1.3. Geographical aspects of dynamics of the industrial enterprises innovative activity of Ukraine during 2007-2017

A deepening of the globalization processes and the emergence of the world economy are characterizing world economic development. Today the production of industrial goods crosses national borders. In response to the challenges posed by this global economic trend, Ukraine's industry faced with a choice: to stay with low-tech and labor-intensive industries, which during the specialization and geographical fragmentation of the world economy usually transferred to the territory of underdevelopment countries, which may lead to deindustrialization [6, 12], or step up innovation in industry. The second way is considered [1-5, 14] to be the most effective means of increasing the competitiveness of industrial enterprises and including them into a global value chains on more profitable basis.

Innovative activity of industrial enterprises of Ukraine. The situation with innovation in industry for a long time remains difficult, not least because in Ukraine maintains a gap between the political and economic statements and their implementation. Until now, innovation activity is not perceived by industrial enterprises as the main way to create competitive advantages for profit. I. Yu. Pidoricheva [11] believes that this is a natural tendency, taking into account the peculiarities of the economic system of Ukraine, focused on the subordination of economic transformation policy of the country not to national interests, but the benefits of a narrow circle of economic entities that are close to authority. The weakness of the economy and totality of the negative economic conditions prevailing (massive corruption, bureaucracy, the prosperity of corporate raid, a powerful system of kickbacks as one of the elements of shadow economy) are the factors reducing the interest of industrial managers to innovations [11, p. 61].

In 2017, 759 enterprises were engaged of innovative activities in industry, which is only 16.2% of the industrial enterprises surveyed [10]. It is significantly below the minimum 25% threshold [13, p. 125]. Over the past 10 years (Fig. 1), these percentages ranged from 12.8% (2009) to 18.9% (2016) that indicates a long stagnation of the industrial enterprises innovative activity in Ukraine. Moreover, even among the so-called "innovatively active" industrial enterprises, not all were engaged in the production of innovations. Thus, in 2017, only 88.5% of all innovatively active companies introduced innovations (or 14.3% of all surveyed industrial enterprises). During this year they introduced 2,387 types of innovative products, of which a smaller part – 477 were new for the market, and the majority – 1,910 types became new only for the enterprises.

In terms of economic activities that were most innovative, the production of basic pharmaceutical products and pharmaceutical preparations should be mentioned – 53.8%, production of vehicles (except for motor vehicles, trailers and semi-trailers) – 37.1%, computers, electronic and optical products – 34.0%, beverage production – 25.9%, electrical equipment manufacturing – 25.2%, production of chemicals and chemical products (25.0%).

In 2017 the Ukrainian enterprises spent for innovations about UAH 9.1 billion, including acquiring of machines, equipment and software – UAH 5.9 billion, on domestic and external scientific research and experimental-constructional works – UAH 2.2 billion, on acquiring of existing innovation knowledge from other enterprises or organizations – UAH 20 million, and for other works related to the creation and introduction of innovations (other expenses) – UAH 1.0 billion.

From the total number of varieties of the innovative products introduced, 751 accounted for new types of machines, equipment, instruments, devices, etc., of which 30.5% were new to the market. Innovative products were introduced, first of all, on the enterprises where are production of machinery and equipment (except for the production of computers, electronic, optical products, electrical equipment and vehicles) – 23.9%, food products – 21.4%, basic pharmaceutical products and pharmaceutical preparations – 7.8%.

