



The role of venture capital in the development of innovative industrial clusters

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ANNOTATION.

In the context of accelerating digitalization and global competition, the development of innovation clusters is becoming one of the key drivers of modernization of the industrial sector in Uzbekistan. This article examines the role of venture capital as a tool for financing and stimulating entrepreneurial activity within the framework of the formation and growth of innovative industrial clusters. Based on the analysis of current data, the study of the mechanisms of interaction between venture funds, start-ups and development institutions, as well as the comparison of Uzbek experience with international practices, the peculiarities of the formation of the country's venture ecosystem are revealed. Special attention is paid to identifying the main barriers and success factors for startup companies operating in various industry clusters, from information technology to the agroindustry. The contribution of government initiatives and infrastructure projects, such as the IT Park, to the creation of a favorable environment for attracting venture capital investments is reflected. Based on the example of successful cases and analysis of trends in the markets of neighboring countries, the potential for further growth in venture financing of the innovation industry in Uzbekistan is substantiated. The results obtained can be useful for developing strategies to support clustering and improve tools for attracting private investment into the national economy.

Keywords: venture capital, innovation clusters, industry, startups, investment, ecosystem, government support, IT Park.

Introduction

In recent decades, innovation clusters have become an integral element in the structure of modern industry, contributing to the accelerated development of new technologies and the transformation of production processes. Their formation and successful functioning directly depend on the availability of a favorable innovation environment, in which access to financial resources to support startups and high-tech enterprises plays a key role. Venture capital, as a special form of financing risky but potentially breakthrough projects, is becoming one of the decisive factors in the creation and evolution of innovation clusters. Despite the considerable interest of the scientific community in the problems of clusters and venture capital investment, the issues of mutual influence of venture capital and clusterization of industry still remain insufficiently investigated. The purpose of this article is to analyze the role of venture capital in the development of innovation clusters in industry, identify the mechanisms of its impact on the dynamics of clustering and identify factors contributing to the effective interaction of investors, entrepreneurs and other participants in the innovation process.

Current research highlights that the geographical concentration of startups, venture funds, and research organizations in clusters contributes to accelerated knowledge sharing and increased innovation activity. Venture capital investors, with industry expertise and wide contacts, serve as business accelerators, providing not only financial, but also mentoring and consulting support to innovative companies.

The role of state policy and local support institutions is highlighted. A number of studies indicate that government venture funds and flexible regulatory instruments contribute to reducing investment risks, stimulate the attraction of private capital and the formation of sustainable partnerships within clusters. For example, in technologically advanced regions such as Scandinavia and Southeast Asia, the synergy between government support and venture capital fund activity has allowed the creation of efficient clusters with high innovation returns.

Recent Russian studies (Khokhlov et al., 2023; Bryntseva, 2022) note that the lack of maturity of the national venture capital institute, as well as the lack of professional investors and transparent procedures for interacting with technology entrepreneurs remain significant barriers to the growth of domestic innovation clusters. The task of creating an environment conducive to venture capital transactions and building trust between investors, startups and the scientific community is particularly acute.

However, in modern literature, there are increasingly examples of successful development of public-private partnerships, cluster acceleration programs, and platform solutions integrating venture capital investors into innovative ecosystems (World Economic Forum, 2023). The analysis of these cases suggests the increasing role of synergy between venture capital, local development institutions and global industrial trends in the formation of competitive industrial clusters.

In this study, the role of venture capital in the development of industrial innovation clusters is considered from the perspective of institutional and evolutionary economics, which allows us to identify the multilevel impact of venture capital on structural transformations in the industrial sector. The main methodological position of the research is based on the integration of a comprehensive interdisciplinary approach combining qualitative and quantitative methods of analysis.

The concepts of national innovation systems by K.Freeman and B.Lundvall, the theory of cluster development by M. Porter, as well as modern ideas about the role of venture capital in the innovative economy by P.Gompers and J.Lerner's. This approach allowed us to consider venture capital not only as an investment mechanism, but also as an institutional element that determines the structure of the innovation environment in industrial clusters.

