	1.01
2013	2.99	0.37	0.32	1.01	1.28
2014	3.40	0.38	0.31	1.01	1.70
2015	3.30	0.33	0.33	0.86	1.78
2016	3.43	0.31	0.36	0.79	1.98
2017	3.67	0.29	0.42	0.71	2.25
2018	3.83	0.28	0.41	0.64	2.50
2019	4.05	0.27	0.40	0.59	2.78
2020	4.23	0.25	0.37	0.56	3.04

* CVTPPBA - cinema, video, production of television programs; program and broadcasting activities.

** CPCIS - computer programming, consulting and information services.

Source: calculated based on statistical data from the State Statistics Service of Ukraine. URL:

<http://www.ukrstat.gov.ua/>

Between 2010 and 2020, the share of people employed in computer programming, consulting, and information services in Ukraine increased 4.5 times, and in 2020 it was on par with Estonia, Ireland, and Finland. The main reasons were the growing demand for products in this industry, career prospects, and high wages. In this way, computer programming, consulting, and information services are becoming the flagships of creative economy in Ukraine.

In 2008-2020, the EU countries recorded a general increase in spatial differences in the output of the SIC (Table 5). The speed of structural changes in this indicator showed increased regional differences in the development of creative economy. During this period, the trends in the indicators of variation for output in the publishing activities of European countries showed a downward trend, and the analyzed population remained heterogeneous. Regional differences in this industry are associated with the goals and measures of state support for publishing, the level of media development, reading traditions and culture, and the use of innovation.

In the EU countries, the dynamics of indicators of variation in the output of cinema, video, television programs, and broadcasting activities in 2008-2020 was fluctuating, while spatial differentiation remained (Table 5). In the regional context, the output of this industry was characterized by stable positions due to the involvement of EU consumers in habitual leisure practices and their affordability. During these years, the values of the indicators of output variation for telecommunications in the EU countries slightly increased, while the study population remained homogeneous in terms of standard deviation coefficient (SDC). This is due to the existence of relatively well-established approaches to the provision of telecommunications services in these countries, as well as limited technological capabilities for expanding wireline and wireless coverage networks.

Table 5

Indicators of variation of structural changes in the EU countries' ICS

Name of the Indicator*	2008	2009	2011	2013	2014	2015	2016	2017	2018	2019	2020
Production of ICS products, % of GDP, including:											
RV	7.24	8.02	10.67	15.57	15.75	13.56	11.74	12.96	14.75	14.96	17.36
Variance	1.804	2.340	3.281	7.054	7.420	5.769	4.712	5.828	7.608	8.606	12.852
average square deviation, %	30.81	32.32	39.77	55.23	56.05	48.94	43.11	47.11	52.31	53.63	59.85
RV	3.24	3.11	4.05	4.68	6.09	1.62	1.97	2.01	2.02	2.77	1.08
Variance	0.371	0.372	0.568	0.801	1.298	0.186	0.203	0.189	0.195	0.323	0.076
average square deviation, %	90.94	90.50	117.81	133.55	157.69	83.07	88.89	89.38	92.11	116.39	76.18
RV	0.77	0.86	0.85	0.83	0.80	0.87	0.95	1.01	1.05	0.88	0.73
Variance	0.030	0.036	0.036	0.039	0.037	0.032	0.037	0.038	0.041	0.028	0.030
average square deviation, %	34.22	36.29	38.22	40.00	38.79	35.31	36.66	37.92	40.10	34.14	39.54
RV	1.18	2.24	2.31	1.85	1.76	1.46	1.42	1.29	1.18	1.22	1.49
Variance	0.098	0.228	0.218	0.174	0.144	0.116	0.119	0.103	0.086	0.085	0.131
average square deviation, %	18.07	25.12	28.34	27.33	25.78	23.87	24.31	23.42	22.70	23.33	28.13
RV	4.60	6.20	7.43	11.53	10.53	10.86	9.32	9.81	11.41	11.31	11.99
Variance	0.765	1.199	1.655	4.003	3.324	3.532	2.587	2.926	3.904	4.268	7.165
average square deviation, %	60.19	67.37	72.81	95.03	85.14	82.28	68.07	68.65	73.68	71.16	78.62
RV	3.12	3.09	3.05	2.77	2.68	2.48	2.63	2.66	2.67	2.58	2.73
Variance	0.632	0.637	0.550	0.540	0.545	0.539	0.569	0.572	0.527	0.472	0.483
average square deviation, %	29.97	29.29	26.44	25.35	24.96	24.24	24.37	24.12	22.49	20.89	20.57
RV	0.68	0.73	0.73	0.64	0.64	0.64	0.60	0.59	0.55	0.56	0.54
Variance	0.041	0.038	0.038	0.034	0.033	0.035	0.029	0.027	0.024	0.025	0.023
average square deviation, %	43.39	42.46	43.68	43.82	43.76	46.93	43.72	43.93	42.12	43.77	42.69
RV	0.75	0.72	0.71	0.73	0.73	0.62	0.61	0.61	0.53	0.51	0.49
Variance	0.023	0.020	0.024	0.024	0.024	0.020	0.021	0.020	0.019	0.018	0.016
average square deviation, %	43.85	40.50	43.77	43.47	43.57	40.61	40.87	41.00	38.47	37.41	33.73
RV	0.73	0.81	0.69	0.68	0.74	0.75	0.97	0.83	1.10	1.03	0.99
Variance	0.030	0.039	0.034	0.031	0.037	0.039	0.045	0.038	0.049	0.045	0.057
average square deviation, %	30.08	33.78	32.50	31.07	33.80	35.16	37.88	36.36	41.31	40.71	42.07
RV	1.91	1.86	1.75	1.72	1.73	1.66	1.90	2.15	2.35	2.23	2.45
Variance	0.290	0.290	0.219	0.231	0.238	0.231	0.249	0.289	0.285	0.261	0.349
average square deviation, %	44.50	42.14	33.66	31.98	31.05	28.91	28.73	29.67	27.80	25.54	27.44