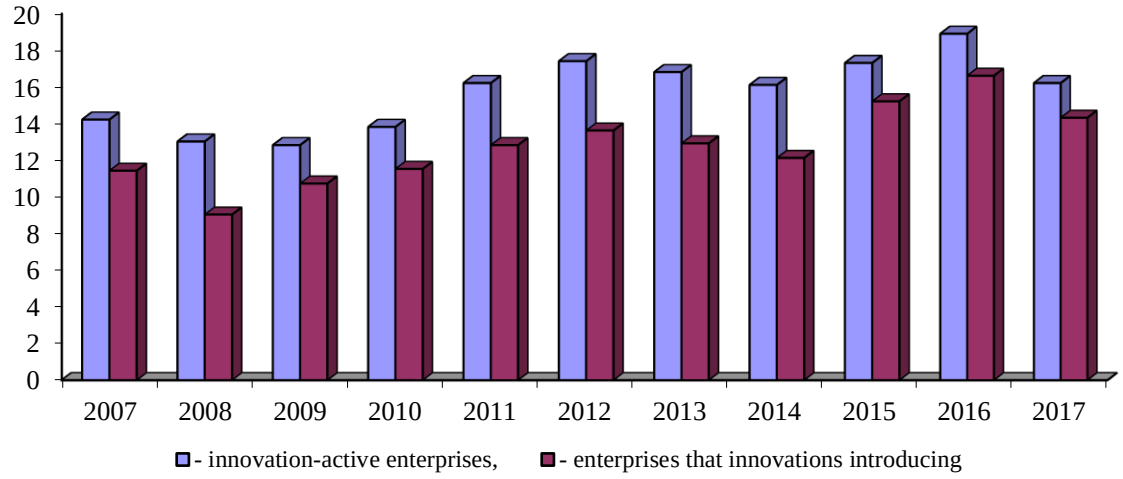

Fig. 1. The percentage of innovation-active enterprises and enterprises that innovations introducing (% of the total number of industrial enterprises) [10]

During 2017, the number of innovative technological processes introduced into production (new or improved methods of processing and production) was 1831, among which 611 technological processes could be attributed as low-waste / resource-saving. The above-mentioned processes were mainly introduced on the specified enterprises for the production of machinery and equipment (18.8%), natural gas production (17.7%), the production of finished metal products, except machinery and equipment (13.4%) and in the production of food products (7.9%).

It should be noted that out of 759 enterprises that carried out innovation activity, in 2017 only a little more than half – 59.3% (450 enterprises) have been sold innovative products. Among them, only 171 enterprises created products for export. For this year, industrial enterprises of Ukraine sold innovative products of UAH 17.7 billion, including exported it of UAH 5.5 billion. However, only every fourth company sold products, new to the market, and its volume was amounted to UAH 4.5 billion (including 41.5% for export). A significantly larger number of enterprises (83.8%) sold products that were new only for the company. Such products during 2017 were created of UAH 13.2 billion (of which products worth about UAH 3.7 billion were shipped abroad).

In order to implement innovative pioneer works in 2017, 170 enterprises acquired 832 new technologies, of which 129 were purchased outside Ukraine. Of the total number of technologies, 386 were purchased with equipment, of which 81 were outside of Ukraine; 305 new technologies were the result of research and development (including 10 outside Ukraine), 110 were received under contracts for the acquisition of rights to patents, licenses for the use of inventions, industrial designs, utility models (including 36 outside of Ukraine), 10 – under contracts for the acquisition of technology and know-how (including 2 – outside of Ukraine) and 12 – along with targeted recruitment of qualified specialists. As a result of the innovation activity, 8 industrial enterprises created new technologies, of which 59 were transferred to other enterprises, including 2 – outside Ukraine.

Methods for evaluating the innovation activities of industrial enterprises of Ukraine. To determine the level of the industrial enterprises innovation activity by the region of Ukraine, a methodical procedure consisting of several successive stages was used: 1) selection of indicative indicators reflecting the level of the industry innovativeness; 2) reduction of diverse the indicators to a single standardized form through the procedure of rationing; 3) the calculation of the integral index of the industrial enterprises innovation activities by the region. This technique has

previously been successfully used to assess the geography of the process of tertiarization and informatization in the economy of Ukraine [7-9].

