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Experience and prospects of innovation development venture capital financing

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A B S T R A C T

The article aims at studying the theoretical basis and developing a methodological approach for assessing the development of urban infrastructure from the point of view of the use of venture capital. The article explores the tendencies of the development of venture capital investments in the world. Particular attention is paid to comparing volumes of the formal market of venture capital investment in the EU and Ukraine. The emphasis is placed on the fact that venture capital is a way of targeted investment in innovative development and can become a catalyst for the introduction of innovative technologies. It is substantiated that science and education are reliable segments for the diffusion of innovations. The focus is on the functioning of technology parks and it is revealed that they have become the most effective organizational and economic form of integration of science and production among all other innovative structures in the world. The best practices of Ukrainian universities on the commercialization of innovative developments and technology transfer in the domestic and foreign markets are presented. The creation of an innovative educational-production cluster based on the principles of public-private partnership in the form of a multilateral treaty union of state authorities and economic entities without unification of deposits is proposed. The results of calculating the accumulative influence of the multiplicative effect from the development of urban infrastructure have been presented and the effectiveness of its influence on the development of the regions of Ukraine economy has been proved.

1. Introduction

In today's economic conditions, Ukraine tries to create a favorable business environment to attract investments and to ensure growth of the economy, taking into account the innovative component. All institutions should be involved in this process, including: higher education system; innovative intellectual technologies and venture capital investment. As the global experience of venture capital investment shows, classical innovative developments – startups – most of all are created in the university creative environment and go through all development stages of trainings according to various technology transfers and development programs. They cover not only scientific and technological progress, but also the ways of its introduction into the innovative economy. Startup is a partnership of people who are dealing to create an innovative product or service that is at the early stage of entrepreneurship performance with limited resources, and requires additional venture investments (Markopoulos et al., 2020). Cacciolatti et al. (2020) consider startups as a social mission, acting in new markets, and causing some skepticism in the investors' eyes. Startups may improve business activities through strategic equity-based alliances to attract growth. van Winden & Carvalho (2019) in their 'Startup in residence' research in Amsterdam consider startups as a new type of policy to engage startups in urban innovation through a process based on public procurement of innovation.

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2. Literature review

Many scientists notice, that due to the financial crisis of 2008, the amount of investments decreased globally (Dixit, 2011). To ensure market liquidity and raise the economy, government officials from different countries of the world took certain steps. For example, to overcome the impact of the financial crisis, the Chinese government initiated in 2008 a set of economic incentives in the amount of four trillion Yuans. Financial resources were used to invest in priority sectors such as education, health care, transportation and industry in the United States (Aisbett et al., 2010). European regions were always characterized with the high level of involving investments, in particular, venture capital. In his writings, Cassella (1996) says that only high level of return on investment per capita is important for their successful involvement. Dijkstra (2007) emphasizes that the choice of managerial decision at the state level will depend on venture capital investments, made by major investors.
Transformation of the entrepreneurial idea into the innovative project is possible with the transfer of innovations to the market environment, and these innovations enable business and the state to move away from the inertial development trajectory and to develop their own model of continuous modernization of the economy. This approach is connected with the most progressive investment form – venture capital. Scientific paper of Franck and Wylie (2015) is dedicated to the influence of venture investments in education on the development of regions. The impact of venture investment in education on the development of the state economy has been the subject of research by Kinash et al. (2019). The authors prove the multiplicative effect of building an innovation infrastructure. One of the forms of innovation infrastructure is business incubators. The importance of their development is proved in their work (Imanberdiev et al., 2018). Akhmadeev et al. (2018) conducted a comparative analysis of Russian and foreign experience of venture capital investment and concluded that venture financing is the future. Speaking of Asia studies by Wonglimpiyarat (2013), the proposed intervention model is successful in Singapore and Taiwan due to clear policy-makers. American scholars Black and Gilson (1998) propose two venture capital directions: the relatively quick exit of venture capital providers from investing in portfolio companies; and the usual exit practice through an initial public offering. Groh and Lieser (2010) calculated the investment attractiveness indices of 27 European countries for institutional investment in venture and private capital. The results in all European countries indicate that while investor protection and capital markets are in fact very important determinants of investment attractiveness, there are numerous other criteria to consider. Chinese scientists Conti et al. (2019) in their work proved that funded startups receive less funding during the financial crisis than in non-crisis times. Bernstein et al. (2016) argue that attracting venture capital on the ground to their portfolio companies leads to an increase in both innovation and the likelihood of successful exit. Li et al. (2011) argue that establishing venture capital funds for universities is an important way to strengthen education and business. The need to create venture funds for university students is suggested; and a methodology for managing student venture funds is proposed. Research (Sathaworawong et al., 2019; Grilli 2019) prove that in order to increase the cost of raising funds, an entrepreneur must have extensive experience and education while a startup company should be large in size and the executive team should perform a full management function. The experience of China (Ning et al., 2019; Wu & Xu, 2020) proves the feasibility of introducing venture capital for the innovative development of Ukraine.

