Creation and Development of Regional Venture Ecosystems

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***Abstract*—The article is devoted to the peculiarities of regional venture ecosystems functioning in a context of digital economy development. Facility development for venture projects financing is one of the strategic targets of the state policy in innovation development. The aim of the study is to provide reasonable arguments for the necessity of pursuing domestic state policy considering regional peculiarities of RF entities development in the sphere of innovation and investment. The study methodology is based on the non-parameter DEA analysis in effectiveness estimation of venture ecosystems functioning in RF entities. Output-oriented mono models allowed to perform quantitative assessments of effectiveness of public financial institutions and venture investors interaction in federal entities and to classify the entities by major types of innovation territories. Based on the empirical data, a number of hypotheses related to creation and development of national venture ecosystems in digital economy have been confirmed. Practical relevance of the study is proved by the fact that identifying RF entities with different levels of venture ecosystem development will allow to use different facilities in managing them, to master venture investment tools as a factor of steady economic growth.**

Keywords—national innovation system; regional venture ecosystem; effectiveness; venture projects financing, DEA-analysis

I. INTRODUCTION

Transition of resource-based economy to knowledge-based economy with effective use of economic resources and high technologies is mostly determined by the level of venture investment development which is a driving factor of innovative entrepreneurship.

Implementing innovative projects is known to involve considerable costs and high risks. Financing facilities for venture projects within the framework of the government pump-priming and innovation development are becoming more important in these settings.

The aim of the article is to provide a rationale for the necessity of taking into account the best world practices of pump priming and innovation development, as well as regional peculiarities of innovation investment development of the RF territorial entities, and the interaction between public financial institutions and venture investors while providing state domestic policy.

The following hypotheses have been put forward:

- Hypothesis 1: national models of financing government-backed venture projects were created at the turn of XXI century in developed countries.
- Hypothesis 2: nowadays national venture ecosystem is being created and developed in Russia.

II. NATIONAL MODELS OF VENTURE PROJECTS FINANCING WITHIN THE CONTEXT OF THE GOVERNMENT SUPPORT AND INNOVATION DEVELOPMENT

The comparative analysis of the best world practices in the sphere of venture investment shows that in spite of the differences in forms (business incubators, technological parks etc.) and tools of the innovation projects government support (grants for first-time entrepreneurs, budget appropriation for youth entrepreneurship etc.), it is possible to identify basic models of government financing of venture projects:

- American model: it is widely spread in such countries as Australia, UK, Canada, New Zealand, the USA, Latin America countries etc. Distinguishing feature of this model is related to the government financing which is provided for a great number of venture projects at early implementation phases, i.e. seed and start-up phases [1, 2];
- Continental model: it is common for Western European countries (Germany, France, Finland, the Netherlands, Italy etc.). A cluster-sector approach to the system of innovation project venture financing is peculiar for this model. Intensive government support of the venture activity is mostly focused on life quality-oriented innovation projects (education, energy saving solutions etc.), and on the innovation projects being at final implementation phases, such as expansion and exit, when the risks are not so high [3–5];
- Asian model: it is mostly used in Japan, China, Singapore, India and other countries of Eastern and South-Eastern Asia. The peculiarity of this model is a corporate approach to the venture investment where the basic entities of the innovation process are large business, banks, scientific and research institutions as well as administrating authorities in the sphere of

The article has been prepared based on the results of studies supported by budgetary funds in accordance with the state order for the Financial University in 2019.

implementation of innovation-related government policy [6–8];

- Mixed model: it is common for countries with resource-based economies (Russia, Belorussia, Ukraine, Brazil etc.) where the venture project financing system is based on the world best practices in the sphere of the government pump-priming and innovation development [9–11].

Differences in the models of venture projects financing are caused by factors that affect creating and developing national venture ecosystems where "companies coevolve capabilities around a new innovation: they work cooperatively and competitively to support new products, satisfy customer needs, and eventually incorporate the next round of innovations" [12, p.76]. Thus, focus shifting from early phase implementation to the final phase implementation (with clear perspectives) is specific for creating Russian venture ecosystem, while in a more developed venture ecosystem, e.g. in the USA, it is the early phases, when venture investment is more prevalent (Fig. 1).

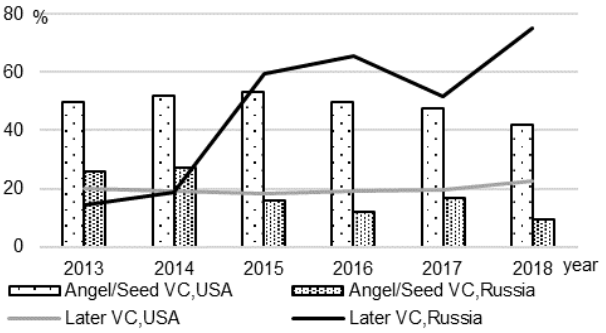

Fig. 1. Distribution of venture investment over innovation implementation phases in Russia and the USA versus the total amount of venture investments for 2013–2018.