To study the peculiarities and trends of development of the industry innovation sector by the administrative region of Ukraine, we used 15 particular indicators characterizing various aspects of such activities (all scientific, technological, organizational, financial and commercial activities that actually lead to innovation, or conceived for this purpose, as well as a research and development not directly related to the preparation of a specific innovation). In particular, these: 1) the number of organizations that carried out the scientific research and experimental-constructional works; 2) the number of researchers involved in the implementation of scientific research and experimental-constructional works; 3) scientific research and experimental-constructional works expenses (expenses include labor costs, material costs and other current expenses, capital investments, except for the amount of depreciation for the full restoration of fixed assets).

Also, the indicators characterizing creation of new innovative products were taken into account (such innovation is new for the market, when an enterprise that introduced it first, introduces innovation to its market, which is understood as an idea of the enterprise itself, possibly taking into account the geographical aspect or a typical product series which are competitors of this product). The minimum level of novelty for enrollment into the category of "innovation" is defined as "new to the enterprise" – such a product can already be used (manufactured) in other enterprises, but if it is new or significantly improved for this enterprise, then such a change can be considered for it as an innovation); 4) the number of industrial enterprises engaged in innovation activities in 2017; 5) the cost of innovation; 6) the number of industrial enterprises that introduced innovations in 2017 (implementation means the introduction of any new or significantly improved product (commodity, service) or process, new marketing method or new organizational method on an enterprise, workplace organization or external relations); 7) the number of innovative technological processes implemented; 8) the number of titles introduced innovative types of products; 9) the number of enterprises that have implemented innovative products (innovative products are products that are new or significantly improved in terms of their properties or methods of use). New products are products or services that differ significantly by their characteristics or designation from products manufactured by the company earlier. Significant improvements can be made by changes in materials, components and other characteristics of products that improve their properties. This includes significant improvements in specifications, components and materials, firmware, and other functional features); 10) the percentage of innovative products in the total volume of sold industrial products; 11) the number of enterprises that have sold innovative products outside Ukraine; 12) the number of enterprises engaged of innovation activities during 2012-2014; 13) the share (%) of employees on innovation-active enterprises; 14) the share (%) of enterprises receiving state financial assistance for innovation activities; 15) the share (%) of enterprises that had an innovative partner in Europe.

It was found, that among individual regions, the percentage of innovatively active enterprises among Ukraine was higher in Kharkiv, Ternopil, Mykolaiv, Cherkasy, Kirovohrad, Ivano-Frankivsk, Sumy, Zaporizhzhya regions and Kyiv city. Most of the funds for innovation have been spent by enterprises of Kyiv city, Zaporizhzhya, Dnipropetrovs'k and Kharkiv regions. The greatest numbers of innovative types of products were introduced on the enterprises of Kharkiv (16.6% of the total number of introduced types of the innovative products), Zaporizhzhya (13.4%), Lviv (10.3%), Sumy (9.1%) regions and Kyiv city (8.3%). The number of implemented innovative technological processes (new or improved methods of processing and production) was 1831, most of which were introduced by the enterprises of Kyiv city (30.0%), Kharkiv (12.6%), Sumy (12.3%), Zaporizhzhya (7.8%) and Dnipropetrovs'k (5.8%) regions.

In order to standardize of the above-mentioned differently measured indicators, we performed the procedure of their rationing. There are various methods for converting absolute values of different scales into relative indices. For example, such transferring can be made using the "method of deviations" [9], which allows calculating the complex weight coefficient of deviations of the indicator of the regional industry innovation activity level, based on which the rating of each region in the aggregate of administrative units of Ukraine is determined. According to this method, for each i-region, we calculated the standardized value of all the above-mentioned indicators, which varies from 0 to 1 and characterizes the level of industry activity in a particular region by one or another innovative direction, compared to their best values in other regions of Ukraine. In other words, the value of normalized indicators, equal to 0 or 1, is characteristic for regions with, respectively, the smallest or greatest (better) values of a certain indicator among the administrative units of Ukraine. The integral index was defined as their sum.

