INFORMATION AND COMMUNICATION SECTOR AT THE CORE OF UKRAINE'S CREATIVE ECONOMY: ASSESSING THE STRUCTURE OF INTERCORRELATIONS FOR SUSTAINABLE DEVELOPMENT AND POST-WAR RECOVERY

Marianna Kichurchak

Ivan Franko National University of Lviv,
18, Svobody Avenue, Lviv, Ukraine, 79008
email: Marianna.Kichurchak@lnu.edu.ua
ORCID: https://orcid.org/0000-0002-1927-5704

Abstract. *The development of the information and communication sector (ICS) is one of the most crucial components of the creative economy, reaching the goals of sustainable development and post-war economic recovery in Ukraine and its regions. The purpose of this paper is to identify the key trends in the functioning of the ICS in the creative economy and to explore its contribution to sustainable development and post-war reconstruction in Ukraine. The author has examined the key social and economic indicators of the ICS by types of economic activity, compared the dynamics of structural changes in the ICS regionally using the Krugman, Herfindahl, and Theil indices of regional specialisation, and developed a simultaneous model of the functioning of this sector by regions of Ukraine. In 2010–2021, the increase in the contribution of ICS to the fostering of Ukraine's creative economy, achieving the sustainable development goals concerning economic growth, decent work and innovation was shown by the number of active business entities (% of the total), capital investments (% of the total), turnover of enterprises (% of the total), number of the employed at enterprises (% of the total), and value added at factor costs of enterprises (% of the total). In 2022, the war led to a broad adaptation of business entities in the ICS of Ukraine to operate in unfavourable conditions, and they managed to be profitable. Given the indices of regional specialisation, the transformation of the economic structure of Ukraine's regions driven by the development of the ICS is insignificant, slow, and gradual due to the relative stability of their industrial specialisation. The simultaneous equations model explaining the functioning of the ICS by region of Ukraine includes four regression equations describing the value added at factors costs of enterprises, the number of active business entities and workers employed by them, and the structure of service exports in this sector. The research findings would be useful to elaborate sectoral national and regional public policy aimed at expanding the post-war growth of Ukraine's creative economy and achieving the sustainable development goals.*

Key words: *information and communication sector, information and communication technologies, sustainable development, Ukrainian regions, creative economy, post-war recovery, regression analysis and structural equations.*

Problem statement. The digitalisation of business entities, households and the state, and introducing innovations related to information and communication technologies (ICTs) are recognized to be fostering a stronger position of the information and communication sector (ICS) and the development of the creative economy in Ukraine and its regions. The ICS also contributes to the achievement of sustainable development goals (SDGs) focused on the self-realisation of the creative potential of the economically active population, accelerating structural modernisation and increasing the share of high-tech sectors, and transitioning to economic growth in an environmentally sustainable way. Unfortunately, the military aggression of the russian federation against Ukraine is one of the significant factors having a destructive impact on the development of the ICS and other industries at the regional and national levels because of deaths, wounds and forced internal and external migration of the population, suspension of business, damage or destruction of enterprises, disruption of logistics and restrictions on electricity supply. Given these facts, it is crucial to assess the spatial structural changes in the ICS to achieve the goals of sustainable development and post-war reconstruction of the creative economy in Ukraine.

Analysis of latest research works and publications. The definition of the position and role of the ICS in the processes to form the creative economy, its contribution to the enhancing of structural changes in the national economy and implementing the SDGs is complex and broad. The contributions of the creative industries to the support and development of the Austrian innovation economy are assessed both from the standpoint of the producer of innovations and the user of new technologies, especially information and communication technologies, and the innovation policy measures to promote microfirms are recommended [1]. The researchers compared the contribution of ICTs to the forming of the sustainable economic development by analysing the relationship between network readiness, global competitiveness and the share of this sector in the EU member states [2]. The theoretical framework for the efficiency of policy to stimulate and finance innovation in the creative industries is elaborated and some of its conclusions are empirically tested based on data from OECD countries (2000–2013), demonstrating that such policy actually leads to a declining equilibrium level of innovation, bank confidence and network externalities in a low Nash equilibrium [3]. From the standpoint of the dynamic growth of the creative economy, the researchers have substantiated a set of promising product and spatial models of international specialisation of creative production in the countries of Central and Eastern Europe and have determined their current positioning in the structure of international specialisation of the EU 28 (+3) [4].

Sustainable development for creative economies is explored not only in terms of the use of natural resources and environmental issues, but also in terms of the shortage of intangible resources and goods, such as ideas, freedom of thought, leadership, tolerance, quality of education, and the impact of local authorities on the sustainability of such economies is assessed [5]. This paper examines how the structure and agent are changed during the transformation of Porto Digital, which is an urban local ICT production cluster in the metropolitan region of Recife (Brazil), into a creative economy pole called Portomídia [6]. Given the comparison of the creativity and sustainable development indices in the Baltic countries, the current state of implementation of the creative economy and progress in achieving the SDGs have been assessed, and several recommendations for the policy of promoting the development of civil society and creative hubs, and implementing the strategy of the digital single market have been worked out [7]. Because of the comparative analysis of three UNESCO approaches to culture as a unique dimension, driver and factor of

sustainable development, the position of culture and cultural factors in the United Nations sustainable development agenda is clarified and expanded [8].

At the theoretical and methodological level, the author has identified the major trends in how the ICT sector influences the production of public goods, assessed the features of structural changes in the ICS, and analysed the priority directions of the ICT sector development, in terms of its contribution to the formation of the EU's creative economy [9; 11; 15]. Using the calculation of the dynamics of structural changes, the paper also has shown the slowness of shifts and significant interregional differentiation in the Ukrainian economy, which hinders the implementing of the sustainable development model in the following priority fields: increasing the share of high-tech production, telecommunications, financial and business services, and socially oriented activities [10]. A quantitative analysis of creative activity in the EU and Ukraine has been carried out, which allowed to identify growth criteria, principles and priorities of state policy aiming at the recovery of the Ukrainian economy [12].

For a 140-country panel covering the 2001–2019 period, the results revealed a positive impact of ICTs on the sustainable development, although this depends on the choice of ICTs assessment method, geographical location of the country, and income group category [13]. Based on statistics from 24 OECD countries over 40 years (1980–2019), the benefits of using ICTs to ensure environmental sustainability are explained and the mechanisms through which this takes place are examined – education, transport, quality of institutions, and foreign direct investment [14]. An agenda for post-war recovery of Ukraine, including digitalisation, structural modernisation, comprehensive integration and ICT development, was presented at the Lugano conference in 2022 and an official website was launched [16; 17]. Although the research findings of the previous papers are scientifically valuable, there are still some issues to be examined considering strengthening the position of the ICS as a part of Ukraine's creative economy and assessing its role in implementing sustainable development and post-war reconstruction.

