THE IMPACT OF INNOVATION POLICY ON EFFECTIVE REGIONAL DEVELOPMENT

ВЛИЯНИЕ ИННОВАЦИОННОЙ ПОЛИТИКИ НА ЭФФЕКТИВНОЕ РЕГИОНАЛЬНОЕ РАЗВИТИЕ

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Abstract: *The aim of this paper is to analysis the impact of innovation policy on effective regional development in Ukraine. The main goal is to identify the role which innovation policy plays in regional development. We apply hierarchical cluster analysis for comparing the regions of Ukraine in terms of innovative development. Economic and statistical methods used to assess the level of innovative development in Ukraine's regions. The adoption and application of innovation policy measures propose to reduce inequality smoothing and increase competitiveness in Ukraine's regions. Substantiated the development and implementation policies taking into account the innovative components for each individual regions. The proposed regional innovative cluster policy is based on activity coordination, financing and investment attraction within the analyzed regions, and is stimulated innovations' increase in regions.*
Keywords: *innovations, development, input factors of production, innovation policy.*

1. Introduction

The aim of this paper is to analyze the impact of innovation policy on effective regional development in Ukraine. The main goal is to define the basic causes of regional disparities', and the estimation of the role of innovation policy for regional inequalities smoothing. Innovation policy in regions vary by country. Some countries include the crucial role of innovation in regional strategy. Other countries emphasize the role of innovation for economic growth based on regional territorial advantages.

Schumpeter's approach to the technological accumulation and creative destruction is the basic theory of dynamic economic growth explaining the nature of innovation. The concepts of technological accumulation and creative destruction are fundamental in the theory of J. Schumpeter. The author distinguishes investments in R&D from two other common kinds of capital investment, including physical and human capital.

Metcalfe & Ramlogan (2006) consider innovation to be the process of knowledge generation, connecting investment, demand, and structural transformation. Technical progress and the competitive process carried out inseparably, a moreover adaptive evolutionary process coordinated by diverse market structures, changing patterns of economic behavior. Kingston (2017) examines capitalism using the concept of property rights. He explains the historical development of economic cycles of capitalism through the changes of property's forms, especially intellectual property rights. The author emphasizes the creative innovations have been captured by a group of people who wanted mostly to benefit from them. The reduction of wealth generalization and inequality growth contradicts the modern capitalist system's progress.

Antonelli (2017) applies the Schumpeterian creative response by implementing the tools of complexity economics. The consequent introduction of innovations may knock firms further out of equilibrium and cause positive changes in the system's properties that feed the introduction of further innovations and vice versa. The path - dependent loop of interactions between the system properties and individual actions of firms ascertain relationships among knowledge, innovation, technological advancement and economic growth. Aghion et al. (2001) address the product market competition, and imitation good and prove a positive effect on growth. The authors point to complementary roles for competition (antitrust) policy and patent policy.

The application Schumpeterian model for human capital accumulation determines a country's capacity to absorb knowledge and provide its diffusion. After increasing a country's absorption capacity, it starts to be not an imitator, but an innovator who create new knowledge itself.

We apply general scientific and special methods of cognition: structural-logical method – to build the general structure of the research. Content analysis and bibliographic search applied to study of innovation policy in regions based on a theoretical study of national innovation systems and regional policies supporting innovations, the role of policymakers who are making the tough decisions about the future of competitiveness and innovations, and empirical works considering the linkages between R&D, patents, innovations, entrepreneurship, and growth. The comparative analysis used to study and compare forms and methods of innovation development in Ukraine.

We use hierarchical cluster analysis for comparing the regions of Ukraine in terms of innovative development. Economic and statistical methods used to assess the level of innovative development in Ukraine's regions. The comparison of regional competitiveness estimation of 12 Ukraine's regions based on the methodology of the Global Competitiveness Index (GCI) for 2012 and 2018 demonstrates an increase in territorial unevenness and aggravation of socio-economic and political problems in the country.

The graphic method used to visualize estimation calculation results. The application of graph analysis of data of GDP and index of economic freedom for Ukraine 1991-2017 illustrates economic activity decrease in unpredictable world conjuncture, and regional economic and social disparities increase. Scientific generalization justifies the results of an investigation, make conclusions, and propose policy recommendations.

In the first part of the paper, we consider the basic approaches to innovation system and innovation policy, and their forms and methods. Entrepreneurs' innovations considered a factor in the long-term company's growth. The destruction of old company values is the basis for its further modernization. Innovative activity determination based on economic assessment, continuous technological and product rivalry of old with new ones that use to replace them.