Geography of the industrial enterprises innovative activity of Ukraine in 2017. As shown by the results of our calculations, most of all zero values (eleven out of twenty-one) are characteristic of only two regions: Luhansk – six values (the smallest number of industrial enterprises engaged of innovative activities both during 2012-2014 and in 2017, the smallest number of industrial enterprises introducing innovations in 2017, the smallest number of implemented innovative technological processes and enterprises implementing innovative products), and Rivne region – five values (lowest volume of expenses for innovative activity, the smallest number of companies that have implemented innovative products as well as shortest list of the introduction names of such products, the low percentage of innovative products in the total volume of industrial products sold as well the least number of companies that have realized an innovative products outside Ukraine). This eloquently indicates the level of innovation of the industry of these regions.

Two more zero standardized values are fall on the Donetsk region, reflecting here the smallest number of researchers involved in performing scientific research and experimental-constructional works among administrative regions of Ukraine (here are only 170 specialists, who work in this area) and low scientific research and experimental-constructional works costs (only UAH 13.2 million). At the same time, the percentage of innovative products among total volume of the sold industrial products here remains quite high (fifth place among the regions of Ukraine), and in many other indicators this area cannot be considered an outsider.

One zero standardized value is falls on the Volyn' region (the smallest percentage of enterprises receiving state financial assistance for innovation), the Transcarpathian and Khmelnytskyi regions (the smallest, like in the Donetsk region, number of scientific research and experimental-constructional organizations), the Kirovohrad region (the smallest percentage of enterprises with innovative partners in European countries – only 2.9%, while on average in Ukraine this figure is 10%), Dnipropetrovs'k, Sumy and Cherkasy regions (none of which was not enterprises receiving state financial support for innovation) and Chernivtsi region (the smallest share (%) of professionals who working on innovative active enterprises – only 16.9%, while the average Ukrainian figure is 41.2%).

The greatest number a values of 1.0, that reflect the maximum absolute value of industrial innovation indicators are inherent for Kyiv city and the Kharkiv region (six and five maximum values among the regions of Ukraine, respectively). In Kyiv, there are more organizations that carried out scientific research and experimental-constructional works and researchers involved in their implementation, high costs of scientific research and experimental-constructional works and innovation activities, the largest number of enterprises engaged of innovation activities during 2012-2014, as well as the largest number of innovative technological processes implemented. In the Kharkiv region are more of all industrial enterprises engaged of innovation and introduced the innovations in 2017, as well as the largest number of titles of the innovative products introduced and the number of enterprises that have sold innovative products, including sold products outside

Ukraine. Among other regions – the leaders of the "second echelon" are the Zaporizhzhya region, where, according to the results of 2017, there are high percentage of innovative products in the total volume of sold industrial products as well professionals who working on innovatively active enterprises. The Luhansk region is the least innovative region, but somewhat unexpectedly got to this list. This is because that here is the largest percentage of industries enterprises had an innovative partner in Europe. The integral index of the industrial enterprises innovativeness among Ukrainian regions was ranges from 1.01 in the Khmelnytskiy region to 10.33 in Kyiv city (Fig. 1).