The purpose of the paper is to identify the key trends in the functioning of the ICS in the creative economy and to explore its contribution to sustainable development and post-war reconstruction of Ukraine. To achieve this goal, it applies to use the following scientific and methodological approach: to analyse the key social and economic indicators of Ukraine's ICS by type of economic activity; to compare the features of structural changes in the ICS by regions using the index of regional specialisation (Krugman index), the Herfindahl regional specialisation index and absolute Theil index; to identify the structure of interrelations impacting the spatial expansion of the ICS by specifying the parameters of a simultaneous equations model. It is necessary to develop a set of scientific and practical recommendations concerned with enhancing the position of the ICS to facilitate the growth of the creative economy, to ensure the achievement of the SDGs and to recover Ukraine's post-war economy.

Methods. Obviously, this involves using a set of scientific methods, including induction and deduction, comparative spatial analysis, synthesis, and simultaneous equations modelling. In Ukraine, the classification of the type of economic activities related to the ICS is based on the KVED-2010 (section "Information and Telecommunication") [18], which corresponds to NACE Rev. 2a. [19] in the EU countries. The difference exists in the ways we translate the English word "communication", which in Ukraine is interpreted as "telecommunication". In this paper, we would like to use the word "communication", which is etymologically more consistent with the English equivalent of this noun. Ukraine has approved a list of economic activities focusing specially on creative industries [20], according to which the chief KVED-2010 codes for the ICS (except the section 61

"Telecommunications", which is an infrastructure component) are included in these industries. The following key indicators will assess structural changes in the ICS by the Ukrainian regions [21; 22]:

- index of regional specialisation (Krugman index) r (CS_r):
$$CS_r = \sum_{i=1}^{I} |I_{ir} - I_i|, \qquad 0 \leq SC_r \leq 2(1 - I_i^*) \qquad (1)$$

where $I_{ir} = \dfrac{L_{ir}}{L_r} = \dfrac{L_{ir}}{\sum_i L_{ir}}$ – the share of industry i in the total employment in the region r;

I_i – the share of the same industry in the total employment in the referent economy as a whole;
$$I_i^* = min_i I_i$$

- the Herfindahl Regional Specialisation Index (Hr)
$$H_r = \sum_{i=1}^{I} (I_{ir})^2, \qquad \frac{1}{I} \leq H_r \leq 1 \qquad (2)$$

- absolute Theil index (T^A)
$$T_r^A = \frac{1}{I} \sum_{i=1}^{I} \frac{I_{ir}}{1/I} \ln\left(\frac{I_{ir}}{1/I}\right) = \sum_{i=1}^{I} I_{ir} \, ln(I * I_{ir}), \qquad 0 \leq T_r^A \leq \ln I \qquad (3)$$

Presentation of principal material of the research. In 2010–2021, given the dynamics of relative social and economic indicators, the growth of the ICS in the creative economy and its expanding role in the modernisation of Ukraine's sectoral structure were showed (Table 1). In fact, in 2021, compared to 2010, the share of active business entities in the ICS has grown 5.7 times and, in 2021, it was nearly 1/7 of the total number of such entities in our country. In 2014, due to the invasion of Ukraine by the russian federation and the economic crisis caused by these circumstances, the share of active business entities in the ICS declined slightly, but then returned to growing. This indirectly shows the ability of the ICS to respond quickly to an unfavourable social and economic environment. The leading factors were the widespread use of digital technologies among households, firms, and the state, business deregulation reform, and changes in the tax system. This is an indicator of the expansion of the creative economy in Ukraine and steps to promote the implementation of the SDGs. In particular, the assignment for 2020 stipulates that, according to the target 9.6.1, the level of Internet coverage should exceed 50 subscribers per 100 inhabitants, which was achieved [23].

In the fields of publishing activities, programming and broadcasting activities, the share of active business entities in Ukraine showed a downward trend in 2010–2021 (Table 1). In our point of view, the chief reasons could include changes in demand for goods in these types of activity because of the development of ICTs, growing competition, and the lack of an effective framework to protect copyright and intellectual property, especially on the Internet. In the motion picture, video and television programme production, sound recording and music publishing activities, computer programming, consultancy and related activities, information service activities, the trends were the opposite – the share of active business entities has been gradually increasing during the period. These effects were driven by government support programmes aimed at developing those subsectors, including sanctions and the wider use of the Ukrainian language in the public space, growing demand for information services, the spread of the Internet and the increasing level of digital literacy.