This article aims at studying the theoretical basis and developing a methodological approach to assessing the development of urban infrastructure from the point of view of the use of venture capital.

3. Results and discussions

According to the European Private Equity and Venture Capital Association (EVCA), the global investment priorities are focused on social technologies which provide sustainable global development (The European Venture Capital Association 2017; *The Boston Consulting Group (BCG): TOP-50* innovative companies in the world 2019*)*. Venture funds accumulate venture capital and invest their accumulated funds in projects, which are characterized with the highest level of risk, mostly in the innovative sector. Based on different interpretations of venture capital in the institutional sense, we may say that all of them are connected with innovative nature of entrepreneurship and combine venture capital with the formation of investment sources. Specific feature of venture capital is high degree of risk and the profitability of such investments. The essence of venture capital institution is revealed through the synthesis of financial and intellectual capital, and is characterized with high-risk character (Kraus, 2016). There are precise estimates of the amount of formal venture capital investment market. According to KPMG (Klynveld Peat Marwick Goerdeler), the professional auditing company which is part of Big Four, investments in global venture capital (VC) in 2017 remain to be substantial, despite a significant decrease of investors' activities. According to their estimates, the global level of venture capital in 2017 decreased by 24% in comparison with the same period of last year. Despite the global slowdown of the investment activity, the total amount of venture capital remained substantial (total value – $ 127.4 billion during the year). Although this amount is lower than the peak of $ 140.6 billion, invested in 2015, it almost twice exceeds the total investment in 2013, (VC) (Venture Pulse, Q4'16, Global Analysis of Venture Funding, January 12, 2017). Experts believe that the redistribution of investment shares in VC in 2016 is the evidence of gradual emergence of software in various industries which want to minimize harmful influence on the environment and switch to renewable energy sources. And even if general investment client invested during the past few years, pharmaceutical and biotech companies still attracted large amount of VC, due to high demand for innovative health improvement methods (Fig. 1).

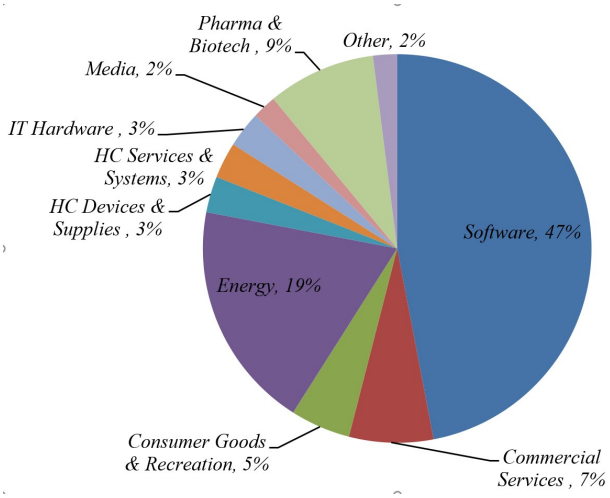

Fig. 1. The structure of venture capital in the global financing of innovative industries of the European Union countries, 2017
Source: Created by authors on Venture Pulse, Q4'16, Global Analysis of Venture Funding, January 12, 2017.