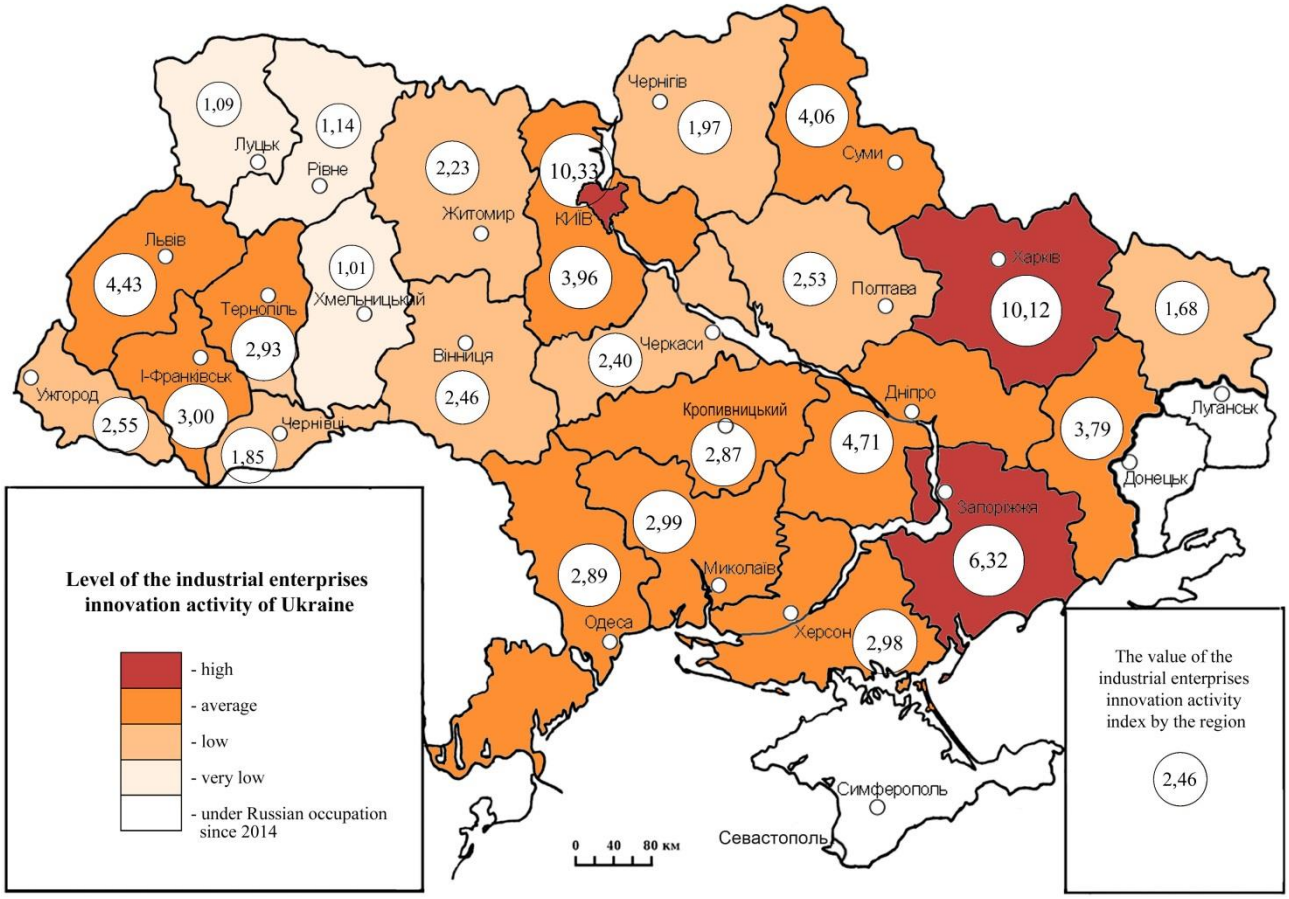

Fig. 2. Geography of the industrial enterprises innovation activity of Ukraine in 2017

If we talk about "leaders" and "outsiders" of our regional rating, then after Kyiv city into the main group are Dnipropetrovs'k, Zaporizhzhya and Kharkiv regions. The lower part of the ranking consists the agrarian regions: Khmelnytskiy, Volyn', Rivne. Immediately after them is the Luhansk region, whose industry suffered the greatest losses because of Russian occupation.

Dynamics of industrial enterprises innovative activity of Ukraine during 2007-2017 and its geographical aspects. In order to track the dynamics of the industry innovation during 2007-2017, the similar calculations were carried out for 2007. The data for 2007 contains the indicators for all regions of Ukraine, including the Autonomous Republic of Crimea and Sevastopol'.

The greatest numbers (almost all) of the values of 1.0 that reflect the maximum absolute value of the industrial innovation indicators were inherent of Kyiv city. In addition to Kyiv, the one maximum value was in the Donetsk region, where in 2007 the enterprises carried out more expenditure for innovative activities. In the Volyn' region, the unexpectedly, the highest percentage of innovative products in the total volume of industrial products sold was 38.3%, at the sometime in Ukrainian average being 6.7%. In addition to Donetsk, the Kharkiv, Dnipropetrovs'k, Lviv, Zaporizhzhya and Luhansk regions had also high rates of the innovation activity (Fig. 2).