Table 1

Major indicators of the social and economic development of the ICS in Ukraine

Type of economic activity	Year	Number of active BE, % of the total*	CI*, % of the total, including			Turnover of enterprises, % of the total	Personnel costs of business entities, % of the total			Value added at factor costs of enterprises, % of the total	Number of the employed at enterprises, % of the total
			Total	CI in tangible assets	CI in intangible assets		Total	wages and salaries	social security costs		
Information and communication, including	2010	2.563	…	…	…	1.977	…	…	…	…	2.586
	2014	5.918	4.552	3.156	1.396	2.293	3.626	3.740	3.303	3.929	3.400
	2015	5.882	10.727	4.785	5.943	2.475	3.678	3.809	3.277	4.088	3.302
	2018	9.492	6.301	2.734	3.567	2.697	3.434	3.513	3.062	4.927	3.829
	2019	10.617	4.054	2.498	1.556	3.122	3.317	3.372	3.056	5.157	4.048
	2020	11.866	5.607	3.309	2.298	3.504	3.482	3.553	3.143	5.647	4.233
	2021	14.524	4.429	2.623	1.806	3.468	3.422	3.482	3.139	…	4.827
publishing activities	2010	0.551	…	…	…	0.228	…	…	…	…	0.450
	2014	0.493	0.045	0.034	0.012	0.150	0.312	0.314	0.306	0.213	0.376
	2015	0.434	0.066	0.053	0.013	0.134	0.279	0.278	0.283	0.201	0.333
	2018	0.426	0.033	0.022	0.011	0.121	0.222	0.221	0.224	0.172	0.279
	2019	0.431	0.028	0.022	0.006	0.120	0.210	0.208	0.219	0.170	0.274
	2020	0.445	0.022	0.014	0.008	0.120	0.196	0.194	0.201	0.155	0.254
	2021	0.464	0.033	0.024	0.009	0.111	0.196	0.194	0.205	…	0.258
motion picture, video and television programme production, sound recording and music publishing activities	2010	0.169	…	…	…	0.270	…	…	…	…	0.200
	2014	0.139	0.119	0.105	0.014	0.077	0.171	0.173	0.166	0.136	0.143
	2015	0.157	0.113	0.102	0.011	0.078	0.165	0.167	0.158	0.122	0.139
	2018	0.197	0.211	0.157	0.054	0.111	0.186	0.187	0.182	0.241	0.180
	2019	0.225	0.272	0.195	0.077	0.143	0.215	0.216	0.209	0.294	0.205
	2020	0.240	0.186	0.110	0.076	0.120	0.255	0.263	0.219	0.231	0.196
	2021	0.271	0.168	0.120	0.047	0.121	0.246	0.250	0.229	…	0.214
programming and broadcasting activities	2010	0.123	…	…	…	0.073	…	…	…	…	0.128
	2014	0.063	0.869	0.105	0.764	0.138	0.282	0.288	0.263	0.348	0.170
	2015	0.065	0.875	0.110	0.765	0.104	0.308	0.311	0.299	0.303	0.190
	2018	0.063	0.758	0.070	0.688	0.100	0.337	0.340	0.321	0.327	0.225
	2019	0.061	0.811	0.056	0.755	0.127	0.330	0.330	0.332	0.372	0.198
	2020	0.056	1.081	0.064	1.017	0.107	0.299	0.299	0.297	0.320	0.177
	2021	0.054	0.958	0.086	0.873	0.092	0.300	0.303	0.285	…	0.172
telecommunications	2010	0.198	…	…	…	1.055	…	…	…	…	1.136
	2014	0.159	3.136	2.613	0.523	0.981	1.696	1.743	1.562	1.910	1.006
	2015	0.166	9.151	4.152	4.999	0.846	1.520	1.549	1.434	1.955	0.863
	2018	0.219	4.523	1.938	2.585	0.611	1.074	1.095	0.975	1.515	0.642
	2019	0.216	2.243	1.695	0.548	0.662	0.988	1.006	0.900	1.426	0.590
	2020	0.211	3.585	2.541	1.044	0.706	0.994	1.011	0.910	1.555	0.563
	2021	0.199	2.449	1.834	0.615	0.593	0.925	0.944	0.836	…	0.523
computer programming, consultancy and related activities	2010	0.999	…	…	…	0.210	…	…	…	…	0.407
	2014	4.049	0.243	0.203	0.040	0.751	0.807	0.856	0.669	1.045	1.272
	2015	4.034	0.317	0.249	0.068	1.067	1.033	1.122	0.760	1.188	1.323
	2018	7.016	0.527	0.399	0.127	1.426	1.065	1.113	0.844	2.052	1.901
	2019	7.918	0.501	0.409	0.092	1.686	1.079	1.112	0.925	2.214	2.136
	2020	8.934	0.573	0.488	0.085	2.015	1.208	1.250	1.010	2.653	2.369
	2021	11.115	0.592	0.456	0.137	2.090	1.177	1.209	1.026	…	2.844
information service activities	2010	0.523	…	…	…	0.141	…	…	…	…	0.264
	2014	1.014	0.140	0.097	0.044	0.197	0.358	0.366	0.338	0.277	0.432
	2015	1.025	0.205	0.118	0.087	0.246	0.372	0.382	0.343	0.320	0.453
	2018	1.572	0.248	0.147	0.100	0.328	0.550	0.557	0.516	0.619	0.602
	2019	1.766	0.199	0.121	0.077	0.384	0.495	0.500	0.473	0.681	0.645
	2020	1.980	0.160	0.092	0.068	0.436	0.530	0.536	0.506	0.733	0.675
	2021	2.421	0.228	0.103	0.125	0.461	0.578	0.582	0.558	…	0.815

* BE – business entities; CI – capital investment. Source: calculated based on [24]

In 2010–2021, other social and economic indicators of Ukraine's ICS did not show high growth rates (Table 1). In this period, the change in the structure of capital investments

concerning the ICS was fluctuating, with the highest share in 2015 and the lowest in 2019. In terms of the types of capital investment in the sector, investments in tangible assets are leading. The only exception is activities in programming and broadcasting, where licensing, branding, copyright and related rights protection are crucial. This implicitly shows the sensitivity of the capital investments in the ICS to the current social and economic situation in the country, which is due to the existence of exogenous and endogenous risks. One of the obvious consequences of this may be a slowdown in the development of the creative economy in Ukraine. The state of investment in the ICS for the target 8.6 [23] means that the formation of institutional and financial opportunities fostering self-realisation of the creative potential of the economically active population has contradictory trends.

In terms of structure, the largest share of capital investment in Ukraine's ICS is in the telecommunications (Table 1). It is expected that the key factors were the processes of integration into the global information society, activities to expand the telecommunications infrastructure to ensure the access to services in rural and mountainous regions of the country (which is in line with targets 4.7 and 9.6 of the SDGs), and the need to upgrade technologically the network. In the Ukrainian ICS, programming and broadcasting activities are also an investment-intensive sector. If in 2014–2019, the share of capital investment in this sector was 0.8–0.9% of the total, in 2020–2021 it was already 1.0–1.1%. This was driven by changes in the current legislation caused by the requirements to increase the volume of national audio-visual products and broadcasting in the state language, quarantine restrictions, and demand on national media products. In 2010–2021, the growth trend in the share of capital investment was 2.4 times higher in the computer programming, consultancy and related activities. This was supported by digital reforms in the education, healthcare, public administration, and other economic activities, as well as the expansion of IT-services exports. In 2010–2021, the structure of capital investment in other types of economic activity in the ICS was affected by the state priorities concerning the support of the specific subsectors, the market situation, and consumer preferences. Given the development of the creative economy and achievement of the SDGs in Ukraine, this means that the economic growth depends on the directions and priorities of investment in these types of economic activities of the ICS.

In 2010–2021, the structure of the volume of the turnover of enterprises in the ICS indicates an increasing contribution of this sector to the development of the creative economy in Ukraine (Table 1). During this period, the share of the turnover of enterprises in the Ukrainian ICS grew by 1.75 times. In other words, the positive dynamics of the structure of the turnover of enterprises in the ICS demonstrates a steady growth in demand for the sector's goods both in the domestic and foreign markets. This has been encouraged by government policies aimed at actively introducing digital technologies into various types of economic activity, improving the quality of information and communication services and their price affordability, and the impact of integration and globalisation processes related to the spread of social networks and the development of the digital business ecosystem. In these years, the ICS of Ukraine also showed a decline in the share of the turnover of enterprises: it fell by 2.1 times in publishing activities, motion picture, video and television programme production, sound recording and music publishing activities and by 1.9 times in telecommunications. In 2020–2021, this share increased 9.9 times in the computer programming, consultancy and related activities, 3.3 times in the information service activities, and 1.3 times in the programming and broadcasting activities. Actually, these subsectors have become the drivers of economic growth in Ukraine's ICS. As a result, the development of these sub-sectors had a positive impact on the formation of the creative economy and the achievement of the SDGs in our country before the war.

In 2014–2020, it also strengthened the position of the ICS in the creative economy of Ukraine in terms of the indicator of value added at factor costs of enterprises (Table 1). Given that the ICS is focused on the production of goods with a high added value, this also implies its importance to achieve target 9.4 of the SDGs [23] and to contribute to the competitiveness of business entities. In these years, the situation with the structure of value added at factor costs of enterprises in some types of economic activity in the Ukrainian ICS has been positive, while others have been negative. To illustrate, the computer programming, consultancy and related activities, information service activities, as well as the motion picture, video and television programme production, sound recording and music publishing activities are among the economic activities which have improved the structure of their value added at factor costs of enterprises and strengthened their position in Ukraine's creative economy. At the national level, the key factors behind this were changes in the taxation system and implementing objectives in regional development strategies aimed at creating and operating IT and creative clusters.

