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Global Determinants and Models of Innovations Financing

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ABSTRACT. The present article covers the conceptual foundations of innovation activity financing in the current context. Due to the fact that the innovation development of all agents of global economy play a crucial role to provision of their competitive ability, the vast majority of transnational corporations and countries try to create more efficient variants of financing of innovation activity. The interrelation between various indices of innovation activity and the indicators of development of national economies was investigated. The European practice of innovation activity financing was summarized based on the analysis of regional program "Horizon-2020" and innovation localization systems. Characteristic of legislative and regulatory solutions regulating the innovation activity in Ukraine was given. Modern approaches to innovation activity financing were classified and the conclusion about vital necessity of formation of integral system of innovation activity financing was made. The analysis of international practices of innovation management in developed countries and leading global companies provide evidence of reasonability of use of alternative sources of innovation activity financing at certain stages of cycle of creation and implementation of innovations. The opportunities of state support of the activity of innovation-oriented companies were identified through the example of developed countries. The activity of business angels and venture funds in relation to the support of drastic innovations became the subject of special study. The problems were identified and the courses of promotion of influence of international and national banks in the innovation activity financing were substantiated. The offers on determination of priority directions of innovations financing were proposed at the end of the article on the basis of comparative analysis of the structure of financing of research and development in certain countries and sectors.

KEY WORDS: innovations, innovation activity, finances, banks, European Union, venture funds, business angels, innovation investment, financing models.

Introduction

Innovation activity financing has rather contradictory character. On the one part, the investment of various innovation projects is extremely risky due to the fact that very small percentage of results of researches

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is implemented in new products or services, much less part of which is brought to the market and generate proper revenue of the investors. On the other part, successful innovation developments, as shown in the practice of such innovation-oriented corporations as Apple, General Electric, Hewlett-Packard, Dell etc., not only cover all the expenses many times over, but also transform little-known small companies into high-technology corporations – world class leaders. So, search of models of adoption of optimal decisions in relation of innovation investment objects, choice of financial sources of support of certain innovation projects, improvement of the efficiency of use of funds of public grants are of ever-greater interest both for wide range of researchers and for managers of various levels, primarily, for heads of large multinational enterprises.

The problems of innovation activity financing took pride of place in researches of leading professionals abroad and within the country, whose papers show key approaches to choice of models of innovation projects investment. First of all, we have to mention the developments of A. Afuan[2] and R. Taker[3] including basic provisions on combination of innovation and financial strategies. Tools of provision of profitability of innovation developments were substantiated in papers of T. Davil[4] and E. Dandon[5]. Yu. Yakovets[6] developed a model of rent financing of innovation activity. O. Yeroshkin[7], Ye. Panchenko and M. Voichak[8] generalized an experience of state support of innovation activity with further export of its results in the form of advanced technology products. L. Fedulova[9] classified factors of insufficient financing of innovation activity both at the level of Ukraine in general and at the microlevel. Papers generalizing an interesting experience of innovation developments financing in world-class corporations, in particular, Apple[10],

[2] Afuan, Allan. *Innovation Management: Strategies, Implementation and Profits*. Second Edition. New York: Oxford University Press, 2003.

[3] Tucker, R.B. Driving Growth Through Innovation. San Francisko: Berret-Koehler Publishers, 2002.

[4] Davila, T., Epstein, M.J. and R. Shelton. *Making Innovation Work. How to Manage It, Measure It and Profit from It*. Filadelfia: Wharton School Publishing, 2006.

[5] Dundon, Elaine. *The Seeds of Innovation. Cultirating the Synergy That Fosters New Idias*. New York: Amacom, 2002.

[6] Yakovets ,Yu.V. *Epokhalnye ynnovatsyy XXI veka*. M.: ZAO «Yzdatelstvo «Эkonomyka», 2004. [In Russian].

[7] Eroshkyn A. "Mekhanyzmy hosudarstvennoi podderzhky ynnovatsyi: zarubezhnыi opyt". *Myrovaia ekonomyka y mezhdunarodnые otnoshenyia* 10 (2011): 21-29. [In Russian].

[8] Panchenko, Yevgen and Voychak Mykola. "State support of the higkt-tech technology export corporate potential." *The International Economic Policy* 2 (2016): 99-125.

[9] Fedulova, L.I. *Tekhnolohichnyi rozvytok ekonomiky Ukrainy: Monohrafiia*. K.: In-t ekonomiky ta prohnozuvannia, 2002. [In Ukrainian].

[10] Lashynsky, Adam. *Apple zseredyny / Per. z anhl*. K.: Brait Star Pablishynh, 2012. [In Russian].