In the second part of the paper, we turn our attention to Ukraine's regional economic performance assessment. We estimate the factors influencing the existence of disproportions between the sectors. We define the basic problems of regional development where we show that the lack of capital investments, old capital assets, and the high share of unprofitable enterprises, enterprise's indebtedness, low innovations' level, and insufficient infrastructure level hamper economic upswing. In the third part of the paper, we estimate the results of hierarchical cluster analysis for 27 Ukrainian regions and emphasize such of them, which have high or low innovative potential. The assessment of Ukrainian competitiveness shows the market concentration at the national level and inadequate finance and human capital distribution in regions. The competition is still weaker at the regional level. Concentration has a negative and highly significant effect on labor productivity growth. The financial shortage causes the reduction of the number of enterprises applied the innovations. Applying

Schumpeter's approach to dynamic economic growth, we propose proposals for regional equalizations based on asymmetric innovative development in regions.

2. Review of Related Studies

Most scientists identify the company's innovative activities as the main component of economic growth. Using innovation allows you to adapt to the constant changes in the external environment. Chaminade et al [2018, p.79] examine the innovation system related to economic, social, and environmentally sustainable development. Authors consider innovative policy in regions based on the theoretical study of national innovation systems in globalization, the legal environment, and regional policies supporting innovations. Edler &Fagerberg, J. (2017) focus their research on the definition of innovation policy, theoretical rationales. They consider the innovation policy mechanism and introduce the model designed to identify, analyze, and deepen our understanding of innovation policy, and its application mechanism.

Edler et al (2016) attempt to understand the logic and effects of innovations. The scientists present meta-evaluations for 16 key forms of innovation policy instruments and their complex analysis. They underline the role of policymakers who are making tough decisions about the future of competitiveness and innovations. Granstrand (2018) reviews the connections between R&D, various patents, different kinds of innovations, entrepreneurship, and effects on growth rate. The author concludes proposals for spreading entrepreneurship, innovativeness as a generator for industrial growth in Europe.

Schomberg and Hankins (2018) develop the concept of reasonable innovation and explore the prospects for its further implementation in emerging markets. The authors consider the impacts of investigation through reconnecting science and innovations using the same standards opposite other existed public policies. They argue that responsible innovation needs to be sensitive to local, regional, and specific cultural contexts. The discussion on shared values may well lead to a variety of different requirements for good innovations (Schomberg & Hankins, 2018, p. 6). Fagerberg (2018, p. 16) ascertains that various national factors influenced firms' abilities to benefit from their own technological capabilities. National and firm - level capabilities interact in the process of development. Edler &Fagerberg, J. (2017) focus their research on the definition of innovative policy and theoretical rationales. They consider the innovative policy mechanism, how it designed, implemented, and governed. Eriksson et al (2010) apply the Strategic Niche Management (SNM) approach that designed to facilitate the introduction and diffusion of new technologies through setting up protected experimental settings (niches) in which actors learn about the design, user needs, cultural and political acceptability, and offers suggestions for regional policy.

Polverari [2018, p.10] points out the current paradigm, open innovation, that considers innovation as an open process that takes place in 'innovation ecosystems', 'in which companies, public research institutions, financial institutions, and government bodies interact through the exchange of skills, information, and ideas. The author proposes to exploit synergies between innovations in general and in regions. First, by pulling financial resources from both kinds of policies to fund the same programs, schemes, or projects, and second, strategic alignment. *Pyka et al (2019) introduce an agent-based model that provides a virtual simulation environment for ex-ante evaluation of policy intervention in regional innovation systems. Their findings show that regional learning and knowledge exchange processes tend to be accompanied by pronounced non-linearity. Different policy interventions may affect each other in complex and often-unexpected ways that have far-reaching implications for policymakers.* Bogliacino et

al. (2016) prove that without complementary investments, it will not be possible to fully benefit from the advantages of ICT capital for productivity growth.

Understanding the national innovation system, we define regional policy. Implementation mechanism supports the idea of interdependence and direct effects of innovations into economic sectors, improved synergies in regions, and internationalization of firms increasing cooperation at the international markets (Nosova, 2017, p. 117). The utilization of the existing approaches` results suggests its usage for proposing innovative economic policy for supporting innovations as a component of regional policy.