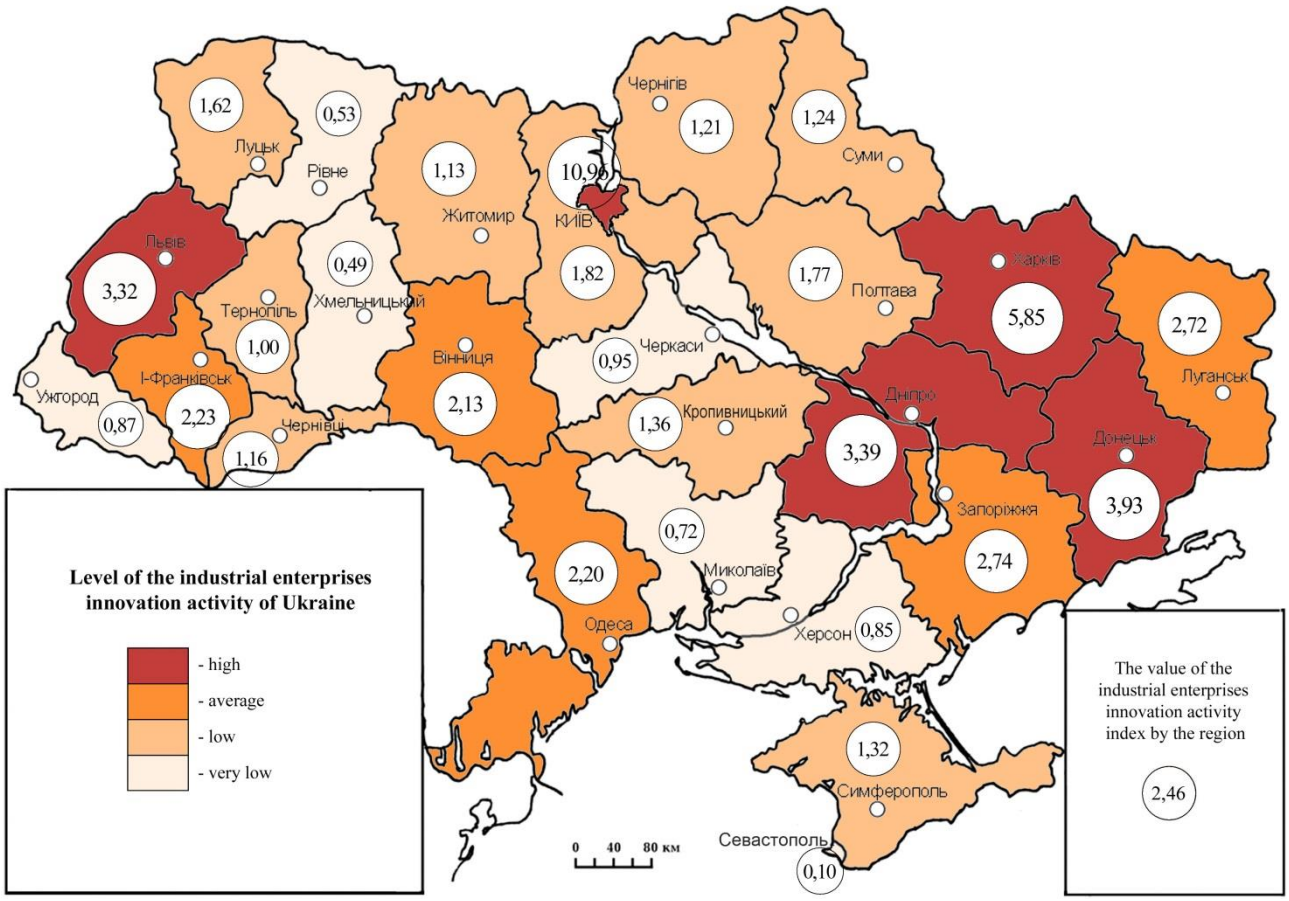

Fig. 3. Geography of the industrial enterprises innovation activity of Ukraine in 2007.

