Determinants of regions smart specialization in eco-clustering

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Abstract. The article identifies and substantiates the determinants of regions smart specialization, highlights the connection with the processes of environmental clusters formation to more effectively overcome the passivity of innovation and industrial policies in combination with the model of structural and organizational reconfiguration. The authors thoroughly studied the experience of EU countries in creating ecological clusters and producing eco-innovations. The main barriers of smart regions specialization in Ukraine and its problematic aspects in ensuring the development of ecological clusters are identified. The authors systematized the main ecological innovations in clusters. The article gives recommendations for the development of environmental clusters in Ukraine under the context of smart specialization.

1. Introduction
The current global trend for leveling the disparities in the economic development of regions is their smart specialization, which is also a guarantee of the economic system cluster development at all levels. In particular, an important prerequisite for the implementation of both processes is a balanced regional policy, which in the current conditions of systemic administrative reform on the basis of decentralization, outlines new determinants for both organizational development of the economic system and its environmental component. In this sense, the regional policy in Ukraine has strategic objectives to spread the concept of smart regions, which has recently become a highly effective tool for realizing the potential of regional development EU countries. However, this concept has a certain structure duality. On the one hand, it helps to increase environmental and business activity of companies and local public administration, on the other - to increase the responsibility of the regions themselves for organizational design of the local economic system, rational use of resource potential, dissemination of innovations and promotion of environmentally friendly industrial policy. In our opinion, it is relevant to use the methodological basis of ecological clustering and regions smart specialization as a symbiotic model to achieve synergy and improve the regional economic policy of Ukraine, taking into account the positive experience of foreign countries in developing a philosophy of greening clusters. In order to adequately implement the principles of smart specialization and obtain positive results based on it, it is very important for Ukraine to clearly understand the essence of this innovative system of "smart" solutions developed by the EU to intensify structural changes in regional economies, form and develop regional capacity for effective functioning in the most important world markets with a focus on the future. However, the realities of regional distortions in the activity of Ukraine regions of show the opposite, in practical terms, smart specialization remains declarative. This is due to the frames of this concept perception not as a system of innovative solutions based on existing knowledge bases, but only as a structural element of the region innovation infrastructure,
which contradicts the primary meaning of the smart specialization. In addition, changes due to smart specialization are structural in nature, which further encourages horizontal organizational transformations of the economic configuration, i.e., there is a logical mutual provision of "smart" specialization and environmental clustering of regions. Given the specifics of both processes, there is a difficulty in their essential understanding and delimitation of strategic goals and priorities, so the study of this plane is transdisciplinary.

2. Related works

Scientists and experts-practitioners in economics and regional development, innovation and industrial policy were at the origins of the theoretical substantiation of smart specialization effectiveness and the development of appropriate regional policy. The most weighty researches and scientific substantiations were made by D. Forey [1], P. David [2], B. Hall [3]. In their works, the authors introduced the paradigm of creating competitive advantages of regions on the basis of innovation and research activity. As a result of the research it was emphasized that the implementation of the idea of region smart specialization completely excludes the a priori establishment of this specialization through the definition of priority industrial sectors in accordance with the territorial development strategy or a certain industrial potential of the territory. At the same time, the same strategic goals are inherent in other instruments of regional development - clusters.

In this regard, scientists are still arguing. Some experts on the introduction of smart specialization in regions with environmental sectors emphasize its connection with cluster policy and accentuate the potential of using the latter in providing smart specialization [4]. In opposition, D. Forey denies the existence of such potential in cluster policy, noting its reverse direction to counter fundamental structural changes, which occurs due to the emphasis on industrial development of territories using a standardized knowledge base [3].

The clustering processes have an organizational character of restructuring the regions economic system, and smart specialization occurs as a result of structural changes. However, both smart specialization and environmental clusters have a common denominator that is ensuring the competitive advantages of regions on the basis of innovative development.

Regarding Ukrainian scientific thought, the approach of I. Yegorov and G. Dubynsky [5] consider smart specialization as a mechanism to increase competitiveness and ensure economic growth of the regional economy, among the main purposes of which is to ensure innovation orientation. At the same time, O. Snigova [6] believes that the disadvantage of these approaches is the loss of its comprehensive and complementary vision as an innovative approach to quality assurance of regional development, which arises due to changing the focus of modern regional policy from the mechanical smoothing of regional socio-economic disparities to stimulating their self-development. Under such conditions, the innovativeness of the approach is directly lost, which does not improve the quality of these policies.