3. Peculiarities of innovation development in Ukraine

The late and incomplete reforms impede economic development in Ukraine. It creates numerous market distortions and arbitrage opportunities that generated highly concentrated rents for powerful special interest groups. The modern spatial development of Ukraine characterizes by such main transformational tendencies as:

- strengthening interregional socio-economic differentiation;
- combination processes of interstate interregional integration and disintegration;
- transition from downturn to economic growth with significant regional peculiarities.

Disproportionate regional development negatively affects a country's growth. It should be noted an increase in disproportions between regions in many indicators, both economic and social in Ukraine's regions in transition (Nosova, 2017, p. 90)).

The period from 2009-2015 characterizes by financial and economic instability that discourage capital formation, and could be seen in the falling apart of the curves GDP and index of economic freedom (See Figure 1).

GDP shrank by 16% in the two-year period from early 2014 to late 2015, while inflation surged, reaching a peak of 61% in April 2015, the exchange rate weakened, and the terms of trade deteriorated. The crisis of 2014-15 emphasized a number of institutions inherent in the Ukrainian economy (OECD, 2018). The dramatic depreciation of the hryvnia had a devastating effect on the balance sheet of enterprises. Following the latest updates of the overall situation in Ukraine, that country has overcome the heavy crisis caused by armed conflict in the eastern part of the country. At the same time, a 200 per cent devaluation of Ukrainian national currency (hryvnia) in 2014-2015 made Ukrainian goods and services cheaper and more competitive.
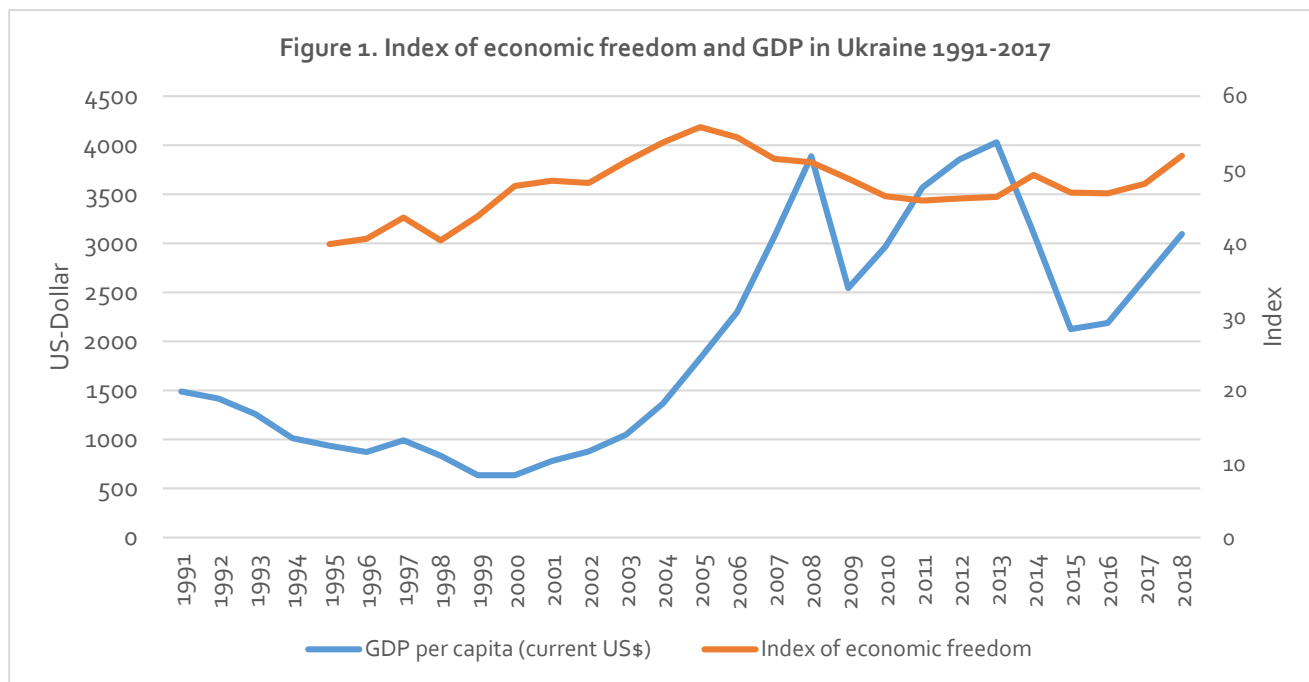
Fig. no. 1. Index of economic freedom and GDP in Ukraine in 1997-2017
Source: Authors' own projection with Excel

