

EFFECTS OF REGIONAL SMART TRANSFORMATION

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Received 21 09 2023; Accepted 14 10 2023

Abstract

The global changes of 2019 - 2020 have impacted every region of the world. Businesses of successful powerful old companies have fallen into the crisis pit, while the startups have entered the category of “gazelles”. There are trends of reshoring (returning) the material-intensive production to European countries, and on the other hand, abandoning the linear economic model. The non-linear model of economic development is particularly evident in the decentralization of decision-making. The concept of components has changed in the value chain as the knowledge-based economy era has started (knowledge economy). The aim of this paper is to analyze the value chain by exploring the role of its primary (market, product/service development, production) and secondary (technologies, human resources, resource management) elements in some innovative start-ups.

The article uses the methods of economic and statistical analysis, including the assessment of economic effect in terms of determining the impact of smart technologies on different economic sectors of the region; regression analysis for econometric assessment of independent variables and functions, which brings us closer to the solution of the problem of the economic effect of ecosystem transformation in the region; correlation analysis for determining the correlation between the economic efficiency of the IT industry and the GRP.

Based on the analysis of secondary and primary elements of innovative startups, the paper proves that the value chain in the modern economy is subject to qualitative changes, while digitalization processes promote the efficient development of regional smart specialization.

Keywords: *industry 4.0, smart strategy, region, IT industry, cluster.*

JEL Codes: *O10, O33, D20.*

Introduction

The moment when the EU countries started lagging far behind USA, Japan, Australia, Canada, and South Korea by the efficiency of innovations and China began catching up at a rapid pace is the challenge of

the development of regional communities that should be the starting point for tracking the transformations. European Innovation Scoreboard (2021) demonstrates that the situation has improved, but there are still many issues and problems, with the new ones

emerging in the pandemic. The stability of large corporations was shaken, while small creative startups are racing with breakthrough technologies with the accelerated paces of “gazelles” (Berg and Popkov, 2003). The new trends of production reshoring to Europe, cyclical economic model, bottom-up decision-making, and paradoxical phenomena of European unity and ethnocentrism have impacted the context of socio-economic efficiency and competitiveness. Developing smart specialization in less developed countries/regions is especially relevant.

Literature review

The researchers address the selected subject all over the world, and most of the problems are similar. Theoreticians and experts discuss the problems of the strategizing processes. The development of a Smart Specialisation Strategy (RIS3) takes place bottom-up (Smart Specialisation Platform European Commission, 2022). Therefore, a range of questions emerges in this direction: Is the bottom-up approach better? Regarding the cooperation between regions and inside a region, what is the optimal way to attract entities to disclose regional innovative capacity to the maximum? Should the list of priority economic sectors of a region be compiled? Regarding the balance between technologies and corporate resilience, do smart technologies impact corporate stability and environmental and social resilience? These and other topical issues that remain to be debatable are addressed by (I. Irtyshcheva et al. 2022; D. Iacobucci, 2014; R. Capello and H. Kroll, 2016; S. Shults et al. 2022; D. Foray, 2017; Pasko et al., 2020).

It is a difficult task to develop an ecosystem to the level of the niche business competitiveness in the countries with the prevailing linear economy of earlier waves of innovation, yet (O. Dovgal et al., 2017; O. Pavlova et al., 2021; V. Yakubiv et al., 2019; V. Fatkhutdinov et al., 2021; A. Yakymchuk et al., 2021; L. Horoshkova et al., 2020, M. Melnyk et al., 2018) try to cope with it.

Methodical approach

The set of primary information of the research can be grouped into the official and clearly formalized, and the second one – behavioristic. In the framework of the first rational cluster of materials, the author uses the RIS3 Guide and the data of the official statistics services to carry out the current statistical analysis of the dynamics of the students of higher educational institutions. Another cluster of primary materials – neurocognitive – includes the results of sociological surveys for 2016-2021 covering the employed in IT in the western regions of Ukraine (IT Research, 2022) and a panel survey of Ukrainians (IT Reputation Research, 2022).

A simplified approach to the efficiency of transformation is focused on business profitability indicators. Tax revenues from the IT industry to Lviv Treasury account for about a third of all such revenues to the local budget. Yet, management efficiency consists of the elements given in the formula (1):

$$Em = f(G, C, F, M, R), \quad (1)$$

where G – goals;
C – criteria;
F – factors;
M – methods;
R – resources.