3. Related works

The aim of the article is to identify and substantiate the determinants of regions smart specialization, to establish its connection with the processes of environmental clusters formation to more effectively overcome the passivity of innovation and industrial policies in structural and organizational reconfiguration model combination. Despite some differences in the essential meaning and understanding, the processes of regions clustering and smart specialization at the initial stage of implementation have a common methodological basis. The research in this area should be guided by the following indicators:

1. Coefficient of ecological interregional production specialization - the ratio of the industry exports volume \( O_1 \) to the number of all products produced by the industry in the interregional exchange of the country \( O \):

\[
EP_t = \frac{O_1}{O} \times 100\%
\]  

2. Coefficient of marketability – the ratio of the organic products value exported from the region
The coefficient of the industry localization in the region - the ratio of its share in total production of all products in the region to the share of the same industry in the country.

Quantitative assessment of the concentration level in the industry is also determined by a number of other coefficients, including Herfindahl-Hirschman, Gini, Linda. The most generalizing indicator of the smarket state is the Herfindahl-Hirschman index (HHI):

\[ HHI = \sum_{i=1}^{n} S_i^2 \]  

where \( S_i^2 \) – market share of the company; \( n \) – number of all enterprises.

4. The coefficient of production in the region per capita - the ratio of the region products share in the net output of the country to the share of the region population relative to the country population. The calculation of the above data, along with other information is the basis for making the best management decision on the feasibility of creating a cluster based on production and smart specialization of the region.

In Ukraine, according to the above indicators, a study of the economic and production capacity of the regions is conducted, the same methodology is provided for smart specialization. However, EU regions use a different methodological framework based on NUTS-1; NUTS-2; NUTS- 3 standards (Nomenclature of territorial units for statistics). This standard is developed and regulated by the European Union and plays an important role in providing EU structural funds for regional development. In addition, this standard includes the ecological condition of the region assessment which is taken into account in ensuring the formation of the cluster.

The initial indicators for NUTS analysis are gross regional product (GRP), population in the regions. Based on these indicators, the GRP growth in relative values and the GRP indicator per person are determined. Accordingly, the countries are grouped.

Groups 1 and 2 include countries with a high level of development. High GRP growth and high GRP per capita are particularly observed. Group 2 includes EU countries with a high GRP per capita but lower GRP growth compared to Group 1. In these groups the regions are aimed at developing innovations to break the steady state, and search for new technological opportunities. When a high level of GRP is achieved, economic growth decreases. These groups include the regions of such countries as Great Britain, Luxembourg, Ireland, Sweden, Denmark, France, the northern regions of Italy, and Belgium.

Group 3 includes countries with factor-oriented economies, where investments are unproductive and come in small amounts - countries with low growth of GRP and GRP per capita. A large amount of labor becomes unemployed what leads to a deepening shortage of capital and investment. Group 3 countries are Bulgaria, Greece, Romania, Poland, Southern regions of Italy.

Group 4 includes underdeveloped regions of such countries as Bulgaria, Romania, Poland, the Czech Republic, and Latvia. Such regions are growing faster because they are underdeveloped, monopolistic, have macroeconomic problems, problems with institutions, infrastructure, education and health systems, and fundamental problems with the environment and the production of green products in industry. The NUTS classification is defined only for EU Member States. Eurostat, in agreement with the countries concerned, also determines the coding of statistical regions for non-EU countries, but there are: candidate countries waiting to join the EU; potential candidates; countries belonging to the European Free Trade Association (EFTA).
Figure 1. Statistical regions in EU countries, candidate countries and potential candidates according to the latest available bilateral agreements according to NUTS 2019.
Source: Official website of Eurostat [17].

Such countries can potentially include Ukraine (Fig. 1). Note that this methodology is not used in Ukraine, due to the weak development of smart specialization in practice.

The results of the smart specialization spread in the EU regions are the creation of interregional cooperation new forms, what encourages innovation partnerships and environmental clusters to join forces, creating an innovative ecosystem; to modernize European industry. In addition, the European Commission has recognized at the state level the importance of environmental challenges potential unlocking which requires accelerating innovation development for less developed industrial regions. Thus, in the EU, with the help of smart specialization, a pan-European innovation campaign has been launched, almost all European countries are involved in.