In 2016, for the first time since 2010, the economy grew more than 2 %. Ukraine's GDP amounted to approximately 93.26 billion U.S. dollars in 2016. The analysis of Ukrainian macroeconomic data GDP per capita in 2017 depicts on the tendency of industrial production shortage in heavy industry, including metallurgy and coal-mining industry. It explains through the high production costs, inefficient labor organization, and undeveloped infrastructure. The share of R&D expenditures in GDP dropped at all times the low level of 0.48 % in 2016 from 1 % a decade ago. The share of innovative enterprises in industry rose from a minimum level of 10 % to approximately 15-17%. At the same time, expenditure on innovation activities dropped substantially in 2014-2015 in comparison with previous years (Electronic Yearbook on Statistics, 2017). The level of innovation activities remains at low levels in comparison to the neighboring countries in Central and Eastern Europe. Global Competitiveness Report published by the World Economic Forum in 2019, and covered 141 economies. The Global Competitiveness Index measures national competitiveness – defined as the set of institutions, policies, and factors that determine the level of productivity. Competitiveness Index in Ukraine averaged 16.02 points from 2007 and a record low of 3.90 points in 2011. Ukraine scored 57 points out of 100 in 2019. (The Global Competitiveness Report 2019). The report shows various spheres in which Ukraine's competitiveness has dropped. Economic stability has fallen in two places.

The estimation results of index Component Innovation Capability of Global Competitiveness Index for Ukraine in 2019 demonstrate the tendency of decreasing the portion R&D expenditures to GDP from 1,1 % in 1998 to 0,4 % in 2019 (See Table 1).

Table no. 1. Index component innovation capability of
global competitiveness index for Ukraine in 2019

№	Index Component	Value	Score	Rank	Best performer
	Research and Development 0-100	-	31.1	59	Japan
12.05	Scientific publications score	229.3	80.6	50	United Kingdom
12.06	Patent applications per million pop.	1.56	17.3	62	Sweden
12.07	R&D expenditures % GDP	0.4	15.0	67	Germany
12.08	Research institutions prominence 0-100 (best)	0.04	11.8	44	Germany

Source. Authors' own projection constructed on the data "The Global Competitiveness Report 2019", p. 573.

The analysis of the other index components for innovation capability displays low values comparing to world indicators, which demonstrates the need to increase the volume of R&D spending in Ukraine and stimulate generation of economic growth. The deteriorated domestic and external demand affects the output decrease in the major sectors of the Ukrainian economy. It reflected in decreasing the tendency of the volume of industrial production, fixed capital investment, exports and imports of goods and services. Because of uncertainty and high country risks, the consumer price index is increased. The current account and financial account deficits covered by the interventions of the National Bank of Ukraine.

Following the tendency, it should be mentioned that the present stage of economic development characterized by the growing role of regions as economic agents and participants at the international division of labor. Regional development significantly infuses and determines the pace of the country's growth.

The regional development illustrates an increase in territorial unevenness and aggravation of socio-economic and political problems in the country. Gross regional product (GRP) per capita is the most significant index characterizing the regional potential for producing goods and services. Innovation activities in countries behind the technology frontier, such as Ukraine, focus mainly on the adaptation of machinery, equipment, and software (Majcen et al, 2009). The estimation results point out the lower level divergence in terms of GRP per capita. Hanouz, et al (2008) make a conclusion that the degree of economic divergence between Ukrainian regions is moderate compared to other countries.

The innovation cost includes current and capital costs incurred by enterprises to innovate. The amount of expenditures of innovation of industrial enterprises by innovation activity direction shows the asymmetry in distribution and high value in Kyiv, Kharkiv, Dnepropetrovsk, Odesa, Zaporizhzhia, and the rest with low innovation costs in 2019. Internal R&D, external R&D, acquisition of machinery, equipment and software security, other outside knowledge, and other expenses (including design, training, marketing, advertising, and other relevant activities) demonstrate the same tendency. The biggest number of innovative efficient industrial enterprises 119 situates in the Kharkiv region.