In 2010–2020, the positive trends in the development of Ukraine's ICS by indicators such as value added at factor costs of enterprises, volume of turnover of enterprises, and number of active business entities impacted the structure of employed workers, but because of the COVID-19 pandemic, their share slightly reduced in 2021 (Table 1). In this period, the share of employed workers in publishing activities and telecommunications declined gradually, mostly due to changes in labour productivity and the transformation of demand for their products; in programming and broadcasting activities, the share of employed workers remained almost unchanged given the specifics of production and service delivery technologies; in motion picture, video and television programme production, sound recording and music publishing activities, the share of the employed at enterprises continued to increase because of the growing demand for national cultural products; in computer programming, consultancy and related activities, information service activities, the share of employed workers also showed an increase due to the digitalisation process and its integration into various types of economic practice. Consequently, this contributed to the formation of the labour market in the creative economy of Ukraine, with some types of employment showing a shortage and increased competition, while others demonstrated an additional demand for one vacancy. In a nutshell, computer programming, consultancy and related activities, information service activities are the key drivers of employment growth in Ukraine's creative economy, with the best results in 2021 during the COVID-19 pandemic.

In 2010–2020, the contribution of the ICS to the growth of Ukraine's creative economy in was relatively stable in terms of the share of personnel costs of business entities (Table 1). Wages and salaries and social security costs in the total amount were virtually unchanged, apart from computer programming, consultancy and related activities, information service activities. This, given the trends in employment in the ICS, shows that there are trends towards reducing staff costs, focusing on increasing labour productivity, outsourcing and self-employment. In the ICS, labour productivity grew (target 8.2 of the SDGs), which is 7.5% higher than in the Ukrainian economy [calculated based on 23]. In other words, this means that before the war, the ICS of Ukraine was actively involved in raising production efficiency based on sustainable development and the development of high-tech competitive industries.

Thus, the analysis of the key social and economic indicators of the ICS for the period 2010 to 2021 shows that this sector has taken the lead in the development of the creative economy in Ukraine. Before the war, the ICS was actively involved in modernising the structure of the national economy in terms of increasing the production of high value added

goods and creating new workplaces. It also has had a positive impact on the achievement of the SDGs. Given the need for Ukraine's post-war recovery, the ICS may become one of the crucial drivers of the creative economy's growth because of its ability to adapt quickly to unfavourable economic conditions.

The key trends in the structural changes in Ukraine's ICS at the regional level, calculated based on formulas (1), (2) and (3), show different speeds in 2014–2020 (Table 2). With the Krugman index, the impact of the ICS on the structure of employment in the regions is not significant; the values of the index in most of the regions of Ukraine were close to the values for 2014, except for Volyn, Zakarpattya, Rivne, and Kharkiv regions. Changes in the structure of employment in the ICS by region of Ukraine depend on the demographic situation, the wide network of educational institutions and the system of training/advanced training for this sector, regional policy and investment priorities. We consider that strengthening the impact of the ICS on the post-war recovery of Ukraine's creative economy and achievement of the SDGs will depend on efforts to stimulate employment in this sector, aimed at resuming entrepreneurial activity in the regions.

In 2014–2020, the dynamics of structural changes in the ICS according to the Herfindahl regional specialisation index confirmed their occurrence in all regions of Ukraine (Table 2). However, spatial specialisation shows a low level of concentration of the ICS in the regions of Ukraine, with Lviv and Kharkiv regions and the city of Kyiv as the leaders of change. The assessment of structural changes in the ICS by region of Ukraine based on the analysed index proved that this type of economic activity was promising before the war, although it needs support from local authorities. From the standpoint of sustainable development, competitive advantages are being increased and conditions to train and attract highly skilled human resources are being created. With the creative economy, positive changes in the structure of employment in the ICS due to the Herfindahl regional specialisation index additionally show the potential for its spatial growth in Ukraine. Faced with the ongoing war in Ukraine, there are risks of a deterioration in the spatial structure of employment in the ICS because of the growing internal and external migration and brain drain among young people.

Table 2

Structural changes in the ICS by regions of Ukraine in 2014–2020

Region	Index of regional specialisation (Krugman index)					The Herfindahl-regional specialisation index			Absolute Theil index			
	2014	2017	2019	2020	2014	2017	2019	2020	2014	2017	2019	2020
Vinnytsya	0.0108	0.0083	0.0100	0.0093	0.0002	0.0003	0.0004	0.0005	0.0568	0.0715	0.0747	0.0781
Volyn	0.0197	0.0151	0.0207	0.0231	0.0000	0.0001	0.0001	0.0002	0.0460	0.0446	0.0539	0.0651
Dnipropetrovsk	0.0171	0.0153	0.0141	0.0151	0.0001	0.0002	0.0003	0.0003	0.0649	0.0782	0.0816	0.0819
Donetsk	0.0202	0.0188	0.0094	0.0089	0.0000	0.0001	0.0000	0.0000	0.0446	0.0524	0.0334	0.0341
Zhytomyr	0.0133	0.0118	0.0123	0.0129	0.0001	0.0002	0.0003	0.0003	0.0528	0.0550	0.0704	0.0721
Zakarpattya	0.0121	0.0157	0.0164	0.0165	0.0000	0.0001	0.0001	0.0002	0.0356	0.0504	0.0538	0.0564
Zaporizhzhya	0.0180	0.0133	0.0111	0.0142	0.0001	0.0002	0.0003	0.0003	0.0682	0.0664	0.0753	0.0845