The concept of S3 smart specialization, which was launched in the EU, allowed the government to implement a large-scale pan-European innovation policy and involve 19 countries of the European Union (178 EU regions) and 7 countries outside the EU (33 regions) [10]. In particular, the European Commission has identified the priority of involving less developed regions in smart specialization which will accelerate their development and unleash their potential. The active involvement of regions in S3 is a manifestation of their regional cooperation and partnership, as such cooperation allows the exchange of resources and technologies and, as a result, the development of an innovative ecosystem.

In Ukraine, the concept of smart specialization is actively used in practice only by the Ministry of Economy of Ukraine in forming the foundations of a new industrial policy, in particular - in the draft Strategy for the development of Ukraine’s industrial complex until 2025. However, smart specialization is seen only in a narrow sense of the phenomenon: as an EU approach to identifying the unique functions and assets of each country and region, emphasizing the competitive advantages of regional industry, and as an element of decentralization policy. This approach is equated with the development or modernization of industry, rather than a radical, structural realignment of the industry on an innovative basis in the environmental aspect. In Ukraine, the implementation of the smart specialization concept is also reflected in the framework of transnational cooperation and mutual learning S3, by supporting activities for EU neighbors. However, only a few regions have identified key areas of specialization and move to innovative transformation and environmental clusters.
Among the reasons for this situation, due to the low level of communication between central authorities, local government institutions, business in the regions and research institutions are [11]:

- insufficient efficiency of state stimulation mechanisms for the development of the national innovation ecosystem; partnership of private investors, business, science and the state in the process of ecological infrastructure formation (technology development zones; industrial parks; business incubators, eco-clusters) which are effective tools for capitalization of scientific developments and commercialization of innovations;

- weak interaction of science and ecological production in the early stages of innovation and low demand for intellectual property. Only a small part of domestic producers make orders for scientific developments, so in fact researchers are forced to guess the needs of the economy sector. As a result, a significant number of inventions are not commercially available. And companies, in turn, are in no hurry to invest in research, as is the case in developed countries, where science is funded mainly by private business;

- insufficient awareness of access to financial resources, including environmental grants and technical assistance projects in the field of eco-innovation, and weak activity of small and medium-sized businesses in obtaining such funding.

Overcoming these barriers convincingly demonstrates the future advantages of "smart" regions in the economic system (Fig. 2).

Figure 2. Advantages of smart specialization in ensuring regional development.

Regarding the development of regions on the basis of smart specialization in the key of intensifying eco-cluster regional policy, the EU's experience in this segment, which determines competitive advantages, sets strategic priorities and implements intellectual policy to maximize development potential based on knowledge and principles of environmental industries. 10 new industries have been identified in EU cosines:

1. Advanced Packaging.
2. Biopharmaceuticals.
3. Blue Growth Industries.
4. Creative Industries.
5. Digital Industries.
6. Environmental Industries.
7. Green Tourism.
8. Logistics Services.
9. Medical Devices.
10. Digital Technologies.
Environmental industries among other industries have a pervasive impact. They include 20 of the 51 categories in cluster industries. The sphere of ecological industries or "green" economy includes any economic activity that leads to a reduction of ecological pressure on the environment due to human activity. Such economic activity involves obtaining results from improving the efficiency of natural resources and reducing harmful emissions.

Environmental industries produce a wide range of products, services, technologies, production, which are used in various economic sectors. Among the 20 industrial cluster categories that use green technologies in the European panorama of clusters are the sectors of financial services, hospitality and tourism, insurance services, technology and heavy engineering, transport and logistics, production of plastics.

In the clusters of environmental industries of the EU: 8.7 million employees are employed, which is 7.41% of employees in all clusters or 3.47% throughout the economy; there are 71,882 thousand enterprises, which is 6.77% of all cluster enterprises, or 4.14% of all enterprises in the economy; the average wage is 38,466 thousand euros, which is 110.51% of the average wage for all clusters and almost 120% for the whole economy; the average wage is 38,466 thousand euros, which is 110.51% of the average wage for all clusters and almost 120% for the whole economy [2].