The analysis of the economic assessment of Ukrainian competitiveness shows the market concentration at the national level and the high degree between regional markets. The competition is still weaker at the regional level. Concentration has a negative and highly significant effect on labor productivity growth (2019 Index of Economic Freedom, 2019). Ukraine ranked 71 among 190 economies in the ease of doing business, according to the latest World Bank annual ratings. The rank of Ukraine improved to 71 in 2018 from 76 in 2017. Ease of Doing Business in Ukraine averaged 112.36 from 2008 until 2018, reaching an all-time high of 152 in 2011 and a record low of 71 in 2018 (Ease of Doing Business in Ukraine, 2019).

Estimation of the data for science, technology, and innovation in Ukraine shows that in terms of innovation activity, the state of high-tech products' production, the volume of science investigations, the infrastructure entrepreneurship development of Ukraine is far behind the leading countries in the world. Following the research, the approach focuses our attention on the complex character and comprehension of diverse factors influencing regional economic development. In order to activate the innovation process in the country, it should be considered the driving force of scientific, technological, and economic activity as a breakthrough to higher efficiency, productivity, competitiveness, and better quality of products.

4. Methodology research

We analyze the results of hierarchical cluster analysis for Ukrainian regions from 2009 to 2013. The data of the State Statistics Service of Ukraine used for assessment Gross Regional Product from variables defining regional development for 27 Ukrainian regions (Statistical Publication. Regions of Ukraine, 2019).

Hierarchical cluster analysis identifies and organizes data object structures into clusters. It identifies homogenous groups of cases of unknown groups of estimation. Considering the regional innovation development, we apply hierarchical clustering analysis of Gross Regional Product (GRP) from the employment, industrial production index, fixed capital investment index, the number of organizations, conducting scientific research, the total value of innovating costs per one thousand employed workers, and foreign direct investment (FDI). The hierarchical clustering analysis uses the SPSS Statistics program. The application Ward's method calculates the simple Euclidean distances from each case in a cluster to the mean of all variables. We assume that GRP is associated with total industrial production in Ukraine's regions. Employment defines labor in the region. The industrial production index, fixed capital, investment index determine regional capital. The number of organizations, conducting scientific research, total value of innovate costs per one thousand employed workers and FDI in region denote total factor productivity.

4.1. Research hypothesis

We test the following hypothesis: the dependence of regional cluster classification on the input factors of production combination in regions in Ukraine. We assess calculated distances between the most developed regions and the least undeveloped regions in hierarchical clustering. We estimate the single linkage criteria, showing the distance between the closest neighboring points. The estimation results outline that the Kyiv distinguished from other regions. Capital Kyiv considered an outlier from other Ukrainian regions for all estimated periods with the biggest share of GRP.

The strong specialization by regions producing specific kinds of heavy industry products caused division between highly industrialized developed regions with high urbanization and 'less developed' rural regions with agrarian orientation in Ukraine. The centralized industrial organization and the inefficient regional structure formation resulted in the disproportionate regional division in the former Soviet Union.

Growth in incomes during the decade before the crisis was driven by favorable prices for commodity exports (particularly steel and chemicals) rather than much-needed improvements in productivity and competitiveness (OECD, 2013). Consistent delays in implementing structural reforms and recurrent political instability left the economy stuck in transition and overly exposed to external shocks. The external position also strengthened, with the current account deficit falling from 9.2% of GDP in 2013 to 3.6% in 2016. Gross reserves remain low but have doubled to USD 15 billion.

Low demand and liquidity problems remained the major impediments for business development for Ukrainian industrial enterprises in 2013. Other important barriers to development were excessive taxation (which includes tax rates and tax administration) and unfavorable regulatory climate. Enterprise managers assessed the investment climate in 2013 as unfavorable. The share of the enterprises that considered the year 2013 to be "unfavorable for the purchase of equipment", the indicator that measures investment environment, increased by 13.9 % to 71% in 2013. According to the results of the survey conducted in the 1st quarter of 2014, among major obstacles that hampered investment activity of companies in 2013 were insufficient income value (45.5%), unstable political situation (34%), and high cost of capital (28.7%) (Innovation support measures currently in place in Ukraine, 2017).

4.2. Model specification

The Gross Regional Product estimation interdependence from variables of the employment (thousand people), industrial production index (%), fixed capital investment index (%), the number of organizations, conducting scientific research (number), the total value of innovating costs per one thousand employees (%) and FDI (UAH) strengthens the dependence of regional cluster classification on the input factors of production combination in Ukrainian regions.