Since GDP is the basic macroeconomic indicator, it, in fact, represents the complex interaction between the components in the Formula.

The hypothesis is verified to conduct a more in-depth analysis of the region’s ecosystem efficiency mechanism. Econometric estimation (regression analysis) of independent variables (x) and function (y) can be presented in the form of the logical formula (2):

$$Ee \text{ (niche specialization development level)} = f(GRP), \quad (2)$$

where Ee – economic effect of IT industry;

GRP – Gross Regional Product.

The mechanism of the region’s management transformation efficiency should be considered element by element (pairwise

correlation), i.e. the factors that determine the results of the managed object's activity should be examined.

The results of the calculation of variables' numerical characteristics are processed using STATISTICA 6 software package. Econometric estimation (regression analysis) of independent variables (x) and function (y) has helped to get closer to the answer to the problem of economic effect of a region's ecosystem transformation.

Results

Participation in Industry 4.0 (Industry 4.0 European Commission, 2022), i.e. the industries of the 4-6th waves of innovation, is nowadays of decisive importance for the competitiveness of a country or a region. The progress of the Ukrainian economy based on the non-linear concept started in the 2000s from the cluster approach (Cabinet of Ministers of Ukraine, 2008). The cluster consolidates the players of a certain geographic area with socio-economic and professional interests. The advantages of the cluster model of economic development are undeniable in terms of new functional and resource-related links, infrastructure, labor markets, and scientific, educational, and research services. Yet, the problem of prolonging the life cycle of traditional activity types on some territories is debatable. The conservatism regarding the emergence of a new direction is not in the favor of the employment of young generation as millennials will not be forced to get employed in difficult physical production.

However, a small number of projects are synchronized with the EU framework programs (Horizon Europe European Commission, 2023), (Industry 4.0 European Commission, 2022), and smart strategy (Smart Specialisation Platform European Commission, 2022). For that matter, Western Ukraine is the progressive region as the IT cluster is being framed. The knowledge economy era has come and the classic Porter's scheme of value chains has qualitatively changed, which would be

interesting to examine in order to determine the reserves of improving the efficiency of business models (M. Porter, 1998). The value chain in the industries of new waves of innovation substantially differs from the one in those of earlier waves. For instance, the innovative startup in digital technologies uses hardware and software, which are the mean of labor, as input materials. Intellectual operations are the second element of creating a new product. Due to the domination of digital technologies, the output logistics mostly depends on the speed of information transfer, i.e. the Internet connection characteristics. Marketing framework of business operations in the value chain is hardly different from classical methods of activity on the market. The marketing innovations are spreading wherever they first appear. For instance, the capacity of advertising in social networks has covered all types of businesses with viral speed. The peculiarities of after-sales service are caused by the differences between the service business and the manufacturing enterprise, as well as the category and types of products of the IT company.

Auxiliary components of the value chain in the industry are of equal importance. Technological development, qualitative and quantitative composition of employees, their training and enhancing the competences are the decisive elements of a company's competitiveness.

Large national (state) universities were closely monitoring the market of promising professions and trying to increase their license volume. 16.378 bachelors of IT specialties completed their education in 2020, 94% of them graduated from national (state) universities. Private educational institutions also increase the share of graduates due to total digitalization, yet they do it slower than the leaders. In 2014-2020, the share of IT-graduates from state universities increased by 2.8 p.p., from private ones – by 1.1 p.p. Meanwhile, private colleges increase the share of IT-graduates faster: 3.3 p.p. against 2.6 p.p. for state colleges (D. Lebedev and I. Samokhodsky, 2021). Among other things, it

happens due to fewer requirements to the organization of education in educational institutions of lower accreditation levels. In 2020, 6.776 students received the diplomas of junior specialists in IT. The graduates of state colleges prevailed among them (89%). The number of junior specialists is growing on the market mostly due to the growing number of specialized schools and courses as the

profession is promising and fashionable. Yet, over half of college graduates do not start working but continue their studies.

Three universities and other higher educational institutions prepare specialists in Lviv. The trend of an increasing number of students and young specialists in IT is consistent (Table 1).