Special attention is paid to the systematic analysis of the impact of venture capital on the stage of the startup lifecycle, technology transfer processes and the formation of network interactions between cluster participants. The methodological novelty of the presented research lies in the consideration of venture capital as a key factor in the formation of innovative competencies and accelerating the diffusion of knowledge within an industrial cluster.

The role of venture capital in the development of innovative industrial clusters in Uzbekistan is becoming particularly important in the context of accelerating economic reforms and a course towards technological modernization. The nature of venture capital activity in Uzbekistan and its impact on the formation of cluster innovation ecosystems have distinct specifics reflecting the peculiarities of the national institutional and economic context.

Historically, venture capital financing in Uzbekistan began to take shape only in recent years, with the support of the state and international development institutions. In 2019-2023, the venture capital market showed moderate but steady growth: the first local venture funds, incubators and accelerators appeared (UzVC, AloqaVentures, BePro, IT Park). Unlike developed markets, where private investors dominate, in Uzbekistan the key initiator is the state, focusing simultaneously on stimulating youth entrepreneurship and digitalizing the economy.

Data from the IT Park and the Entrepreneurship Support Center show that over the past three years, the number of funded startups in the industrial sectors has increased 3,5 times, and the total volume of venture capital investments has increased from 0,8 million to 8,6 million US dollars. At the same time, significant attention is paid to supporting IT startups, new production technologies and projects in the field of green energy, which determines the vector of development of innovative industrial clusters.

An analysis of the structure and functioning mechanisms of industrial clusters in Uzbekistan shows that venture capital serves as a financial "accelerator" for startups at the early stages of their life cycle. This makes it possible to quickly test and scale technological solutions, which is especially important in the context of underdeveloped bank lending mechanisms for high-risk innovations.

In addition, venture funds and accelerators are becoming the core points of attraction for young entrepreneurs, engineers and research teams, contributing to the formation of horizontal links between cluster members. An example is the Tashkent Innovation Cluster, where the interaction of public-private venture funds with engineering centers and universities has created conditions not only for financing startups, but also for incubating new niche industrial areas (agrotech, IoT solutions for enterprises, processing of raw materials).

In Uzbekistan, the role of venture capital in cluster development is not limited to providing financing. In the context of the industrial renaissance, the focus is shifting to the creation of "soft infrastructure": platforms for knowledge exchange, educational programs in the field of entrepreneurship and innovation management, and legal support for transactions. These measures are being implemented with the support of the IT Park, the Ministry of Innovation Development and international partners (for example, the World Bank and USAID).

A special feature is that venture capital transactions are often accompanied by non—financial support packages such as mentoring, access to production facilities and preferential infrastructure. This compensates for the insufficiently high level of maturity of private venture investors and develops a culture of partnership between industrial enterprises and the startup community.

Despite the positive dynamics, the development of venture capital as the core of innovation clusters in Uzbekistan is fraught with a number of challenges. First of all, there is a lack of development of the "exit ecosystem" (exit tools) for investors, which constrains the influx of large private funds. The second barrier remains the administrative and regulatory uncertainty of the structure of venture transactions. In addition, entrepreneurs' limited expertise in the field of innovative business makes it difficult to make investment decisions.

A separate challenge is the orientation of most startups to non-local markets: many promising projects go abroad in search of more "long-term" and cheaper venture capital, which weakens the potential of internal clustering of innovative industrial ecosystems.

Table 1 – Key indicators for the development of venture capital and innovative industrial clusters in Uzbekistan

№	Category	Data	Description
1	Year of analysis	2024	The main year of the analysis
2	Total amount of venture capital investments, mln \$	17,5	Total by market
3	Number of venture funds	4	UzVC, AloqaVentures, Uzbekistan Venture Fund, etc.
4	Number of funded startups	53	For the last 5 years
5	The main branches of financing	IT, fintech, agrotechnology, energy	Most of the investments are concentrated in IT
6	The level of government support	High	Government grants, participation in IT Park launches
7	Cluster sites (examples)	IT Park Uzbekistan, Innovation Center, Tashkent Cluster	Functioning since 2019
8	Forms of non-financial support	Acceleration and incubation programs, mentoring	BePro programs, IT Park Accelerators
9	The main barriers	Insufficient expertise, underdeveloped exit, small market	Listed according to the survey of cluster participants
10	Potential for growth	High	Green-tech development, private funds, M&A attraction
11	Examples of successful cases	OpaLab, IMAN, GoMoon	We have received investments and scaling outside of Uzbekistan