* CVPTPPBA - cinema, video, production of television programs; program and broadcasting activities; CPCIS - computer programming, consulting and information services. RV - range of variation; RMS - root mean square coefficient of variation.

Source: calculated on the basis of statistical data from the State Statistics Service of Ukraine: *official web-site*. URL: https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=educ_uoe_cmr01&lang=en.

In 2008-2020, the EU countries experienced a rapid increase in spatial differentiation in the output of computer programming, consulting, and information services, with the range of variation and dispersion increasing by 2.6 and 9.4 times, respectively, and the value of the Coefficient of Variation indicating heterogeneity in the population. The main reasons for this include the growth in consumer demand for the industry's products, the pace of increase in the level of digital literacy in society, investment attractiveness, and ease of starting a business. This industry contributed to strengthening the position of the creative sector in the national economy of the EU countries due to its ability to quickly adapt to social change in the recipient country, its creative nature and flexible work schedule, and measures to stimulate its development. Taking into account the experience of the EU countries, intensifying the development of ICS in the system of Ukraine's creative economy involves creating a favorable investment climate and strengthening state support to stimulate the production of Ukrainian creative products.

In 2008-2020, the dynamics of indicators of employment variation in ISC in general showed a decrease in spatial differentiation in EU countries (Table 5). This is due to the processes of unification of labor legislation in the EU countries, reduction of regional barriers to employment, and growing demand for skilled workers in this sector. Taking into account the dynamics of employment variation indicators in the ICS, it can be expected that this will have a different impact on the formation of the creative economy in Ukraine, due to the existence of industries where labor demand is relatively stable and those where it is growing dynamically. To strengthen the position of creative economy in Ukraine, indirect state support for employment is important, as it is linked to measures to popularize national creative content, create a favorable investment climate to boost business processes in the ICS, and increase the volume of state orders for training specialists for this sector.

We will use the tools of multivariate regression and correlation analysis to analyze the output of agro-industrial complexes in the EU countries. The dependent variable is Y - I&C output, % of GDP, the independent variables are: X_1 - gross value added (GVA) of information and communications, % of the total; X_2 - unemployment costs, million euros; X_3 - gross domestic product, euros/person; X_4 - total expenditures on research and development (R&D), euros/person. Since the statistical data of 29 EU countries for 2008-2019 are presented as fully as possible, the following multivariate regression-correlation model was built on the basis of these indicators (Table 6). The estimation of the main parameters of the equation showed that it is adequate according to the Fisher criterion and the Student's t -test, and there is no first-order autocorrelation according to the Durbin-Watson criterion.

Table 6

Types of variables	Ratios	Standard deviation *	t- statistics	Confidence interval, 95%		DW, 99%
				Lower boundary	Upper boundary	
Y-section	-2.104	0.214	-9.854	-2.523	-1.686	1.767
variable X_1	1.259	0.042	30.318	1.178	1.341	$d_U=1.633$
variable X_2	0.000013	0.000006	2.389	0.000002	0.000024	$d_U=1.715$
variable X_3	0.000039	0.000006	6.865	0.000028	0.000049	
variable X_4	-0.0008	0.0002	-3.738	-0.001287	-0.000040	
Regression statistics			Analysis of variance			
R	0.883		df	SS	MS	F
R^2	0.780	Regression	4	1488.15	372.04	304.455
Normalized R^2	0.778	Balance	343	419.14	1.22	
Standard deviation**	1.105	Total	347	1907.29		

Notes: * - for the coefficients of the equation; ** - for the regression equation.

Source: calculated based on Eurostat statistics. URL: https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=educ_uoe_enrt01&lang=en

With a probability of 78.02% (Y), it can be stated that the output of SIC in the EU countries depends on the structure of the GVA of information and communication (X_1), unemployment (X_2) and R&D (X_4), and GDP (X_3). It is advisable to interpret the parameters of the multivariate regression equation: if the share of GVA in information and communication increases by 1% of the total, then the output of the ICS will increase by 1.2598% of GDP on average; if unemployment costs amount to EUR 1 million, then the output of the ICS will increase by 0.0000013% of GDP on average; if GDP per capita increases by EUR 1, then the output of the SIC will increase by 0.000039% of GDP on average; if R&D expenditures per capita amount to EUR 1, then the output of the ICS will decrease by 0.0008% of GDP on average.