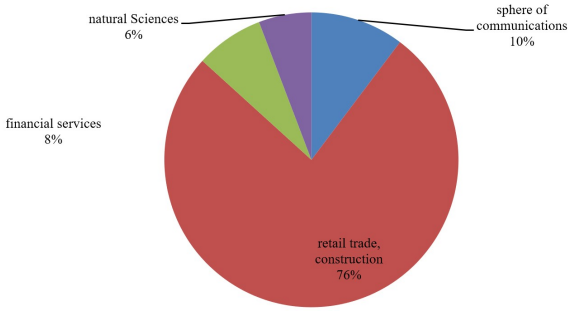

Fig. 2. Venture capital structure by sectors of the economy of Ukraine, 2017
Source: Created by authors on Central and Eastern European Private Equity Statistics 2017.

Sectoral structure of venture investments of joint financing institutions (JFI) in Ukraine according to the European Investment Business Association, on the contrary, shows a completely different dynamics of venture capital redistribution (Fig. 2). If we compare venture capital investment structure in Europe with the structural venture capital map of Ukraine, we can see the orientation on the financial support of innovative enterprises in the financial services sector, communications, consumer goods and construction. This indicates that venture funds in Ukraine are created under the assets of one client (financial and industrial group) to implement medium- to low-risk short-term projects which generate high returns, as opposed to long-term and high-risk innovation and technology projects. It is possible to stabilize the existing situation at the institutional level through the creation of favorable conditions for generating business ideas and transforming them into innovations which the investment community may demand. Science and education is the reliable segment for such diffusion of innovations. They are the objects of methodological activity, aimed at developing institutional formal rules of the society, in particular, in the field of venture investment. Under such circumstances, university science in Ukraine is able to maximize innovative results which are important for all the spheres of life in the country. Here, we focus on the creation and operation of technology parks that combine the potential of universities, research structures, industrial enterprises and entities of regional and national innovation infrastructure. Research materials indicate that in recent years, both in Ukraine and around the world, technoparks or territorial-industrial science complexes have become the most effective organizational and economic form of integration of science and production among all other innovative structures. A system of technology parks has been established in Ukraine (those 12 that operate, can serve as an example of successful implementation of state innovation policy) (Table 1.) The analysis of the process of formation in Ukraine of these innovative structures shows a decrease in the dynamics of their development and functioning.

Table 1
Technoparks of Ukraine

№	Technology parks	Year of creation
	Operating	
1	"E. O. Paton Electric Welding Institute" (Kyiv)	2000
2	"Institute for single crystals" (Kharkiv)	2000
3	" Semiconductor technologies and materials, optoelectronics and sensor technology " (Kyiv)	2001
4	Vuhlemash" (Donetsk)	2001
5	" Institute of Engineering Thermophysics" (Kyiv)	2002
6	"Ukrinfotech" (Kyiv)	2002
7	"Kyiv Polytechnic" (Kyiv)	2003
8	" Intelligent information technologies" (Kyiv)	2003
9	"Yavoriv" (Lviv region)	2007
10	"Agrotechnopark" (Kyiv)	2007
11	"Textile" (Kherson)	2007
12	"Machine-building technologies" (Dnipro)	2008
Are in the process of registration		
1	"Scientific and educational devices " (Sumy)	-
2	"Donbass resources" (Donetsk)	-
3	"Ukrainian Microbiological Center for Synthesis and New Technologies" (UMBCSNT) (Odesa)	-
4	"Eco-Ukraine" (Donetsk)	-