Table 1. Dynamics of indicators of migration attractiveness of countries

	2014	2015	2018	2019	2020
Study for bachelor degree	1687	2429	2405	3200	3314
Study for master degree	989	995	1150	970	938
Total	2676	3424	3555	4170	4252

**Source: built by the author.*

Most IT specialists have Middle Qualification Level: in 2019, Junior – 27%, Middle – 42%, Senior – 31%; in 2020: Junior – 24%, Middle – 41%, Senior – 35%. According to statistics, about a half of newcomers additionally attend private IT courses. About 30 educational institutions provide short-term courses in Lviv with 8,200 graduates in 2019 and over 10,000 in 2020.

The companies' management and funding infrastructure differ by the structure of functional authority and expenditures, etc. Therefore, first mentors and business angels emerged in IT.

Expenditures can be optimized and the value of final products can be increased by evaluating each element and stage of activity in a value chain. Global practice shows higher functioning efficiency for companies if it is consolidated around a fundamentally new idea. The companies of the new waves of innovation reacted to lockdown in different ways. IT companies quickly adapted to the situation in conditions of quarantine: they reduced spending, suspended some projects, readjusted and adapted marketing strategies, and switched to remote work (WFH - Work from Home). In addition to the economic aspect of the business model transformation, the managers (Co-Founder & CEO) see the security and health of employees as top priority goals. The results of WFH even improved and the skills are efficiently developed to achieve competitive

digital advantages. Yet, the security level requires unplanned expenses in terms of confidentiality of official information. Auxiliary process of IT Infrastructure and Information Security Departments had to be organized.

An IT cluster functioning in Lvivska oblast quite successfully integrates informational, intellectual-personnel, material-technical, technological, non-material, financial, investment, and innovative frameworks. So the region's smart specialization continues to develop the components of the investment-innovative process – from the search for prospective innovative ideas and projects to commercialization of the results of innovative and R&D activity, including infrastructure maintenance and development of new innovative products.

The effects of the smart transformation of the region cannot be estimated and measured unambiguously by a single indicator. Yet, we advocate the view that the modern ecosystem is based on three Ps: «profit, people, and the planet» (Harvard Business School online, 2022).

The average age of an employee is about 29 and men prevail. So jobs creation for youth is the advantage of the IT industry. According to research, a consistent trend of the growing amount of companies was observed in the Western Region of Ukraine in 2015-2021 –

their number increased from 192 to 511, respectively, and the number of staff increased from 13,000 to 30,000. Income was also growing continuously: from 1,536 \$/month to 2,480 \$/month. For comparison, in this period, the average wage in the country was 266 \$/month in 2014, 525 \$/month in 2021. In fact, wages are the highest in IT, finance and insurance are in the second place, and public administration and defense – in the third.

According to various estimates, an IT specialist involved in innovation generation and diffusion creates 1.6-1.8 additional jobs because the organization and functioning of offices and production, recreation, and service infrastructure needs labor resources. Several hubs and business incubators are opened, and innovation parks are constructed annually. Moreover, due to high income, the specialists invest in housing. The share of apartments purchased by IT specialists in the primary market is about 15%. If we add rent expense (about \$ 190 on average per month) and land acquisition expense (5% of specialists had bought land three years before the COVID crisis) (IT Research, 2022), we can argue about substantial support for the construction industry and services in the real estate industry.

The experts determine the perspectives of mastering the new development directions and technologies in the IT PR report: Big Data, Data Science, Machine Learning, Artificial Intelligence, and smart devices to improve and simplify the WFH processes – e-commerce, logistics, energy efficiency (IT Reputation Research, 2022).

The size of the company and its business efficiency have a direct linear relationship. The companies' distribution by size shows that small companies prevailed in 2016: 11-50 employees – 54%, up to 10 employees – 22.7% (IT Research, 2022). 196 companies were functioning with about 15,000 employed. So

the average number was 76.5 persons. The surplus of the establishment of new companies was observed in the following 2017-2018.

The companies' structure by size changed dramatically in 2019. Mergers and active human resource policy had led to the fact that micro-companies were almost gone, and the average number of full-time employees had declined and amounted to 52-53 persons. The positive dynamics of the number of companies and personnel continues. The maximum growth of jobs was in 2018 and 2021 for the last five years. 2020 might have been a little different, but it was affected by unpredictable global restrictions.