The industry of city of Sevastopol' had the lowest innovation rates, although there were more organizations involved in research and development than, for example, in Khmelnytskiy or Zhytomyr regions. Sevastopol' has the worst values in all indicators of innovation, except for the three, characteristic of the Khmelnytsky region (lowest of organizations that carried out scientific research and experimental-constructional works, fewer of researchers who involved to the implementation of scientific research and developments and the lowest amount of expenditures on scientific research and experimental-constructional works). Another one negative value was in Volyn', where only four names of innovative industrial products were produced, and in the Mykolaiv region, where the percentage of innovative products in the total volume of industrial products sold was only 0.6%. The indicators of the Cherkasy, Transcarpathian, Kherson and Rivne regions were also not high.

As can be seen from Fig. 3, in different regions of Ukraine there are different trajectories of the industrial enterprises innovativeness. The most significant decrease of innovation volume during 2007-2017 recorded in Kyiv city, as well as in the Donetsk and Luhansk regions, where much of the enterprises and research institutions are on the territory beyond the control of Ukraine authority. In addition, a decrease of innovation activity observed in the industrial complex of the Volyn' and Vinnytsia regions. The growth of the innovation index in the Odessa, Ivano-Frankivsk, Lviv, Poltava, Khmelnytskiy, Chernivtsi, Chernihiv, Dnipropetrovs'k and Rivne regions was extremely insignificant. But the most significant the innovative activity was developed on the industrial enterprises of the Zaporizhzhya, Kharkiv and Sumy regions.

Conclusions. As can be seen, the industrial enterprises innovation activity has a regional determinism and in general is a complex and uneven (asymmetric) economic and socio-geographical process, which has different territorial manifestations. The results that we obtained

are generally consistent with those submitted by the State Statistics Service of Ukraine, calculating its "total innovation index"[21] [10], although they differ somewhat from them. According to the State Statistics Service, the most innovative is activity of the industrial enterprises in the Dnipropetrovs'k region, Kyiv city and Kharkiv region, and the least innovative are the enterprises of the Chernivtsi, Volyn' and Khmelnytskiy regions. Donetsk region according to this index is located below Luhansk, although according to our calculations it should be the other way around.

