

The Innovation Component in Regional Policy

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Abstract

The paper analyses the impact of innovations on stimulating regional development. The main goal is to identify the effect of innovations on reducing the asymmetry of regional development. The study the innovative concepts emphasize the importance of understanding the link between innovations and their implementation via the regional policy mechanism. The utilization of the existing approach results suggests its use of innovative component of regional policy for stimulating equalization GRP per capita in regions and smoothing disproportions.

We test the following hypothesis: the level of development of the region significantly depends on the innovation component. We assess a research model of hierarchical cluster analysis. The innovative component affects decreasing asymmetry in regional development. The proposed model offers a comprehensive set of alternative methods stimulating value creation in regions.

Stimulating spending in the innovation sphere will contribute to the growth of employment, rise income per capita, increase the competitiveness, tax revenues, and promote infrastructure development.

The proposed regional policy includes tax regulation, innovation policy, limited subsidies, and tax allowances, the top-priority investment in R&D, education, informational network.

Keywords: development, innovative component, innovation policy, regions.



1. Introduction

Innovation policy in regions varies by country. Some countries stress the crucial role of innovation in regional strategy. Other countries emphasize the role of innovation for economic growth based on regional territorial advantages. The main goal is to study how the level of innovative development affects regional asymmetries and stimulates equalization of gross regional product per capita. The main tasks to analyse the basic approaches to assessing the impact of innovation on the development of regions, consider the types of innovation policy, and assess the functioning model of regional development in Ukraine.

Innovation policy in regions differs in countries. Some scientists define its crucial role in innovation for regional strategy. Another group of scientists emphasizes the role of innovations for economic growth based on regional territorial advantages. Depending on the forms, methods and means used, regional policy can stimulate the development of regions or, on the contrary, act as a brake on progress on them.

Antonelli (2017) uses 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. Almudi & Fatas-Villafranco (2019) use the Neo-Schumpeterian concept of sectoral systems of innovation to reflect on the uneven sectoral patterns and analyse the interaction between technological factors, income growth, and distinct income elasticities of sectoral demand. They estimate the multisector modeling results that economic growth depends on sectoral innovation and demand – side fundamentals.

Applying the dynamic economic growth concept, we assess a research model of hierarchical cluster analysis model, defining the innovative component application for overcoming asymmetric innovative development in the regions. The assessment of the causes of regional disparities, imbalances, and special regional policy use based on the regional development level stimulate equalization of gross regional product per capita.

2. Literature Review

Literature review shows the widespread approach to innovations stimulating creation, diffusion, and use of scientific knowledge in the companies and research organizations. The study the innovations, the creative innovations, the concept of reasonable innovation, innovation system, innovation policy, the complementary theory of competition and patent policy emphasize the importance of understanding the link between innovations and their implementation via the regional policy mechanism.

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. Metcalfe & Ramlogan (2006) consider innovation as 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 forms, especially intellectual property rights. The author tackles the problem of the creative innovations that 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.

Cook & Memedovic (2003) argue that global economic forces have raised the profile of regions and regional governance not least because of the rise to prominence of regional and local business clusters as vehicles for global and national economic competitiveness. The regional innovation systems are dependent on public support. A combination of public and private governance at the regional level to promote systemic innovation is advocated.

Kristensen et. al. (2019) explores the congruence between place-based development and regional competitiveness in the EU context. The authors highlight the complexity of regional transformation processes, aiming to enhance the applicability and transferability of theoretical approaches to innovation and place-based regional development in diverse European territorial settings. The less-favoured regions and the application of Smart Specialisation are a strategic approach to innovation-based regional development.

Asheim et. al. (2011) relates to the central role of knowledge and learning in clusters and regional innovation systems and in particular to the role and functioning of the labour market. Aghion et al. (2001) address the product market competition, and imitation good and prove a positive effect on growth. The authors point to the complementary roles for competition (antitrust) policy and patent policy.

The understanding of the link between knowledge spillovers, entrepreneurship and regional growth, the use of synergies between innovations in general and in the regions, policy intervention in regional innovation systems explains the nature of the regional development.

The theories of high technological level in regions and the system coordination, territorial innovation models and interactive models of innovation process (Gust-Bardon, 2021) addresses the questions regarding complexity, dynamism, versatility of solving the problems of policy coordination in the region regarding to the use of innovative component in the development.