Source: Created by authors on Technology parks. (Official web-site of the Ministry of Education and Science of Ukraine)

The special mission of the technology park is to commercialize the results of scientific research, inventions and discoveries of scientists and specialists who have decided to engage in small business in the scientific and technical sphere. In this context, with the support of the Ministry of Education and Science of Ukraine, the catalog "Innovative developments of universities and scientific institutions" was presented. Innovative developments mean the results of scientific and research work or independent initiative researches in the form of newly created and (or) improved competitive technologies, products or services, which significantly improve the structure and quality of production and (or) social sphere, and which are protected as an object of intellectual property rights, or are implemented through a licensed agreement as know-how (Yaremik, 2017; Strika & Ilchenko, 2017). In our opinion, information about the experience of universities in the commercialization of innovative developments and technology transfer on the domestic and foreign markets, is interesting. In the national university environment, urban infrastructure for innovation support is formed, which includes business incubators, technology parks, business support funds, information and advisory agencies, business accelerators and start-up schools (Fig. 3).

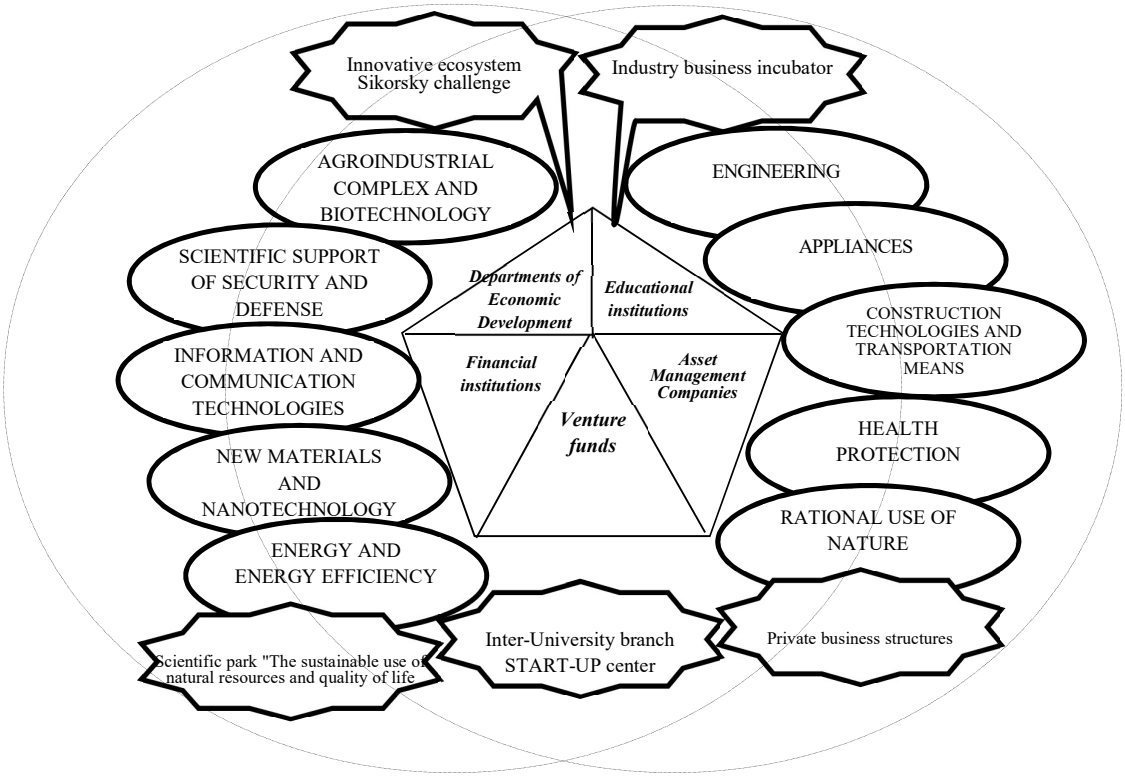

Fig. 3. An innovative cluster of public-private partnership operating in Ukraine

It supports startup projects at the initial stages, including providing jobs, initial investment, technical expertise, coaching services, mentoring, and the ability to join the ecosystem – friendly community, united by common interests. This allows to create favorable environment for startups which combine different industries, to provide success of the first companies, which will be able to involve new members. For innovative development of the regions (we chose Ivano-Frankivsk, Dnipropetrovsk, Kyiv and Kharkiv regions, because venture capital statistical information