Parameters of venture ecosystems are determined by the level of the development of the State-Science-Business interaction system aimed at improving human potential, supporting research and development to provide an innovation branch with necessary technological equipment and investment.

The results of fundamental and applied research of foreign and domestic scientists in economics and management allow to make a conclusion that proper and successful functioning of financial institutions and venture investment tools is significantly determined by the efficiency of the government pump-priming and innovation support.

The tools for breakthrough development of Russia in scientific, technological, social and economic spheres are the national projects and government programs aimed at improving the quality of managing such fields as digital economy; science; education; small and medium entrepreneurship, and individual proprietors support; labor productivity and employment support etc.

III. METHODOLOGY

Russian national venture ecosystem is a mixed system of entities that are different in their innovation and investment development, so the estimation of venture projects financing effectiveness (Эvc) in terms of government pump-priming and innovation development is to be defined as a relative value that describes the outcome level (the results obtained in manufacturing innovative goods and services) versus the invested resources (government costs to produce innovative goods and services):

$$Эvc = R_{i\ outcomes} / Z_{j\ costs} \quad (1)$$

where Ri — outcomes, i=1, ..., m; Zj — costs (resources), j=1, …, s; m≠s.

Methodology of devising DEA-models [13–15] aimed at identifying effective units in the national venture ecosystem S={Rg, Y} out of m-multitude of entities (Rg) that have a number (n) of common indicators (Y) that are characteristics of resources and results of the venture ecosystem functioning in RF entity can be seen as *m x n matrix*:

$$S = \begin{pmatrix} Z_{11}\ Z_{12} & \dots & Z_{1p}\ R_{11}\ R_{11} & \dots & R_{1r} \\ Z_{21}\ Z_{22} & \dots & Z_{2p}\ R_{21}\ R_{22} & \dots & R_{2r} \\ \dots\ \dots & \dots & \dots\ \dots & \dots & \dots \\ Z_{m1}\ Z_{m2} & \dots & Z_{mp}\ R_{m1}\ R_{m2} & \dots & R_{mr} \end{pmatrix} \quad (2)$$

where Zi, Rj – costs (inputs) and results (outputs) parameters of the venture ecosystem performance of RF entities; i = 1, 2, 3, ..., m; j = 1, 2, 3, ..., p; k=1,2, …, r; p+r=n.

Targeting the innovation driven growth model of the Russian economy presumes an effective use of available resources (e.g. budget funds), which dictated the necessity of devising CCR-O (outcome-oriented) model that accepts the conditions of permanent scale-related effect (3):

$$Эvc \rightarrow max \quad (3)$$

if the following terms are met: $\sum_j \lambda_j Z_{ij} \leq Z_{ij_0};\ \forall i=\overline{1,m};$ $\sum_j \lambda_j R_{rj} \geq Э_{vc} R_{rj_0};\ \forall r=\overline{1,s};\ \lambda_j \geq 0;\ \forall j=\overline{1,n}$

For every RF entity (*j*) it is necessary to find a set of weighted coefficients $\lambda = (\lambda_1, \lambda_1, \dots, \lambda_n)^j$ and scalar quantity $Эvc_j$, that would allow to create the benchmark for a certain RF entity performance using all the available vectors. The effectiveness measure for every RF entity will be $Эvc_j$ ($0 \leq Эvc_j \leq 1$), that describes the achieved values versus potential values. The RF entities with high effectiveness values which are more frequently used for creating the benchmark compared to other entities can be considered as leading innovation territories.

In this study RF entities are the federal districts: Central Federal District (CFD), Northwestern Federal District (NFD), Privolzhsky Federal District (PFD), Southern Federal District (SFD), North Caucasian Federal District (NCFD), Ural Federal District (UFD), Siberian Federal District (SFD), Far Eastern Federal District (FEFD).

The outcome indicators are represented with relative values showing the specific gravity of every entity in totality of entities by such characteristics as: investment amount of VC-funds (InVC); number of patents (Pat); number of researchers with scientific degree (Res); amount of internal costs for scientific research and development (Sc); amount of innovative goods or services (InServ).

To increase the reliability of calculations within the study, the parameter *Cash execution to the consolidated budget list* (CECBL) is taken as an input variable, and it is seen as the quality indicator of public finance management for every RF entity and is displayed on the official portal[1] of the RF Treasury on regular basis.