Huggins & Thompson (2015) draw upon aspects of endogenous growth theory and the knowledge spillover theory of entrepreneurship. They propose that the nature of the networks formed by entrepreneurial firms is a key determinant of regional growth differentials. In particular, network capital, in the form of investments in strategic relations to gain access to knowledge, is considered to mediate the relationship between entrepreneurship and innovation-based regional growth. The scientists argue that network dynamics should be further incorporated into theories concerning the link between knowledge spillovers, entrepreneurship and regional growth.

The majority of 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. The 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 (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.

Zabala-Iturriagoitia et al. (2007) present study results that show the higher the technological level of a region, the greater is the need for system coordination. Where this is lacking there is a loss of performance efficiency compared with other similar regions. Policy-making in relation to Regional Innovation Systems (RIS) depended in the past on systemic analysis. The proposed methodology combines quantitative and qualitative analyses to enrich the knowledge base for future policy decision-making.

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, innovation as a generator for industrial growth in Europe.

Schomberg & 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 innovation policy mechanism and introduce the model designed to identify, analyze, deepen our understanding of innovation policy, and its application mechanism.

Eriksson et al. (2010) apply the Strategic Niche Management (SNM) approach that's 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 the regions. First, by using 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.

Gust-Bardon (2021) focuses on the main forces enabling regions to enhance their innovative performance. They are innovative interactions as a result of networking both among regional actors and between regional and external actors; science, public and private actors cooperating with each other; monitoring of the external environment to draw from the experience, knowledge and skills of others; sharing with own knowledge, ideas and experiences with other companies, regions etc.

The literature review reveals a guiding framework for understanding the determinants of regional development from innovations. The national innovation system setting define regional policy. The goal of the national policy to achieve maximum growth for the regions and the entire country. Implementation mechanism supports the idea of interdependence and direct effects of innovations into economic sectors, improved synergies in the regions, and internationalization of firms increasing cooperation at the international markets (Nosova, 2017, p. 117). The utilization of the existing approach results suggests its use of innovative component of regional policy for stimulating equalization GRP per capita in regions and smoothing disproportions.

2.1. Innovations as Economic Development Driver

This section is devoted to discussing (1) innovations as a driver economic development and economic growth, (2) innovation system, (3) innovation policy mechanism. 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.

2.2. Concept of Innovation Policy

Ukraine's policy has priority tasks reflecting solution uneven development of regions, restructuring of rural areas, and nature restoration. Capello et al. (2011, p. 305) discover regional policy as a competition among global players, combining the rich, central regions and poor periphery ones in countries. The prospects for priorities and directions of innovative development require increased positions in the international division of labor in a specific region and focus on investment in R&D, learning process, and innovations. Gonzalez-Lopez & Asheim (2020) assess empirical results of interdependence regions and innovation policies. They propose the strategies and define the role of European Union institutions responsible for the promotion diffusion innovation. In order to facilitate Ukrainian development, it should be noted that defining and taking advantage of the specific region, determining basic spheres of investment, and inclusion innovation components in regional policy are basic directions for ensuring, and accelerating economic growth in regions.

The new law 'On innovation activity of technological parks'; has to determine the forms of public-private partnership (PPP) in the innovation sphere (clusters, technological platforms, startups). The deep literature analysis confirms our understanding of interdependence innovation, strategy, political and innovation institutions, responsible for forecasting

economic, scientific, technical, and informational functions. The study of various scientific works, gives an empirical evidence that spreading innovations enhance advancement technologies and economic growth.

Polverari (2018, p. 12) presents models of innovation process which focus on linear models, interactive models, network models, open innovations models. Barjak (2001) uses cluster analysis to construct regional models for East Germany and Poland using economic indicators. The author receives empirical results that the most capable regions are those with or near the largest agglomerations in both countries. The author suggests two regional types: rural regions peripheral to the agglomerations and old industrialized regions. The innovative policy in regions based on the theoretical study of national innovation systems and regional policies supports the policymakers who are making tough decisions about the future of competitiveness and innovations. Sukhanova (2015, p.98) proposes the complex innovative model. She includes territorial innovative clusters in it. Such a model reflects the connection socio-economic structures of regions with global economy. The interaction between elements of an innovative system stimulates the circulation information and accelerate new knowledge creation.