Some companies that have already captured a large market share have developed a solid image due to the implementation of ambitious projects and cooperation with business partners from other industries. For instance, a project of launching e-tickets in public transport was developed based on participation in product development tenders. In expansion, some companies change the value chain and take risks when processing a possibility to open official representations abroad.

The correlation coefficient is statistically significant for the hypothesis. $t_{2r} = t_{2b}$ in the pairwise linear regression. So verification of hypotheses on the significance of regression and correlation coefficients is equal to verification of hypothesis on the significance of linear regression equation (table 2). According to the values of the coefficient of determination, the regression equation is chosen accurately. Autocorrelation between the parameters arranged by years is absent. According to Durbin-Watson Test, the autocorrelation of residuals is absent too, which is the positive qualitative feature of modeling (Figure 1).

Table 2. The hypothesis regression equations quality parameters

Parameter	Hypothesis 3(H3)
Coefficient of determination	0.9763
Average coefficient of elasticity	0.99
Average approximation error	2.82

*Source: built by the author.

As the result of calculations, the empirical pairwise regression equation is: $y = 0.00614x + 10.7593$

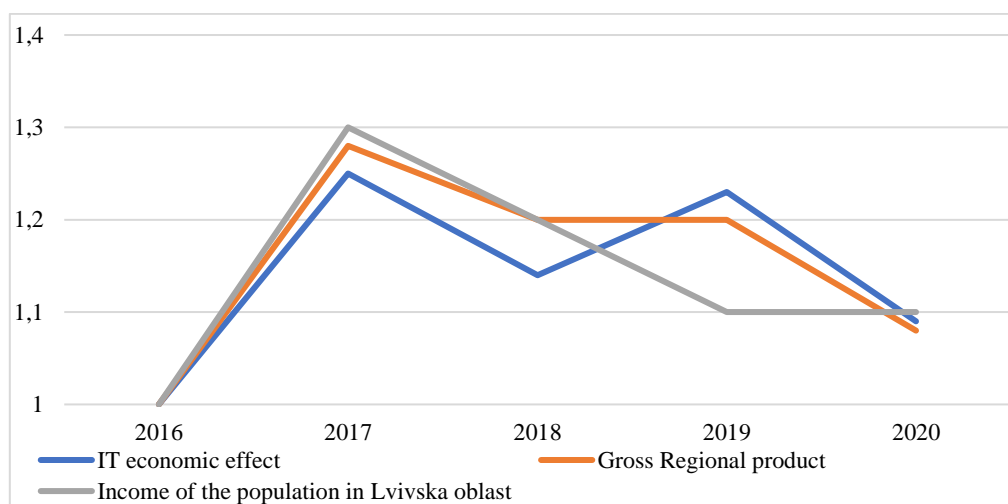


Figure 1. Shows the graphic representation of parameters dynamics in Lvivska oblast.

*Source: built by the author based on (State Statistics Service of Ukraine, 2022).

The key coefficient of correlation between economic efficiency of IT industry and GRP is 0.99734, which confirms the outcomes of the regression analysis.

Conclusions

The value chain undergoes qualitative changes in the modern economy. The ecosystem transforms by investment in IT and the attraction of local governments to cooperation in terms of infrastructure development. The competitiveness of such ecosystems is based on the objectives of social, financial, and ecological nature, creating an environment for a resilient regional economy. Demographic changes and a circular economy urge the analysis of smart specialization in Ukraine as it does not want to be a periphery. The progressive Western Region with an operating IT cluster differs from the country's economic industries of earlier waves of innovation as it does not require the spending

of non-renewable resources and governmental subsidies. Moreover, technology-intensive companies automatically have the circular business model, they "save" their and their partners' financial resources. Their product as a service business model is a value for customers since the package services offer includes the after-sales service. Boosted IT education and promotion of profession-oriented business education have fostered the emergence of economic effects of transformation of the region's ecosystem. The paper proves that the long-term perspective of resilient functioning of companies of the 4-6th waves of innovation and digitalization will continue bringing significant positive economic and social results.

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