Database for devising the DEA model of effectiveness estimation of public financial institutions and venture investors interaction includes the data that reflect the venture ecosystem status of RF entities in 2018 (Table 1). It is displayed on official information resources of Rosstat, in analytical materials of the RAVI (Russian Association of Venture Investing) etc.

TABLE I. DATA BASE FOR PERFORMING EFFECTIVENESS ESTIMATION OF VENTURE ECOSYSTEM DEVELOPMENT IN RF ENTITIES

RF entity	CECBL, %	InVC, %	Pat, %	Res, %	Sc, %	InServ, %
CFD	91.51	73.73	52.00	52.00	52.43	25.62
NFD	95.77	11.53	10.00	12.00	13.94	13.20
PFD	92.77	2.48	16.00	9.00	15.18	20.32
SFD	90.92	4.08	7.00	5.00	2.55	5.60
NCFD	89.34	0.00	2.00	3.00	0.48	1.02
UFD	91.9	1.38	6.00	5.00	6.61	17.51
SFD	93.33	6.77	6.00	11.00	6.86	12.28
FEFD	94.22	0.03	1.00	4.00	1.95	4.45

Data processing was done using MaxDEA Software (http:// http://maxdea.com).

IV. CONCLUSION

The DEA model-based estimation allowed to range the RF entities by the level of venture ecosystem development and to set objectives in achieving optimal values for noneffective federal districts (Table 2).

TABLE II. PARAMETERS OF NATIONAL VENTURE ECOSYSTEM DEVELOPMENT BY RF ENTITIES

RF entity	$Э_{vc}$	Benchmark region (and the coefficients used in creating hypothetic object)	Rank
CFD	1.000000	CFD (1.000000)	1
NFD	0.492164	CFD (0.515075)	4
PFD	0.782350	CFD (0.793122)	2
SFD	0.219909	CFD (0.218491)	6
NCFD	0.059094	CFD (0.057692)	8
UFD	0.680323	CFD (0.683222)	3
SFD	0.470059	CFD (0.479408)	5
FEFD	0.168583	CFD (0.173576)	7

The comparative analysis of Table 2 data shows that CFD is effective in terms of interaction between public financial institutions and venture investors and that is why it is the benchmark for the other federal districts. Moreover, it should be noted that the CFD-related weighted coefficients stand for the amount of input of a certain RF entity into a hypothetic object that in its turn will be the target federal district for a noneffective RF entity.

Descriptive statistics values related to the totality of RF entities (the average value of effectiveness parameter $Э_{vc}$ accounts for 0.48; the minimal value $Э_{vc}$ is 0.06 (NCFD); standard deviation is 0.33) point to the inhomogeneous distribution of RF entities by the criterion determined (coefficient of variation v_σ is 67.3%, v_σ >33%). The territorial differentiation by the level of the venture ecosystem development is caused by the impact of different factors that prevent the development of venture entrepreneurship in Russia.

There are grounds to presume that implementation of national projects and government programs in the sphere of priming and innovation will allow to improve the quality of making managerial decisions. Improving effectiveness of interaction between public financial institutions and venture investors presumes tackling existing problems such as:

- Prevailing of rental economy in Russia, which means that welfare depends on the access to the resources and control over them;
- "Geographic inequality", i.e. the access to the investment tools of the venture market is distributed unevenly on the territory of RF;
- Insufficient development of financial facilities of creating and distributing venture capital;
- Lack of sufficient demand for products of innovative technological companies in the country, including the real sector;
- Insufficient availability of information related to the government-backed innovation project programs;
- Few "exits" of VC-funds within the innovation projects.

As a result of the review of the world best practices in the sphere of venture financing, the following aspects have been determined: foreign experience and Russian practice show that the public finance regulation system of venture activity is one of the facilitating factors for innovative modernization of national economies. The major models of financing government-backed innovation projects being identified, the proposed hypothesis is in line with the actual data.

The obtained quantitative data of the effectiveness of the interaction between public financial institutions and venture investors in RF entities using the DEA analysis demonstrate that the proposed hypothesis related to creation and development of the national venture ecosystem in Russia is not rejected.

Evaluation of DEA analysis used in the qualitative assessment of the territorial differentiation of RF entities by the national venture ecosystem status confirmed the government impact on the creation of the Russian venture market landscape. Identification of RF entities with different levels of venture ecosystem development allows to apply different financing facilities to innovation projects. The RF entities with the developed culture of venture entrepreneurship ("centers") may be considered as the territories of intensive innovation and investment growth in future, so their early identification in Russia is an important application task.

It should be noted that to improve the quality of managerial decisions in the sphere of public finances, it is necessary to master not only the facilities and tools of venture projects financing but the availability of complete and reliable statistic information about the national venture ecosystem status in RF entities that will improve the robustness and reliability of cost-effectiveness estimation of government pump-priming and innovation development.

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