The innovative development in Ukrainian regions continues to be constrained by high innovative costs, lack of state financing, absence of business partners, low demand for innovative products, absence of information for technologies, and qualified personal.

Assessment of the integral index for small business development in the region demonstrated that in 2010 seven regions in Ukraine had the lowest values comparing the national average level. In 2017, only six regions had an index below average, and only three regions had the value higher the national level 10 %. It confirms the asymmetry deepening, differentiated impact of small business at the regional level. In 2017, 14% of enterprises in the total economy were located in the capital city Kyiv, employing 24% of the workforce. It should be noted, that 11% of all individual enterprises were in Kyiv, and 25% of all legal entities. The latter employed 30% of the workforce and generated 40% of the turnover in the total economy of Ukraine (OECD, 2018). The major part of the number of enterprises by legal form concentrates in Kharkiv, Dnipropetrovsk, and Odesa regions. The small business indicators' evaluation at the regional level shows widening imbalances in economic development that strengthens the predominant effect and demonstrates differential character for regions.

2.3. 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. Social and economic differentiation, combination processes of interregional integration and disintegration, significant regional peculiarities are the typical tendencies of development. Disproportional regional development negatively affects the economic growth. It should be noted an increase in imbalances between regions in economic and social indicators, both in Ukrainian regions (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.



Figure 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. The strong specialization by regions producing specific kinds of heavy industrial products caused division between highly industrialized developed regions with a 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 largely 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. The value of gross reserves remains low, but it has doubled to 15 billion USD.

Low demand and liquidity problems remained the major impediments for business development of Ukrainian industrial enterprises. Other important barriers to development were excessive taxation (which includes tax rates and tax administration) and unfavourable regulatory climate. Enterprise managers assessed the investment climate as unfavourable. The share of the enterprises that considered the year 2017 to be “unfavourable for the purchase of equipment”, the indicator that measures investment environment, increased by 13.9 % to 71%. According to the results of the survey, among the major obstacles that hampered companies’ investment activity 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). It explains through the high production costs, inefficient labour 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 1. Index component innovation capability of global competitiveness index for Ukraine in 2019

No	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. Due to 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 mentioned 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 innovation expenditures 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.

3 Research Framework

We use hierarchical cluster analysis for comparing the regions of Ukraine in terms of innovative development. Hierarchical cluster analysis identifies and organizes data object structures into clusters. It classifies homogenous groups of cases of unknown groups of estimation. Statistical analysis was carried out with the use STATISTICA program. Ward's method is a criterion applied in hierarchical cluster analysis. This program uses a general agglomerative hierarchical clustering procedure, where the criterion for choosing the pair of clusters to merge at each step is based on the optimal value of an objective function (Murtagh & Legendre, 2011).

We assume that Gross Regional Product (GRP) is associated with total production in the region. We use annual data of economic performance from 2015 to 2017 for 24 Ukrainian regions. In detail the following variables are available and are considered where index i runs over all 24 regions, and index t over all time periods considered (years).¹

The Gross Regional Product (GRP) per capita at market prices is defined as the sum of gross value added of all economic activities at basic prices, including net taxes on products. GRP is independent from the following variables. We estimate the following equation 1 in the hierarchical cluster analysis for 24 Ukrainian regions in 2015 to 2017. We assess how GRP depends on innovation indices.

$$GRP_{it} = F(NE_{it}, NEI_{it}, ICIE_{it}, VIPS_{it}, CTI_{it}, NTP_{it}, NANT_{it}), \quad (1)$$

where GRP_{it} – real gross regional product per capita (UAH);

NE_{it} - the number of employees engaged in R&D (quantity);

NEI_{it} - the number of enterprises implementing innovations (quantity);

$ICIE_{it}$ - the innovation costs of industrial enterprises engaged in innovation activity (thousand UAH);

$VIPS_{it}$ - the volume of innovation products sales (quantity);

CTI_{it} - costs of technological innovations (UAH);

NTP_{it} - new technological products (goods and service) (quantity),

$NANT_{it}$ - the number of applied new technological products in the enterprise's production) in the Ukrainian regions (quantity).