is available for processing), it is advisable to use cluster approach, which means the introduction of the informal interaction, partnership, cooperation, dialogue among the interested subjects. This approach coincides with the notion of the effective cluster policy of T. Anderson, who considers it to be an "umbrella brand" for the unification of the traditional development directions during the choice of the common strategic development vector (Andersson et al., 2004). Taking this into account, we developed the innovation and production cluster management scheme (IPC). Management structure of the innovative educational and production cluster demonstrates a set of interconnected elements which are in constant relationships and ensure their functioning and development for managing venture capital fund (Fig. 4). The elements of the structure are: the investment committee of the innovative education and production cluster, which consists of venture capital investors, supervisory board, asset management company. Relationships among them are maintained through the communication, due to which management process takes place. This process consists of information flows and management decision making, tasks and functions are divided among them, as well as management rights, and the responsibility for their implementation. Consequently, management structure can be researched as the interaction and distribution process of management performance, within which management process takes place, which is aimed at solving current problems in accordance with certain purposes. The organizational structure of management can be changed under the influence of internal and external environment factors. To estimate the effectiveness of functioning of the suggested cluster, the indicators which reflect urban structure of managing the innovative educational and production cluster,

were arranged. Five indicators were chosen which particularly show the effectiveness of hierarchical and functional constituents of management structure as one of the stages of the analysis of the innovative educational and production cluster venture performance (Table 2).