Ivano-Frankivsk	0.0164	0.0125	0.0152	0.0141	0.0001	0.0002	0.0003	0.0004	0.0534	0.0634	0.0797	0.0834
Kyiv	0.0190	0.0133	0.0107	0.0086	0.0001	0.0002	0.0004	0.0006	0.0594	0.0762	0.0869	0.0920
Kirovograd	0.0181	0.0145	0.0188	0.0154	0.0000	0.0001	0.0002	0.0002	0.0425	0.0636	0.0749	0.0616
Luhansk	0.0191	0.0075	0.0049	0.0037	0.0001	0.0000	0.0000	0.0000	0.0462	0.0233	0.0255	0.0193
Lviv	0.0249	0.0210	0.0209	0.0230	0.0008	0.0009	0.0013	0.0017	0.0996	0.1009	0.1043	0.1092
Mykolayiv	0.0163	0.0113	0.0081	0.0097	0.0002	0.0004	0.0005	0.0007	0.0712	0.0696	0.0778	0.0873
Odesa	0.0077	0.0057	0.0078	0.0058	0.0002	0.0003	0.0004	0.0006	0.0905	0.0964	0.0960	0.0997
Poltava	0.0205	0.0195	0.0210	0.0179	0.0000	0.0001	0.0001	0.0002	0.0444	0.0498	0.0700	0.0669
Rivne	0.0128	0.0111	0.0138	0.0149	0.0000	0.0000	0.0003	0.0003	0.0334	0.0320	0.0685	0.0703
Sumy	0.0186	0.0159	0.0199	0.0182	0.0001	0.0001	0.0002	0.0003	0.0481	0.0570	0.0701	0.0754
Ternopil	0.0219	0.0103	0.0130	0.0158	0.0001	0.0001	0.0002	0.0003	0.0572	0.0555	0.0651	0.0728
Kharkiv	0.0278	0.0294	0.0319	0.0337	0.0009	0.0013	0.0019	0.0023	0.1007	0.1057	0.1112	0.1137
Kherson	0.0175	0.0145	0.0183	0.0158	0.0001	0.0001	0.0002	0.0003	0.0639	0.0615	0.0737	0.0694
Khmelnytskiy	0.0225	0.0203	0.0167	0.0199	0.0000	0.0001	0.0001	0.0002	0.0501	0.0615	0.0499	0.0601
Cherkasy	0.0154	0.0117	0.0104	0.0099	0.0001	0.0002	0.0004	0.0005	0.0466	0.0638	0.0730	0.0771
Chernivtsi	0.0159	0.0114	0.0117	0.0140	0.0001	0.0001	0.0002	0.0003	0.0717	0.0483	0.0606	0.0726
Chernihiv	0.0159	0.0077	0.0132	0.0128	0.0001	0.0002	0.0003	0.0004	0.0655	0.0619	0.0673	0.0715
city of Kyiv	0.0564	0.0378	0.0358	0.0338	0.0025	0.0013	0.0015	0.0015	0.1870	0.1796	0.1803	0.1770

Source: calculated based on [24]

In 2014–2020, it fixes positive trends in the structure of the ICS based on the absolute Theil index in all regions of Ukraine, except for Luhansk and Donetsk regions. Regional features include the uneven transformation of the employment structure in the ICS and its variability by this index. In Kyiv, the value of this index has changed little, and it is the highest among the regions of Ukraine. Therefore, the ICS has a positive impact on the spatial development of Ukraine's creative economy and structural changes in the regions, fostering favourable conditions for their adaptation to innovation. At the same time, the intensity of spatial changes varies. This is because of differences in regional sectoral specialisation, objectives, priorities and tasks of regional policy, the level of urbanisation of the territory and the location of business entities.

The hostilities strengthen the risks of uneven development of the ICS in different regions of Ukraine due to disparities in working conditions, access to energy supply and the duration of shelling, etc. During the war the ICS can survive, the financial result before taxation of

large and medium-sized enterprises in this sector in January-September 2022 was positive, with 62.3% of enterprises making a profit and 37.7% making a loss, while in Ukraine the figures were 59.5% and 40.5%, respectively [24]. This is a favourable impulse to further develop the creative economy and achieve the SDGs in Ukraine, as the ICS focuses on producing high value-added goods, improving production efficiency, creating institutional and financial opportunities to promote the creative potential of the employed population, especially young people, and using the "education-science-production" chains.

To develop proposals concerning the growth of the creative economy, implementing the SDGs and the post-war reconstruction of Ukraine's economy, it is necessary to identify the complex cause-and-effect relationships which affect the functioning of the ICS by region. Let the following dependent variables of a simultaneous model characterise the activity of ICS: Y_{1t} – value added at factor costs of enterprises in the ICS by region, UAH thsd.; Y_{2t} – number of active business entities in the ICS by region, units; Y_{3t} – number of the employed at enterprises, persons; Y_{4t} – structure of services exports of the ICS by region, USD thsd. The independent variables of the ICS are: X_{1t} – profit before taxation of enterprises in the ICS by region, UAH thsd.; X_{2t} – structure of services imports of the ICS by region, % of the total; X_{3t} – capital investment in the ICS, % of GDP; X_{4t} – internal current expenditures on R&D in the ICS by region, conducted by scientific organisations, UAH thsd.; X_{5t} – gross regional product (GRP), % of the total.

In a general statement, a simultaneous model of the ICS, which describes the structure of relationships between exogenous and endogenous variables, is represented by the following regression equations:

$$Y_{1t} = a_{11}*X_{1t} + a_{12}*X_{2t} + b_{12}*Y_{2t} + b_{13}*Y_{3t} + a_{10} + \varepsilon_{1t} \qquad (4)$$
$$Y_{2t} = a_{21}*X_{1t} + a_{25}*X_{5t} + b_{21}*Y_{1t} + b_{23}*Y_{3t} + a_{20} + \varepsilon_{2t} \qquad (5)$$
$$Y_{3t} = a_{32}*X_{2t} + a_{33}*X_{3t} + b_{31}*Y_{3t} + b_{34}*Y_{4t} + a_{30} + \varepsilon_{3t} \qquad (6)$$
$$Y_{4t} = a_{43}*X_{3t} + a_{44}*X_{4t} + b_{42}*Y_{2t} + b_{43}*Y_{3t} + a_{40} + \varepsilon_{4t} \qquad (7)$$

where a_{10}, a_{20}, a_{30}, a_{40} – intercept parameters; a_{11}, a_{12}, a_{21}, a_{25}, a_{32}, a_{33}, a_{43}, a_{44}, b_{12}, b_{13}, b_{21}, b_{23}, b_{31}, b_{34}, b_{42}, b_{43} – slope parameters; ε_{1t}, ε_{2t}, ε_{3t}, ε_{4t} – error terms (or disturbances).

In the reduced form, equations (4)–(7) can express in terms of the exogenous variables X_{jt} and the error terms ε_{1t} and can write as:

$$Y_{1t} = \pi_{11}*X_{1t} + \pi_{12}*X_{2t} + \pi_{13}*X_{3t} + \pi_{14}*X_{4t} + \pi_{15}*X_{5t} + \pi_{10} + \nu_{1t} \qquad (8)$$
$$Y_{2t} = \pi_{21}*X_{1t} + \pi_{22}*X_{2t} + \pi_{23}*X_{3t} + \pi_{24}*X_{4t} + \pi_{25}*X_{5t} + \pi_{20} + \nu_{2t} \qquad (9)$$
$$Y_{3t} = \pi_{31}*X_{1t} + \pi_{32}*X_{2t} + \pi_{33}*X_{3t} + \pi_{34}*X_{4t} + \pi_{35}*X_{5t} + \pi_{30} + \nu_{3t} \qquad (10)$$
$$Y_{4t} = \pi_{41}*X_{1t} + \pi_{42}*X_{2t} + \pi_{43}*X_{3t} + \pi_{44}*X_{4t} + \pi_{45}*X_{5t} + \pi_{40} + \nu_{4t} \qquad (11)$$

where π_{ij} – reduced form parameters; ν_{it} – reduced form errors; $i = \overline{1,4}$; $j = \overline{1,5}$.