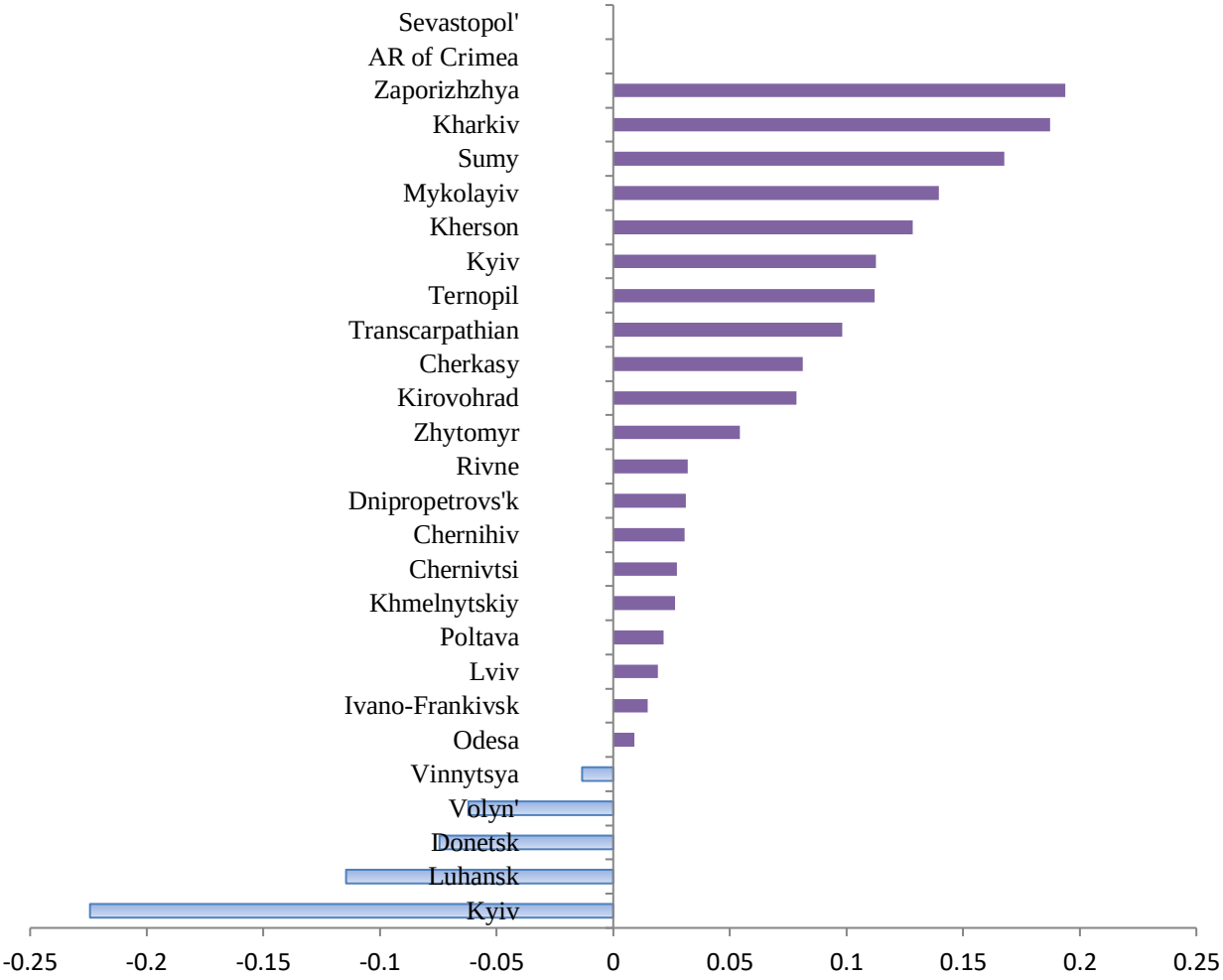

Fig. 3. Dynamics of the index industrial enterprises innovation activity by the region of Ukraine during 2007-2017

Analysis of the industrial enterprises innovation activities of Ukraine indicates a low quality of innovation, weak market incentives for the development of high-tech production and low demand for innovation. Most of the costs of performing scientific and technical work are carried out by organizations themselves and sent to pay researchers (in 2017 it was 53.5% of the total funding for innovation), while the cost of purchasing equipment amounted to only 659.1 million UAH (4.9%).

The percentage of the innovation cost in Ukraine's total GDP in 2017 was amounted to 0.45%, including at the expense of the state budget – 0.16. It is not reaching the threshold value (more than 0.9% of GDP), starting from which a science can influence to the economy development [11]. This situation does not correspond to the developed countries practice, where considerable financial resources are spent for research and development. For example, the

[21] Calculated by State Statistics Service of Ukraine according to the method of Total innovation index calculating http://ukrstat.gov.ua/metod_polog/metod_doc/2015/368/met_rsii.zip.

percentage of scientific research and experimental-constructional works expenditures in EU-28 GDP averaged is 2.03%, reaching maximum values in Sweden – 3.25%, Austria – 3.09%, Germany – 2.94%, Denmark – 2.87 %, Finland – 2.75%, Belgium – 2.49%, France – 2.25%. Chronic underfunding of the research and development sphere undermines the integrity of its structure, continues to deplete of the human resources: from 2007-2017 the number of researchers in Ukraine was decreased by 24.7%, and comparing with 1995 – almost by 60%.

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