In EU countries smart specialization contributes to the transformation of regions into regional environmental clusters and innovation agencies. One of the many examples is the European Commission's project "Greenovate! Europe" that identified clusters as a favorable institutional factor for the development of eco-innovation policy in the EU (Table 1), as well as the practice of implementing environmental innovations not only in environmental industries, but also in traditional industries.

Table 1. Examples of eco-innovations in the terms of environmental industries

| № | Activity | Eco-innovations |
|---|----------|-----------------|
| 1 | Renewable energy sources | Geothermal springs; Solar photovoltaic and solar thermal water heating; Energy of tides; Biomass (electricity and heat generation) |
| 2 | Water use and water purification | Water resources management, infrastructure upgrades; Ensuring efficient water demand, including watermetering and wastewater recirculation; Operational analysis of drinking and contaminated water; Online monitoring networks and automated sensortechnologies; Technologies for restoration of degraded water resources; Disinfection of drinking water and desalination; Wastewater treatment, membranes, sludge reduction |
| 3 | Waste management and disposal | Wastewater and landfills treatment; Highly efficient recovery of energy and chemicals, reuse of gas Disposal of hazardous substances and mercury; Composting and production of biogas from biological waste |
| 4 | Recirculation | Collection, separation and treatment for the reuse or recycling of all materials, including plastics, polymers, tires, accumulators and accumulators, vehicles, ships and aircrafts |
| 5 | Soils | Soil cleaning methods |
| 6 | Environmental monitoring and control | Ecodesign of products and services; Environmental services; Analysis, research and examination of the environment |

Source: compiled by the authors according to [12].
Ukrainian experience in the formation of environmental clusters is concentrated in the agricultural sector of the economy. Cluster policy has not been formed in Ukraine, but a significant part of its elements has been successfully implemented in some international projects. In this context, it is worth paying attention, for example, to the project of the United States Agency for International Development (USAID) "Water for the Agricultural Sector", which was implemented by the Institute for Agricultural Market Development from 2012 to 2017 in Kherson region.

The project design provided a clear definition of the territory within the Kherson region, where the most powerful irrigation system in Europe is concentrated. The irrigation system of the region was in a state of decline and was already associated with significant environmental risks. These are, first of all, the risks of destruction of the fertile layer of soil and muddy groundwater. At the same time, the task was to maintain the ability of local farmers to support profitable agriculture. From the beginning, the project relied on a community of farmers who were directly interested in an efficient and environmentally friendly irrigation system [13, 14].

Modernization of the system could not take place without the support of scientific institutions and local authorities. The stakeholder community, which can be tentatively defined as an ecological agricultural cluster, was united by network arrangements based on a memorandum. The features of the cluster were [15]:

- Clearly defined area based on the irrigation system;
- Community of water and land users who specialize in growing cereals, melons and vegetables;
- A community of national and regional scientists, experts, who had to develop and implement engineering and organizational solutions for the modernization of the irrigation system, ensuring its environmental safety. 5 scientific and expert institutions and about 20 experts were involved;
- Local authorities, which together with the scientist had to form a strategy for the development of land reclamation, to adopt a roadmap of practical measures for its implementation.

First of all, educational and counseling services were set up for the cluster members among the farmers. The training concerned, first of all, ecologically safe water use, observance of requirements of the ecological legislation, use of such technological innovations as drip irrigation [16].

A significant achievement of the cluster project was the joint work on the Strategy for the revival and development of land reclamation in the Kherson region. The most modern methods were used in strategic planning and special attention was paid to consultations with all groups of stakeholders. During the work on the strategy, significant legislative obstacles were identified, especially in the key issue of irrigation system development, formation and involvement of the water and land user community.

4. Conclusions
Regional smart specialization is a holistic system of solutions aimed at increasing the competitiveness of the regional economy through the entrepreneurial choice of regional potential components promising to change the production function based on technological transformations. In addition, it provides structural shifts related to environmental regional diversification in support of "green" innovations in those areas of economic activity that should complement the region's productive assets to increase its potential and form interregional competitive advantages in the future.

Thus, the importance of implementing the concept of smart regions in the formation of environmental clusters for Ukraine is a crucial task, as the regions of Ukraine are integrated into global value chains with broad cooperation and a competitive market, where innovative transformations are constantly taking place. It is equally important that the smart specialization of the regions on the model of the EU will provide the transformational effect necessary for the modernization of industry in the context of the increasing impact of the environmental components.
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