The simultaneous equations model (4)–(7) can be written in a tabular form (Table 3) to check its identification, the matrix ranks for each equation are equal to 3. In terms of the order condition, all equations of the simultaneous model are just identified ones. To estimate the unknown parameters of equations (4)–(7), we use the method of two-stage least squares (2SLS or TSLS). However, this method is developed to estimate the parameters of over-identified equations, it can also estimate the structural parameters of just identified equations.

Table 3

Conditions for the identification of simultaneous equations

The number of the equation, i	The intercept parameter	Y1t	Y2t	Y3t	Y4t	X1t	X2t	X3t	X4t	X5t	Number of excluded exogenous variables, К-кі	Number of included endogenous variables reduced by 1, mi-1	Statement of possible identification
(4)	a10	1	b12	b13	0	a11	a12	0	0	0	2	2	Just identified equation
(5)	a20	b21	1	b23	0	a21	0	0	0	a25	2	2	Just identified equation
(6)	a30	b31	0	1	b34	0	a32	a33	0	0	2	2	Just identified equation
(7)	a40	0	b42	b43	1	0	0	a43	a44	0	2	2	Just identified equation

Source: constructed by the author

The simultaneous model of the ICS by regions of Ukraine would include the following equation:

$$Y_{1t} = 3{,}919 * X_{1t} + 827530{,}017 * X_{2t} + 346{,}281 * Y_{2t} - 88{,}641 * Y_{3t} - 373028{,}847 \quad (12)$$
$$Y_{2t} = -0{,}006 * X_{1t} + 502{,}905 * X_{5t} + 0{,}0016 * Y_{1t} + 0{,}123 * Y_{3t} + 1110{,}423 \quad (13)$$
$$Y_{3t} = -11291{,}450 * X_{2t} + 943331{,}224 * X_{3t} + 0{,}0009 * Y_{1t} + 0{,}064 * Y_{4t} + 3993{,}066 \quad (14)$$
$$Y_{4t} = -4303701{,}423 * X_{3t} + 0{,}025 * X_{4t} - 6{,}678 * Y_{2t} + 13{,}056 * Y_{3t} - 34004{,}294 \quad (15)$$

Every regression equation is adequate with the Fisher's criterion and the Student's t-test, and there is no first-order autocorrelation given the Durbin-Watson test (Table 4). In terms of the identified structural parameters of the simultaneous equations model of the ICS by regions of Ukraine, it is possible to interpret it in the following way.

Table 4

The simultaneous equations model and reporting regression results

Variables	Intercept and slope parameters	Standard error*	t-statistic	Confidence interval, 95 %		DW, 99 %
				low-level	high-level	
Y1-meet	-373028.847	127278.838	2.931	-622495.369	-123562.325	1.914
variable Y2	346.281	33.134	10.451	281.339	411.222	
variable Y3	-88.641	22.190	-3.994	-132.134	-45.148	dl=1.633
variable x1	3.919	0.074	53.287	3.775	4.063	du=1.715
variable x2	827530.017	266491.017	3.105	305207.624	1349852.409	
Regression statistics		**Analysis of variance**				
R	0.9971		df	SS	MS	F
R2	0.9941	Regression	4	424490445437673300	106226113594418300	7187.530
Normalized R2	0.9940	Residual	170	251246814452579	1477922437956	
Standard error**	1215698.333	Total	174	42741692252125900		
Y2-meet	1110.423	386.846	2.870	352.204	1868.642	2.056
variable Y1	0.0016	0.0001	11.580	0.0013	0.0018	
variable Y3	0.123	0.0333	3.679	0.057	0.188	dl=1.633
variable x1	-0.006	0.001	-10.706	-0.007	-0.005	du=1.715
variable x5	502.905	145.568	3.455	217.591	788.219	
Regression statistics		**Analysis of variance**				

			df	SS	MS	F
R	0.9517		df	SS	MS	F
R2	0.9057	Regression	4	13678663675	3419665919	407.996
Normalized R2	0.9030	Residual	170	1424876217	8381625	
Standard error**	2895.104	Total	174	15103539892		
Y3-meet	3993.066	362.009	11.030	3283.530	4702.603	1.999
variable Y1	0.0009	0.0002	3.684	0.0004	0.0013	
variable Y4	0.064	0.010	6.583	0.045	0.083	dl=1.633
variable X2	-11291.450	2157.689	-5.233	-15520.521	-7062.380	du=1.715
variable X3	943331.224	119824.614	7.873	708474.980	1178187.468	
Regression statistics		**Analysis of variance**				
R	0.9882		df	SS	MS	F
R2	0.9765	Regression	4	136940350249	34235087562	1762.776
Normalized R2	0.9759	Residual	170	3301589943	19421117	
Standard error**	4406.940	Total	174	140241940192		
Y4-meet	-34004.294	6040.788	-5.629	-45844.239	-22164.349	1.736
variable Y2	-6.678	1.6859	-3.961	-9.9828	-3.374	
variable Y3	13.056	0.865	15.094	11.361	14.752	dl=1.633
variable X3	-4303701.423	593984.178	-7.245	-5467910.412	-3139492.433	du=1.715
variable X4	0.025	0.011	2.239	0.003	0.047	
Regression statistics		**Analysis of variance**				
R	0.9812		df	SS	MS	F
R2	0.9627	Regression	4	13237762961751	3309440740438	1097.117
Normalized R2	0.9618	Residual	170	512803031826	3016488423	
Standard error**	54922.568	Total	174	13750565993577		

* – the slope parameters and intercept; ** – the regression. Source: Calculated based on [24]

Given the results of calculations based on real statistical data (the equation (12)), an increase of 1 unit in the number of active business entities in the ICS by region adds on average value added at factor costs of enterprises in this sector by 346.281 thsd. UAH. An increase of 1 person in the number of the employed at enterprises in the ICS by region reduces on average value added at factor costs of enterprises in this sector by 88.641 thsd. UAH. An increase of 1 thsd. UAH in the value of profit before taxation of enterprises in the ICS by region leads on average to growth of the value added at factor costs of enterprises in this sector by 3,919 thsd. UAH. Also, an increase of 1% of the total in the structure of services imports in the ICS by region makes on average the value added at factor costs of enterprises in this sector by region by 827530.017 thsd. UAH.

An equally important factor for the ICS by region of Ukraine is the economic activity of economic entities (the equation (13)). For instance, growth in value added at factor costs of enterprises in the ICS by region by 1 thsd. UAH increases on average the number of active business entities in this sector by 0.0016 units. An increase of 1 person in the number of the employed at enterprises in the ICS by region increases on average the number of active business entities in this sector by 0.123 units. An increase of 1 thsd. UAH in the value of profit before taxation of enterprises in the ICS by region reduces on average the number of active business entities in this sector by 0.006 units on average. A 1% increase in GRP provides an increase on average in the number of active business entities in this sector by 502.902 units.