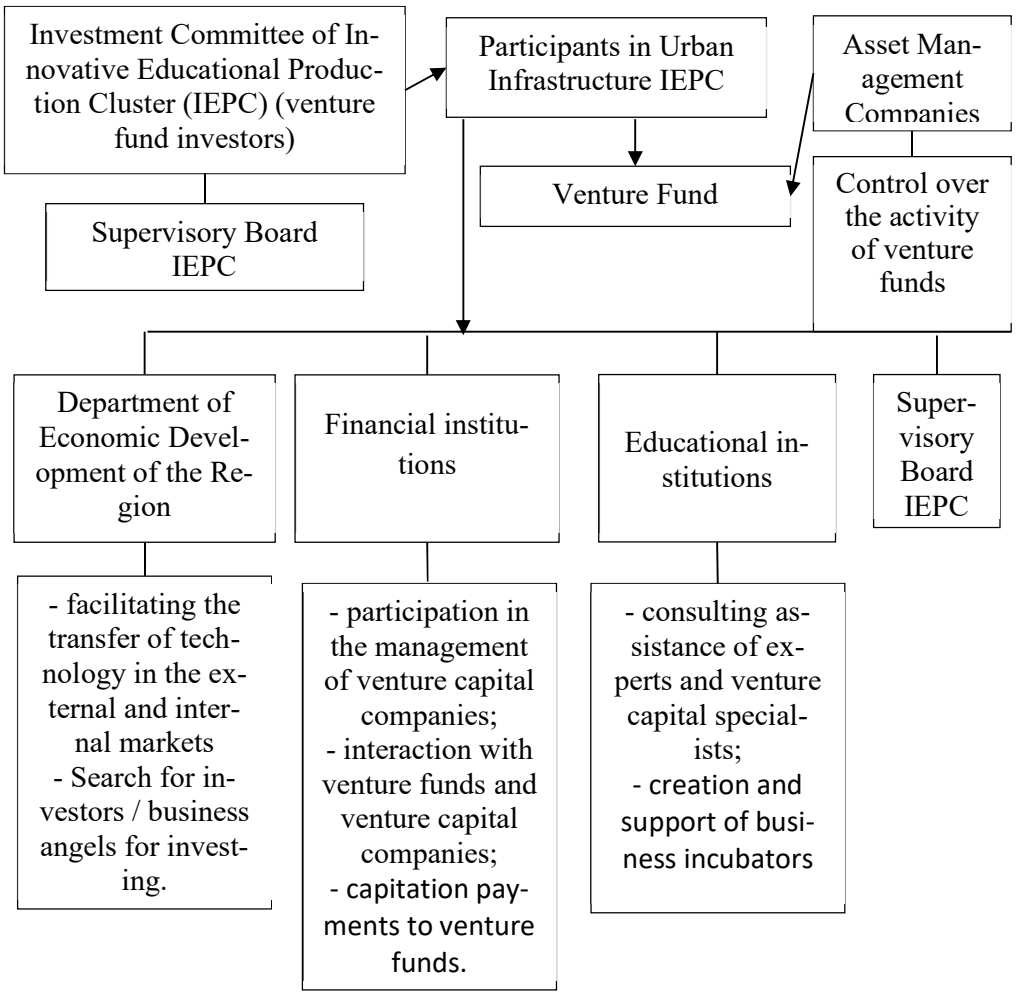

Fig. 4. Innovative educational and production cluster management scheme

Table 2
Calculation of indicators of efficiency of functioning of urban infrastructure of innovative educational and production cluster (IEPC)

Indicator	Calculation formula	Economic interpretation
C_{ef}	$C_{tf} = \frac{P}{C_m}$,	where C_{ef} –the coefficient of efficiency of the urban infrastructure of the innovative educational-production cluster (IEPC); P – the final result of the functioning of the urban infrastructure IEPC – volume of venture investments; C_m – the total administrative and managerial expenses of the Urban Infrastructure IEPC
C_{fc}	$C_{fc} = \frac{C_{md}}{C}$	where C_{fc} – the coefficient of cost factor for the management decisions of the urban infrastructure IEPC; C_{md} – total administrative and managerial expenses of urban infrastructure IEPC; C – general expenses of the urban infrastructure activity IEPC
C_{fi}	$C_{fi} = \frac{I_z}{I_d}$	where C_{fi} – the factor of justification of administrative decisions of urban infrastructure IEPC; I_z – the volume of the analyzed information for making managerial decisions in %; I_d – the required amount of information for making managerial decisions in % of the total amount of information.
C_{te}	$C_{te} = \frac{Z_l - Z_e}{Z}$	where C_{te} – the coefficient of compliance of the making decisions of the urban infrastructure of IEPC, which facilitate the attraction of venture investments in the region's economy; Z_l – the number of decisions made by the management personnel of the urban infrastructure of the IEPC, which facilitate the attraction of venture investments in the region's economy, units.; Z_e – the number of decisions taken that do not facilitate the attraction of venture investments in the economy of the region, units. Z – total number of decisions taken
C_r	$C_r = \frac{P_r \times O_r}{R_v}$	where C_r – the coefficient of risk factor level for managerial decisions of urban infrastructure IEPC; P_r – probability of risk occurrence during making and realization of management decision; O_r – amount of possible expenses as a result of the adoption and implementation of management decisions, thousand UAH.; R_v – costs for the formation of methods for reducing the level of risk, thousand UAH

The calculation of performance indicators for the functioning of the urban infrastructure of on innovative education and production cluster (IEPC) is shown in Fig. 5.