The present structure does not consider the geographical location, the economic endowment, and regional specificity. The graphical analysis of the line of the significant coefficients Ward's method proves the basic three clusters determination. The three clusters differ in particular regard to the levels of industrial development and scientific potential. It should be noted the increase of heterogeneity with every step of econometric analysis. A hierarchical clustering model of 27 regions graphically represented at the dendrogram of regional cluster c classification on the input factors of production combination in regions for 2013. Classification on the input factors of production combination in regions demonstrates that each region has various distributions. The estimation results demonstrate the predominance of the Kyiv region in the analysis comparing to other regions, and indicate their insignificant role in regional development. In order to define the role of the rest regions we exclude the Kyiv region from the sample and analyze 26 regions.

Hierarchical cluster analysis usage for 26 Ukrainian regions in 2013 demonstrates the presence of significant differences in the level of economic, scientific potentials, and confirms the low convergence between three clusters. The sufficient industrial and scientific endowment inheritance creates opportunities to exploit potentials and to improve position in cluster 2 in the rest regions.

The first cluster shows relatively higher than average level of economic estimation in comparison with two others. It distinguishes via the biggest industrial production concentration, the attraction of the significant financial flows of capital, the highest innovation capacity within regions, and more than average per capita income in comparison to Ukraine. The real GDP index decreases, inflation (consumer price index), public debt, unemployment rate increases in 2013.

The current account balance was negative. The business activity decreases, macroeconomic instability and insufficient quality of institutions constitute a major impediment to Ukraine's regional economic performance as reflected in the regional indicators for 2013 (Institute for Economic Research and Policy Consulting Report, 2013).

It is evident that the first cluster includes Kharkiv, Dnepropetrovsk and Donetsk regions (See Figure 2). The first cluster has the biggest industrial production concentration, the highest innovation capacity within regions, more than average per capita income, and attracts the significant financial flows of capital in Ukraine. Kharkiv, Dnepropetrovsk and Donetsk regions show the best performing

capital, labor, R&D capacities in the country. The cluster 2 includes the main regions Autonomous Republic Crimea, Zaporizhzhia, Kyivskay, Lviv, Odessa, Luhansk, and Mykolaiv. The last cluster 3 involves the rest regions, some of which are specialized on agrarian production. Cluster mobility shows the low spread in economic development between regions.
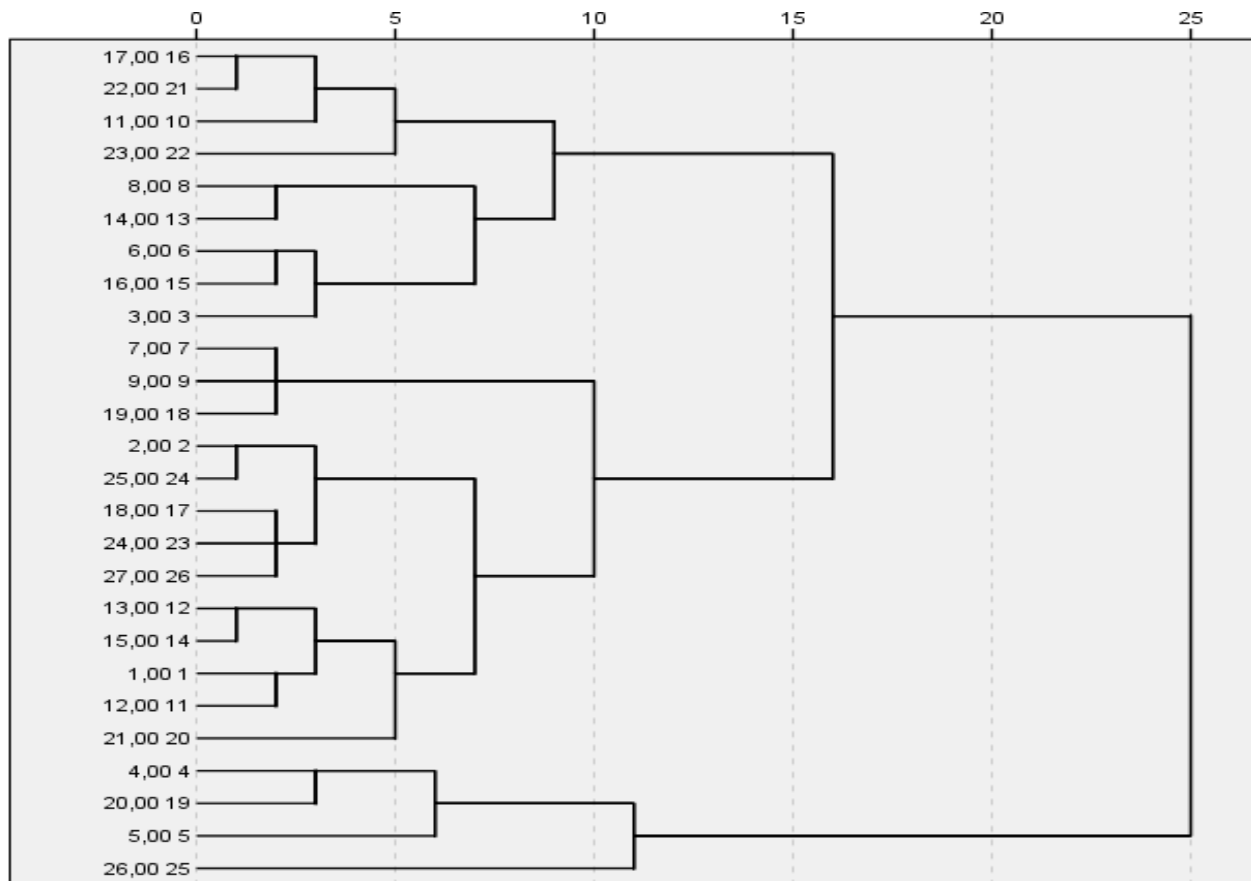
Dendrogram uses an averagee Linkage ((between groups)
Combination of scaled distance clusters
Fig. no. 2. Dendrogram of regional cluster classification on the input factors of production combination in regions
Source: authors own calculation with SPSS