Certain factors influence employment in the ICS by region of Ukraine (the equation (14)). Therefore, an increase of 1% of the total in the structure of service imports in the ICS by region reduces the number on average of the employed at enterprises in this sector by - 11291.450 people. An increase in capital investment in the ICS by region by 1% of GDP increases on average the number of the employed at enterprises in this sector by 943331.224 people. An increase in the value added at factor costs of business entities in the ICS by region by 1 thsd. UAH increases on average the number of the employed at enterprises in this sector by 0.0009 people. Growth in the structure of service exports of the ICS by region by 1 thsd. USD increases on average the number of the employed at enterprises in this sector by 0.064 people.

Fostering service exports in the ICS is associated with the influence of a set of factors described in equation (15). Thus, an increase in capital investment of the ICS by regions by 1% of GDP reduces on average the structure of service exports of this sector by 4303701.423 thsd. USD. The growth of internal current expenditures on R&D in the ICS by region by UAH 1 thsd. UAH increases on average the structure of service exports in this sector by 0.025 thsd. USD. An increase in the number of active business entities in the ICS by region by 1 unit reduces on average the structure of service exports in this sector by 6.678 thsd. USD. An increase in the number of the employed at enterprises in the ICS by 1 person increases on average the structure of service exports in this sector by 13.056 thsd. USD.

The identified structure of the relationships between exogenous and endogenous variables of the simultaneous model for regression equations (12)–(15) may be useful for policymaking to strengthen the position of the creative economy and achieve the SDGs after the war in Ukraine. In that regard, the interdependencies in the simultaneous model of the ICS could be considered updating the Recovery Plan of Ukraine [17] in terms of the following national programmes "Development of Value Added Sectors of the Economy" for the IT sector, "Ensuring Competitive Access to Capital" for financing small and medium enterprises, and adjusting the SDGs for decent work and economic growth and innovation [23]. To do this, it is crucial to intensify entrepreneurship in the ICS in the economy of Ukraine and its regions, stimulate exports and kerb imports of services, attract investment, increase spending on R&D in this sector, and increase labour productivity.

Conclusions and perspectives of further research work. Therefore, in 2010–2021, the key trends in the functioning of the ICS are strengthening its position in the creative economy of Ukraine and in the national economy in the following indicators: the number of active business entities, % of the total, capital investment, % of the total, turnover of enterprises, % of the total, number of the employed at enterprises, % of the total, value added at factor cists of enterprises, % of the total. The crucial reasons concerning the growth in the ICS of Ukraine are the rapid development of ICT, digitalisation and widespread use of Internet technologies, leading to the intensification of entrepreneurial activity in computer programming, consultancy and related activities, and information service activities. This has a positive impact on the opportunities to achieve Ukraine's SDGs, which concerned decent work, innovation, and economic growth. It is revealed that during the war in Ukraine, the ICS could quickly adapt to functioning in adverse conditions. This sector belongs to one of the few sectors of the Ukrainian economy which had a positive financial result in 2022.

Given the dynamics of structural change indices, the impact of the ICS on the modernisation of the structure of the economy of Ukraine's regions is gradual, but insignificant, the intensity is different. Due to this, the development of the creative economy in the regions of our country is slow, because of the peculiarities of spatial industrial specialisation, urbanisation of the territory and the location of business entities. For

sustainable development, this means that although the contribution of the ICS to achieving its goals is not significant, it forms conditions that may improve the situation with creative activity and the use of innovative potential of regions in Ukraine. The role of this sector in the post-war recovery of Ukraine will be to intensify its participation in the structural modernisation of the regional economy.

Having specified the parameters of the simultaneous equations model, the structure of interrelations that affect the functioning of ICS by regions of Ukraine is determined. To continue to have a positive impact of the ICS on the spatial development of the creative economy and the achievement of the SDGs, the results show that a favourable environment should be created at the national and regional levels during and after the war to expand the production of the ICS products, reduce obstacles to the export of ICS services, create new jobs, and attract investment. The determined system of regression equations for the ICS is worth considering when elaborating economic policy in the national economy and regions of Ukraine in terms of stimulating the development of the creative economy, implementing measures to achieve the goals of sustainable development and post-war recovery. Improving the solution of the simultaneous equations model of the Ukrainian ICS in the following analyses may be associated with examining the nonlinearity of the relationships. However, this would complicate specifying such a model and its economic interpretation. Further research will focus on identifying the role of ICS in ensuring knowledge-based economic development during the post-war recovery of Ukraine's economy.

References

1. Müller, K., Rammer, Ch., & Trüby, Jo. (2009). The role of creative industries in industrial innovation. *Innovation*,11 (2), 148–168. DOI: 10.5172/impp.11.2.148.
2. Matei, A.I., & Savulescu, C. (2012). Towards Sustainable Economy through Information and Communication Technologies Development: Case of the EU. *Journal of Security and Sustainability Issues*, 2 (2), 5–17. DOI: http://dx.doi.org/10.9770/jssi.2012.2.2(1).
3. Bae, S.H., & Yoo, K. (2015). Economic modeling of innovation in the creative industries and its implications. *Technological Forecasting and Social Change*, 96, 101–110.
4. Chala, V. (2015). The peculiarities of trade specialization in creative industries in the Central and Eastern European countries. *Eastern Journal of European Studies*, 6, 91–109.
5. Fazlagić, J., & Skikiewicz, R. (2019). Measuring sustainable development – the creative economy perspective. *International Journal of Sustainable Development & World Ecology*, 26 (7), 635–645. DOI: 10.1080/13504509.2019.1651418.
6. Silva, A.D.F., Fernandes, O.L. da C., Paiva Júnior, F.G. , Medeiros, J.J., & Monteiro, F.N. da C. (2020). Conversion of an information and communication thechnology cluster to a pole of creative economy: an analysis from the repspective of Sergio Alves' multidemencial-reflexive model of organization. *Journal on Innovation and Sustainability*, 11 (3), 83–99. DOI: https://doi.org/10.23925/2179-3565.2020v11i3p83-99.
7. Štreimikienė, D., & Kačerauskas, T. (2020). The creative economy and sustainable development: The Baltic States. *Sustainable Development*, 28, 1632–1641. DOI: https://doi.org/10.1002/sd.2111.
8. Wiktor-Mach, D. (2020). What role for culture in the age of sustainable development? UNESCO's advocacy in the 2030 Agenda negotiations. *International Journal of Cultural Policy*, 26 (3), 312–327. DOI: 10.1080/10286632.2018.1534841.
9. Kichurchak, M. (2021). Teoretyko-metodolohichni zasady vplyvu sektoru informatsiino-komunikatsiinykh tekhnolohii na vidtvorennia suspilnykh blah u natsionalnii ekonomitsi [Theoretical and methodological principles of the information and communication technologies sector influence on public goods production].