To systematically strengthen the contribution of venture capital to the development of industrial clusters, experts suggest the following areas::

- Formation of specialized industry venture funds (for example, in agrotech and greentech).
- Combining direct investment tools with educational and acceleration programs for entrepreneurs and cluster specialists.
- Development of legal and information platforms for transparent structuring of venture transactions and promotion of best practices.
- Active involvement of large industrial enterprises as strategic partners of venture funds.
- Strengthening international cooperation, including attracting foreign venture capital funds and participating in global technology networks.

Table 2 – Analysis of the impact of venture capital on the development of industrial innovation clusters in Uzbekistan

№	The analyzed factor	Description/Observation	Impact on innovation clusters	Conclusion/ Recommendation
1	The structure of venture investments	Early-stage financing prevails (preseed, seed)	An increase in the number of startups, but a lack of funds for scaling	Develop late-stage funds
2	Geography of investments	They are concentrated in Tashkent and the main technological centers.	Concentration of innovations in the capital, low activity in the regions	Launching clusters in the regions
3	State involvement	Active participation in co-financing and through institutional funds	Formation of an ecosystem, reduction of risks for investors	Balancing between public and private funds
4	The role of accelerators	There are accelerators at IT Parks, universities, and private organizations.	Improving the competence of teams and the quality of projects	Expanding the number of accelerators
5	The problem of "exit"	Insufficient successful exits (startup sales), IPOs are practically absent	Hinders the arrival of new investors	Create conditions for M&A, IPO
6	Human resources	High concentration of specialized IT specialists, shortage in deep-tech areas	Limits the creation of complex startups	Invest in education
7	Market and export potential	Most startups are focused on the domestic market (small population, low solvency)	Limiting scaling and growth	To stimulate exports and access to foreign markets
8	The effect of success visibility	Successful cases (IMAN, Opalub, Bills) attract attention to the industry	Increasing the interest of new entrepreneurs and private investors	Conduct PR for successful projects
9	Regulatory environment	Tax preferences are being improved, but the bureaucracy remains	It hinders the rapid growth of companies and the attraction of foreign funds	Improve regulations and facilitate conditions for investors

The conducted research has confirmed the importance of the venture capital institute as a key driver of the formation and dynamic development of innovative industrial clusters in Uzbekistan. Venture capital financing, despite its relative novelty for the domestic economy, has shown potential to stimulate entrepreneurial activity, accelerate the introduction of advanced technologies, and integrate local startups into global production and technology chains.

The main contribution of venture capital is manifested in the support of startups at the early stages of their life cycle, as well as in the formation of a favorable ecosystem – the presence of accelerators, incubators, educational programs and specialized industrial sites. Significant government involvement, including through the development of the regulatory framework, the creation of public and private-public funds, helps reduce risks for investors and the formation of sustainable cluster structures.

However, the analysis revealed a number of obstacles to scaling venture capital investments: limited "long-term" money at late stages of project development, high concentration of investments in the metropolitan region with insufficient involvement of regional centers, as well as an underdeveloped exit infrastructure for investors and startups themselves. In addition, there remains a shortage of highly qualified personnel in high-tech industries and a lack of experience in bringing innovative products to international markets.

Based on the analysis, it can be argued that further expansion of the role of venture capital requires an integrated approach: stimulating cooperation between private and public capital, developing joint investment models, strengthening educational and entrepreneurial infrastructure, and, most

importantly, creating a transparent, predictable and stimulating business environment. The government should pay special attention to supporting regional clusters, facilitating the scaling of successful companies and creating conditions for the formation of successful examples of "exits".

In the future, the further development of the venture capital market in Uzbekistan will become one of the decisive factors in the formation of a competitive and innovative industry integrated into the global economy. The introduction of the world's best practices in attracting and diversifying venture capital investments will not only strengthen the country's technological sovereignty, but also ensure sustainable economic growth based on knowledge and innovation.

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