The indicated period has been chosen due to the full set of data. The use of cluster analysis allows us to build a dendrogram that forms the structure of the clusters. In the formation of clusters, the division is performed in accordance with the specified line. We assess calculating distances between the most developed regions and the undeveloped regions in hierarchical

¹ The data for 2015 – 2017 see Statistical Publication Regions of Ukraine 2019. Part1, Part 2. Kyiv, 2019.

clustering. In the structure of clusters, the division is made from left estimating regions to the right, depending on socio-economic, innovative and other factors. We estimate the single linkage criteria, showing the distance between the closest neighboring points.

3.1. Research Hypothesis

We test the following hypothesis: the level of development of the region significantly depends on the innovation component. GRP is generalized indicator of regional development. In case we define that GRP depends on the innovation component, we can make conclusion that innovative component effects regional development and smooth disproportions.

Under the innovation component, we will consider the general indicator of the innovative development of region, determined by a set of indicators for assessing innovation. The equalization GDP per capita in regions will stimulate to decrease regional asymmetry. The present structure does not consider the geographical location, the economic endowment, and regional specificity.

3.2. Modeling regional development: problems and options

The application Ward's method calculates the simple Euclidean distances from each case in a cluster to the mean of all variables. The graphical analysis of the line of the significant coefficients Ward's method proves the basic three clusters determination. The estimation results could be seen in figure 1. Classification of the macroeconomic factors' combination in regions demonstrates that each region has various distributions. The three clusters differ in particular in regard to the levels of industrial development and scientific potential. One could mention the increase of heterogeneity with every step of econometric analysis. A hierarchical clustering model of 24 regions is graphically represented at the dendrogram (Figure 1).

The assessment results of innovation indicators demonstrates the predominance of the Kharkiv and Donezk region in the first cluster. These regions have the highest innovation capacity compared to other items in the cluster classification. Zaporizhya, Dnipropetrovsk, Sumy, Kirovohrad, Mykolaiv refers to the regions with higher average industrial and scientific potential. The first cluster distinguishes via the biggest industrial production concentration, the attraction of the significant financial flows of capital, and high per capita income in comparison to Ukraine. Lviv, Kyiv, Poltava, Odesa, Chernigiv occupy the second cluster position. The rest of the region forms the third cluster with low innovation potential. The regional content of the 2 and 3 clusters are shown as unstable and changeable for all estimation periods. The sufficient economic and technical endowment inheritance creates opportunities to exploit potentials and to improve position in cluster 2 in the rest regions. The estimation results indicate the significant role cluster 1 in regional development.

The lack of R&D financing and low efficiency of innovative activity explain a decrease in the share of realized innovative products in the total volume of industrial production in Ukraine made up 5 % in 2017. This tendency reduces efficient development, leads to the import dependence of high-tech products and technologies.