Ekonomichnyi prostir – Economic Space, 175, 7–12. DOI: https://doi.org/10.32782/2224-6282/175-1. [in Ukrainian]

10. Simkiv, L., Shults, S., Lutskiv, O., & Andrusiv, U. (2021). Analysis of the Dynamics of Structural Processes in the Context of Ensuring Sustainable Development. *European Journal of Sustainable Development*, 10 (1), 153–167. https://doi.org/10.14207/ejsd.2021.v10n1p153.

11. Kichurchak, M. (2022). Strukturni zminy v sektori informatsii ta komunikatsii v systemi kreatyvnoi ekonomiky krain YeS: dosvid dlia Ukrainy. [Structural changes in the information and communication sector in the creative economy of the EU countries: experience for Ukraine]. *Ekonomika i prohnozuvannia – Ekonomy and forecasting,* 3, 115–130. DOI: https://doi.org/10.15407/eip20 22.03.115. [in Ukrainian]

12. Moiseienko, I. (2022). Using the potential of the creative economyto restore Ukraine. *International Journal of Management and Economics*, 58 (4), 381–392. DOI: https://doi.org/10.2478/ijme-2022-0022.

13. Nchofoung, T.N., & Asongu, S.A. (2022). ICT for sustainable development: Global comparative evidence of globalisation thresholds. *Telecommunications Policy*, 46 (5), 102296. DOI: https://doi.org/10.1016/j.telpol.2021.102296.

14. Shobande, O.A., & Ogbeifun, L. (2022). Has information and communication technology improved environmental quality in the OECD? – a dynamic panel analysis. *International Journal of Sustainable Development & World Ecology*, 29 (1), 39–49. DOI: 10.1080/13504509.2021.1909172.

15. Kichurchak, M. (2023). Information and communication technologies sector development as a factor of forming creative industries in the European Union countries: experience for Ukraine. *Financial and Credit Activity Problems of Theory and Practice*, *1* (48), 399–408. DOI: https://doi.org/10.55643/fcaptp.1.48.2023.3934.

16. Ukraine recovery conference. (2022, July). *Ukraine's National Recovery Plan: National Recovery Council.* Retrieved from https://global-uploads.webflow.com/621f88db25fbf24758792dd8/62c166751fcf41105380a733_NRC%20Ukraine%27s%20Recovery%20Plan%20blueprint_ENG.pdf.

17. Ukraine Recovery Plan. (07.07.2023). *National Programmes*. Retrieved from https://recovery.gov.ua/.

18. Klasyfikatsiia vydiv ekonomichnoi diialnosti: ofitsiinyi sait. – Classification of economic activities. (13.06.2023). *Kody vydiv ekonomichnoi diialnosti za KVED-2005 ta KVED-2010. [Codes of types of economic activity according to NACE-2005 and NACE-2010]*. Retrieved from: http://kved.ukrstat.gov.ua/KVED2010/kv10_i.html.

19. Eurostat. (13.06.2023). *Statistical Classification of Economic Activities in the European Community*. Retrieved from: https://ec.europa.eu/eurostat/ramon/ nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL&StrNom=NACE_REV2&StrLanguageCode=EN&IntPcKey=18514214&StrLayoutCode=HIERARCHIC.

20. On approval of types of economic activities related to creative industries: Resolution of the Cabinet of Ministers of Ukraine, 24.04.2019 No 265-p. *Verkhovna Rada of Ukraine: official web-site*. Retrieved from: https://zakon.rada.gov.ua/laws/show/265-2019-%D1%80#Text.

21. Krugman P., & Venables A.J. (1996). Integration, specialization, and adjustment. *European Economic Review*, 40 (3–5), 959–967.

22. Krieger-Boden, Ch., Morgenroth, E., Petrakos, G. (Eds.) (2008). The Impact of European Integration on Regional Structural Change and Cohesion. London: Routledge.

23. State statistics service of Ukraine. (02.07.2023). *Sustainable Development Goals of Ukraine*. Retrieved from: https://ukrstat.gov.ua/.

24. State Statistic Service of Ukraine. (03.07.2023). *Economic statistics.* Retrieved from http://www.ukrstat.gov.ua/.

СЕКТОР ІНФОРМАЦІЇ ТА КОМУНІКАЦІЇ В КРЕАТИВНІЙ ЕКОНОМІЦІ УКРАЇНИ: ОЦІНКА СТРУКТУРИ ЗВ'ЯЗКІВ ДЛЯ СТАЛОГО РОЗВИТКУ ТА ПОСТ-ВОЄННОЇ ВІДБУДОВИ

Маріанна Кічурчак

Львівський національний університет імені Івана Франка
79008, м. Львів, проспект Свободи, 18
ORCID ID: https://orcid.org/0000-0002-1927-5704

Анотація. Однією з важливих складових формування креативної економіки, досягнення цілей сталого розвитку та поствоєнного відновлення економіки України та її регіонів є розвиток сектору інформації та комунікації (СІК). Метою статті є визначення головних тенденцій функціонування СІК в креативній економіці та оцінка його значення для сталого розвитку та поствоєнної відбудови України. Автором проаналізовано головні соціально-економічні показники СІК за видами економічної діяльності, порівняно темпи структурних змін у СІК у регіональному розрізі за допомогою індексів Кругмана, регіональної спеціалізації Герфіндаля та Тейла, створено симультативну модель функціонування цього сектора за регіонами України. У 2010–2021 рр. виявлено зростання внеску СІК у розвиток креативної економіки України, досягнення цілей сталого розвитку для економічного зростання, гідної праці та інновацій за кількістю діючих суб'єктів господарювання (% до загальної кількості), капітальними інвестиціями (у % до загального обсягу), обсягом реалізованої продукції суб'єктами господарювання (% до загального обсягу), кількістю зайнятих працівників (% до загальної кількості), доданою вартістю за витратами виробництва суб'єктів господарювання (% до загального обсягу). Війна зумовила швидку адаптацію суб'єктів господарювання у СІК України до діяльності в несприятливих умовах, які завершили 2022 р. з прибутком. Як свідчать індекси регіональної спеціалізації зміна структури економіки регіонів України, що відбувається під впливом розвитку СІК, є незначною, відбувається достатньо повільно та поступово через відносну усталеність галузевої спеціалізації. Симультативна модель для СІК за регіонами України складається з чотирьох регресійно-кореляційних рівнянь, вони описують додану вартість за витратами виробництва суб'єктів господарювання, кількість діючих суб'єктів господарювання і зайнятих у них працівників, структуру експорту послуг у цьому секторі. Результати дослідження можуть бути корисними для розробки заходів секторальної національної і регіональної політики, пов'язаних із поствоєнним зростанням СІК України для зміцнення позицій креативної економіки та досягнення цілей сталого розвитку.

Ключові слова: сектор інформації та комунікації, інформаційно-комунікаційні технології, сталий розвиток, регіони України, креативна економіка, пост-воєнна відбудова, регресійно-кореляційний аналіз і структурні рівняння.