The estimation results prove a necessity to apply effective regional policy at the state level of innovative development. Strategic tasks of the regional policy in Ukraine: increasing the competitiveness of the regions and strengthening their resource potential; ensuring the development of human resources; determination of spheres innovative breakthrough, development of inter-regional cooperation; creation of institutional conditions for regional development.

Further estimations tree of unification Ukrainian regions in the clusters by the method of single communication using features of the logarithmic scale demonstrates domination the predominance of industrial regions. The variables number of enterprises that introduced innovations, costs of technological innovations, new technological products, low waste; resource-saving, waste -free processes applied for assessment 26 regions in 2014 in Ukraine. The concentration of the bulk R&D resources in Kyiv, Kharkiv, Dnepropetrovsk, and Donetsk causes the necessity of financial redistribution and scientific resources among regions for equalization of its regional gross regional product per capita growth.

The choice and construction of the model of hierarchical cluster analysis suggest the assessment of the economic variables, estimation of the significant coefficients, and determination of some of the basic factors of innovation policy. The solution of the specific research task indicates the problem of availability statistical information, methods of estimation, and receiving results. The increased period of investigation and inclusion of additional variables for estimation will provide a detailed analysis of regional development in Ukraine.

The results of the study confirm the feasibility of applying this approach to assess regional innovation potential. Providing access to the results of hierarchical cluster analysis offers an insightful assessment of innovation policy practice and its evaluation for Ukraine's regions. Following our approach, we consider that regional policy should take into account the innovation component for each individual region.

The innovative breakthrough in regional development considers the active state policy, building up administrative capacity at local and regional levels, comprehensive regulatory support of an innovative activity, and formation favorable institutional environment. The regional authority's function is to elaborate and realize inter - cluster projects, and support of new ideas and experience. The organization attractive innovation policy for innovative cluster development based on coordination activities, financing, and attracting investment will stimulate innovations' increase in regions. The aim of the regional authorities is to elaborate, implement inter-cluster innovative projects, and support the exchange of experience and new ideas.

CONCLUSION

The regional economic policy implementation provides a necessity for paying attention to the innovative component. Cluster analysis confirms the asymmetric distribution of input factors of production in Ukrainian regions. The balanced regional policy stimulates equalization gross regional product per capita. Clusters' creation in the form of technopark is the strategy for innovative development in the regions. The mechanisms for technoparks implementation consider based on zones with attractive innovation climate. The favorable law legislation, tax exemptions, access to financial resources, availability of office production infrastructure, telecommunications, conditions for comfortable living standards are vivid components of analyzed mechanism.

In the process of hierarchical cluster application, it should be noted the crucial role of forms of private - public partnership. The state is responsible for legal initiatives in providing policy for innovative environment formation. Entrepreneurship development plays a crucial role in disseminating innovative ideas and implementing innovative projects.

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