According to the results of the regression and correlation analysis, the development of the ICS and its increasing influence on the development of creative economy in the EU countries involves a focus on the production of items with a high content of added value, and the transition to an economic growth trajectory. For Ukraine, an increase in the share of the SIC in production will strengthen the position of the creative sector, provided that macroeconomic stability is achieved and entrepreneurial activity is encouraged. In the context of the COVID-19 pandemic, the development of the ICS in the creative economy of the EU and Ukraine has shown positive trends. Due to the war, we can expect a deterioration in the position of the ICS and the creative economy in Ukraine as a result of the "brain drain", a decrease in demand for creative industries products, complications in the logistics and communications system, and a reduction in investment. Given the organization of activities in computer programming, consulting, and information services, which is based on remote employment, access to the Internet, and the use of services for working on joint projects, the war is likely to have a weaker impact on such activities,

which will therefore continue to promote structural changes in Ukraine's creative sector aimed at increasing the output of products with higher added value.

Conclusions

Thus, the peculiarities of structural transformation in the ICS in the EU creative economy include a gradual increase in GDP output and employment, with the most dynamic changes occurring in computer programming, consulting and information services. The assessment of structural changes in the EU ICS is based on a scientific and methodological approach that involves: a comparative analysis of the dynamics of output (as share in GDP) and employment in this sector as a whole and in its subsectors between the EU countries and Ukraine; studying the main trends in spatial differentiation by calculating indicators of variation in output and employment for the EU countries; and identifying factors that affect output in this sector using the tools of regression and correlation analysis. In the EU countries, the ICS is actively developing, contributing to the development of creative economy, while this sector is characterized by spatial heterogeneity of development. According to the multivariate regression-correlation equation, the main factors affecting the structure of ICS output in these countries are the current socio-economic situation, R&D expenditures and unemployment. The development of Ukraine's creative economy is also showing positive dynamics, with GDP sales and the share of employment increasing in the context of COVID-19. In the context of the state of affairs in the EU's ICS, it is important for Ukraine to stimulate economic activity in this sector, and structural reforms are an important factor. Although the war in Ukraine has a negative impact on the formation of creative economy, the ICS will continue to maintain its leading position in the latter's structure. Prospects for further research include assessment of the factors of structural transformation in the SIC by Ukraine's regions.

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СТРУКТУРНІ ЗМІНИ У СЕКТОРІ ІНФОРМАЦІЇ ТА КОМУНІКАЦІЇ В СИСТЕМІ КРЕАТИВНОЇ ЕКОНОМІКИ КРАЇН ЄС: ДОСВІД ДЛЯ УКРАЇНИ

Одним із важливих чинників формування креативної економіки в країнах ЄС та Україні є розвиток сектора інформації та комунікації (СІК). Метою статті є оцінка особливостей

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структурної трансформації СІК у країнах ЄС в умовах становлення і розвитку креативної економіки та визначення головних напрямів адаптації цього досвіду до соціально-економічної ситуації в Україні. При дослідженні використано наукові методи індукції, дедукції, аналізу, синтезу, статистичного оцінювання варіації, багатофакторного регресійно-кореляційного аналізу.

Встановлено, що СІК сприяє становленню креативної економіки в Україні та країнах ЄС, підґрунтям чого є поступове збільшення частки цього сектора у випуску продукції та зайнятості у 2008–2020 рр. Сформовано науково-методологічний підхід до оцінювання структурних змін у СІК як складової креативної економіки: порівняльний аналіз динаміки випуску продукції (% ВВП) і зайнятості (% загальної кількості) у СІК між країнами ЄС та Україною; визначення особливостей просторової диференціації на підставі обчислення розмаху варіації, дисперсії та СКВ для головних соціальних і економічних показників СІК; ідентифікація чинників, які впливають на випуск продукції СІК (% ВВП), за допомогою інструментарію багатофакторного регресійно-кореляційного аналізу. Обґрунтовано існування різної динаміки впливу цього сектора на формування креативної економіки в країнах ЄС у 2008–2020 рр. через посилення варіації ознак за показниками випуску продукції (% ВВП) та зайнятості (% загальної кількості). Згідно з результатами багатофакторного регресивно-кореляційного аналізу виявлено, що до чинників, які впливають на випуск продукції СІК у країнах ЄС, належать поточна соціально-економічна ситуація в країні, обсяги видатків на НДДКР і безробіття. З урахуванням досвіду країн ЄС для України важливо стимулювати економічну активність у СІК, підґрунтям чого є проведення структурних реформ.

Ключові слова: *сектор інформації та комунікації; креативна економіка; структурні зміни; аналіз варіації ознак; регресійно-кореляційний аналіз*