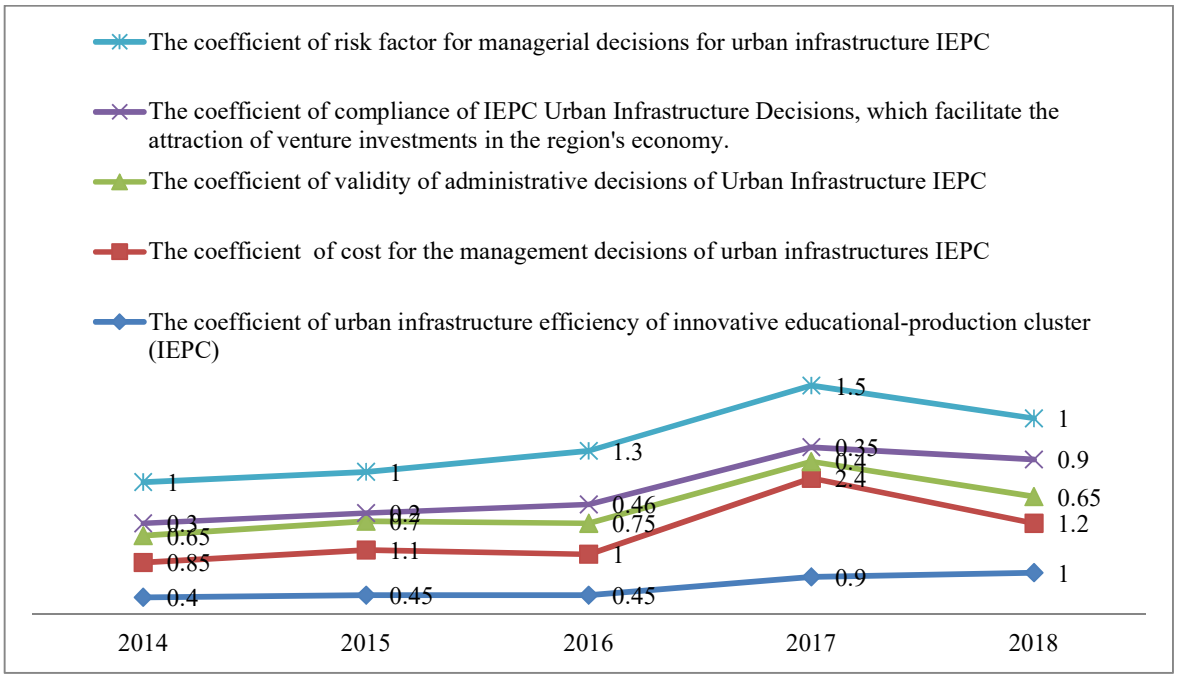

Fig. 5. The calculation of performance indicators for the functioning of the urban infrastructure of an innovative education and production cluster (IEPC).

On the basis of the calculations received, the integral indicator of the effectiveness of functioning of urban infrastructure was determined (Table3).

Table 3

Indicators of Urban Infrastructure Performance Analysis for 2014-2018

Indicator	Estimated value				
	2014	2015	2016	2017	2018
Integral indicator of the efficient functioning of urban infrastructure IEPC	0,586	0,7261	0,8538	0,9317	0,957

The next step is to calculate the multiplier effect of urban infrastructure development and to prove the effectiveness of its impact on the development of regional economy. The mechanism of the innovation multiplier is based on the fact that an additional change in investments in the innovations of some business units becomes the income of other economic entities, received as payment for innovative goods and services. This income takes part in many transformations and is gradually reduced by the amount of savings and is given as a payment for consumer expenses to another entity of the innovation economy, etc. (Dovgal et al., 2017). Thus, the more the inclination to invest in innovations is, the greater the multiplier effect. The mechanism of the urban innovation multiplier of the region is based on the increase of the material reward for workers (average wages). Accordingly, the initial increase in investment costs generates chain reaction of the increase in regional income and its consumer expectations and, as a result, leads to an increase in the welfare of the society. To calculate the multiplier of urban innovations of the region, the following indicators are used: the indicator of average wages at regional level, the integral indicator of the effectiveness of urban infrastructure of innovation performance management and the expected increase of venture investment in conditions of a certain consumer demand of the region. The multiplier effect is calculated with the formula:

$$\Delta S = \frac{K}{\Delta VI}, \quad (1)$$

where ΔS - average wage growth at regional level; YI - integral indicator of the effectiveness of urban infrastructure IPEC functioning; Δ VI - forecasted increase in venture investment in conditions of a certain consumer demand of the region;