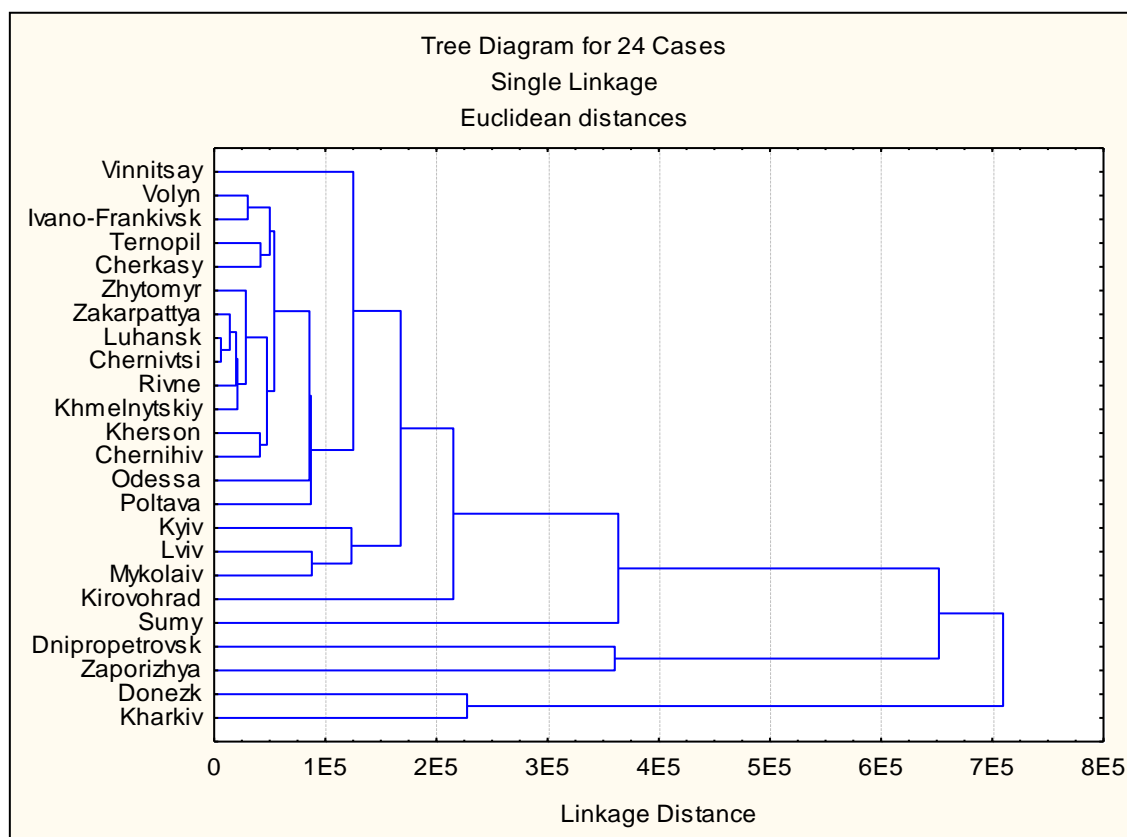


Figure 2. Dendrogram of Ward's Method 2017 classification of the innovation indicators in regions.

Source: Authors' estimations.

The concentration of the bulk R&D resources in Kyiv, Kharkiv, Dnipropetrovsk, and Donetsk causes the necessity of financial and scientific redistribution resources among regions for equalization of its regional gross product per capita growth.

The modeling results prove a necessity to apply effective regional policy at the state level for innovative development. Strategic tasks of the regional policy in Ukraine are 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, and creation of favorable business conditions for regional development.

The results of the study confirm the feasibility of applying this approach to assess regional development with the use innovative component. Following our approach, we consider that regional policy should take into account the innovation component for each individual region. The sufficient innovation policy in regions aims to decrease the asymmetry in development.

The sufficient economic potential in cluster 2 creates opportunities to improve position. The regional policy for regions in cluster 3 have to be concentrated on promotion the growth of backward regions through subsidies, tax allowances, and foreign capital attraction.

The regional policy identification suggests discovering the measures for inequality reduction, foreign capital attractiveness increase, and economic growth stimulation. The regional imbalances cause the need for redistribution mechanism application for financing the depressed regions with low GRP and income per capita. The fiscal equalization provides smoothing income inequality in regions.

The determination of the regions, which are oriented on priority innovation development, will be directed to stimulate economic growth and smooth out regional imbalances and inequalities.

The innovative breakthrough in regional development considers the active state policy, building up administrative capacity at local and regional levels, comprehensive regulatory support of innovative activity, and formation favorable institutional environment. The results of the study shows that the level of development of region depends on the innovation component. Stimulating spending in innovation sphere will contribute to the growth of employment, rise income per capita, increase the competitiveness, tax revenues, and promote infrastructure development.

The choice and construction of the future model analysis need to increase sample size and estimation period. The inclusion new variables suggests assessing the impact determination of other factors. The solution of the specific research task of equalization GRP per capita in regions indicates the problem of availability statistical information, methods of estimation, and receiving results. The increased period of investigation and inclusion of additional estimation variables will provide a detailed analysis of regional development in Ukraine.

4. Result and discussion

The obtained results highlight that the effectiveness of regional policy depends on the degree of implementation of the innovation component in the region.

The assessment of regional indicators taking into account macroeconomic and innovation data confirms the need for a differentiated approach based on the economic and innovative levels. Stimulating the regional development policy provides financial and economic assistance to backward regions. The most effective instruments for the regional development turned out to be a system of investment incentives: subsidies, loans, selective assistance, and the provision of preferences.

The implementation of the regional economic policy provides a need for paying attention to regional authorities to the innovative component in it. The role of the regional authorities is to create incentives for innovative development for SMEs and support the exchange of experience and new ideas.

The state should provide the tax regulation, innovation policy, limited subsidies, and tax allowances. The top-priority investment in R&D, education, informational network improvement in cluster 2 can be the basis for regional development.

The production diversification, elimination unprofitable state enterprises, investment in R&D and in human capital aim to increase GRP per capita to the average level in regions in cluster 3.

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