Organizational innovations multiplier

K - multiplicative coefficient of urban innovations of the region, where

$$K = \frac{1}{1 - YI}, \quad (2)$$

In Table 4 and Fig. 6 it is possible to see the data showing the results of calculations of the multiplier effect of the development of urban infrastructure and the effectiveness of its influence on the development of regional economy

Table 4
Indicators which are used to estimate the multiplier effect of the analysis of the effectiveness of urban infrastructure IPEC functioning (2014-2018).

Indicator	2014	2015	2016	2017	2018
Average wages in the region, $	224	194	202	244	306
Venture financing, million $	2.43	5.50	3.23	9.41	10.1
Integral indicator of the efficiency of urban infrastructure functioning IEPC	0,586	0,7261	0,8538	0,9317	0,957
The coefficient of urban innovation in the region	1,915	2,742	6,214	8, 256	9,489

Source: calculated by the authors

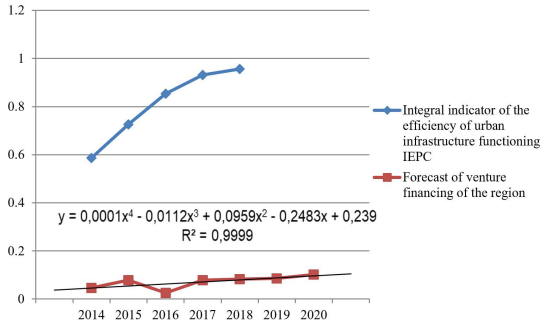

Fig. 6. Multiplicative effect of urban innovations in the region
Source: formed by the authors

4. Conclusions

The formation of national innovation systems is made possible by the creation of appropriate infrastructure. Venture financing is considered most suitable for the investment of such infrastructure. Here, the tendencies of venture investment development in the world are researched. The estimate of the amount of venture investments formal market is presented. We conclude that investments in global venture capital in 2017 remained significant, despite the decline (24%) of the global level of venture capital. The structure of venture capital in the global financing of innovative industries of the EU countries is researched. It was determined that now the sphere of global investment priorities focuses on social technologies which provide world sustainable development. Venture funds accumulate venture capital and invest their accumulated funds in projects, mostly in the innovative sector, which are characterized with the highest risk level. The structure of venture capital differs depending on the economy sector. According to researches, Ukraine focused on the financial support of innovative enterprises in the retail and construction, financial services and communications, which means that venture funds in Ukraine are created for medium- to low-risk short-term projects. The following factors are holding back the development of venture financing in Ukraine:
- lack of sources of venture financing;
- a small number of projects that have a strong marketing strategy and significant market potential;
- the lack of experienced specialists in the field of venture management who have the technologies to identify and selectively choose promising innovative projects, as well as evaluate their future effectiveness with a sufficiently high degree of probability. It is possible to improve the current situation by creating favorable conditions for the generation and implementation of business ideas through the integration of science and production. The most effective organizational and economic form is technology parks. They are able to combine the potential of universities, research structures, industrial enterprises and actors of innovative infrastructure at different levels. The creation of a cluster will contribute the innovative development of the state and its regions. The innovation and production cluster management scheme are suggested. It will be in the form of public and private partnership among state authorities, educational and scientific institutions, professional organizations, financial institutions and business structures. The functioning of such cluster is estimated. The multiplicative effect of the development of urban infrastructure of the region is calculated (Ivano-Frankivsk, Dnipropetrovsk, Kyiv and Kharkiv regions). It is proved that cluster development will increase the growth of venture investments in regional economy.

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