General Electric[11], Procter&Gable[12], Toyota[13] etc are worth noticing. However, many argumentative issues of innovation activity financing still remain. First of all, it is the issue of which the optimal structure between sources of innovation development financing between state, corporate and individual investors and other funds should be. Secondly, which the interrelation between stages of life cycle of innovations and sources of innovation investment should be. Thirdly, how to increase the role of banking sources in the innovation investment. Fourthly, which is the optimal structure of financing of main sectors of scientific researches.

Based on the above, the purpose of the article is a generalization of trends in financing of innovation activity at macro- and microlevel, identification of optimal model of the financial provision of innovation projects at various stages of life cycle of innovations and substantiation of main courses of increasing of the efficiency of innovation investment in Ukraine.

Innovation Investment as a Key Factor of Increasing of Competitive Ability of National Economies

Increasingly larger role of financial factor in the innovation development of countries is beyond dispute currently. Within this context let's take into account the conclusion of authors of chapter "Innovations financing" K. Khalme and I. Bulkin of project of the European Union "Improvement of strategies, policies and regulation of innovations in Ukraine": "Principal motivation of governments consists in provision of availability of financing of innovation companies, considering their leading role in the increasing and upgrade of modern economical systems"[14]. Such an attitude is typical also for researchers within the country. For example, leading scientists of Ukraine – authors of national report "Innovative Ukraine – 2020" specify as follows: "The system of financial provision of innovation activity has to take into account macroeconomic, political and other factors, including the state and type of financial system in every country. High investment risks, losses of paid-in capital typical for innovation activity raise barriers for

[11] Uelch, Dzh. Samaia sut: per. s anhl. M.OOO «Yzdatelstvo ST», OOO «Transknyha», 2007. [In Russian].

[12] Khiuston, L. and N. Sakkab. *Soedyniai y razvyvai: model ynnovatsyi Procter&Gable*. Harvard Business Review – Rossyia, 2006. [In Russian].

[13] Laiker, Dzh. and Dzh.Morhan. *Systema razrabotky produktsyy v Toyota: Liudy, protsessы, tekhnolohyy: per. s anhl*. M.: Alpyna Byznes Buks, 2007. [In Russian].

[14] European Aid /127/694/C/SER/UA. *Innovatsiina polityka: Yevropeiskyi dosvid ta rekomendatsii dlia Ukrainy*. K. Fenyks, 2011. [In Ukrainian].

private investments into this field"[15]. And, finally, let's introduce a provision of the newest report of the Committee on scientific and technological policy of OECD dd. March 156, 2017: "The innovation policies, in particular, in the field of finances play crucial role in facilitation of economic growth in the current context"[16]. So, all abovementioned provisions about the top-priority role of innovation activity financing are based on ever-increasing influence of innovation factors in the increasing of global competitive ability of national economies as evidenced by the data in table 1.

Table 1 **CORRELATION RELATIONSHIPS BETWEEN GLOBAL INNOVATION INDEX (GII), INFORMATION SOCIETY INDEX (ISI) AND INDICATORS OF NATIONAL ECONOMY DEVELOPMENT IN 2017[17]**

Indicators	Correlation coefficients	
	GII	ISI
GDP per capita	0,8902	0,8012
Human Development Index	0,9513	0,9417
Global Competitiveness Index	0,6814	0,8187
Technological development index	0,9402	0,9012
Economical Efficiency Index	0,9217	0,8418

As the presented table shows, high correlation coefficients between GII and ISI, on the one part, and indicators of national economy development, on the other part, provide strong evidence of crucial role of innovations in the increasing of key indices of competitiveness of national economies. Mainly this is the case of human and technological development index, which correlation coefficients exceed 0.94. However, both coefficients also have a high level within the range 0f 0.68 – 0.89 for other indicators. Within this context we have to agree with an attitude of the abovementioned report "Innovative Ukraine – 2020"as to "the innovation is a defining characteristic of modern scientific and technical, production, social and economic and all social

[15] Heits, V.M. edc. and in. *Innovatsiina Ukraina – 2020: Natsionalna dopovid*. NAN Ukrainy, K, 2019. [In Ukrainian].

[16] *Making Innovation Benefit All: Policies for Inclusive Grows*. Paris, OECD, 2017.

[17] Calculations by authors for: The World Bank Data, available at: http://dat.worldbank.org; UNDP. Human Development Report 2016. http://hdr.undp.org/sites/ default/files/2016_human_development_report.pdf; Global Competitiveness Report,. http://www.weforum.org/does/WTF_GlobalCompetitivenessReport_2016-17.pdf; The Global Innovation Index. http://www.globalinnnovationindex.org. – 11.12.2017; ITU.ICT development Index 2016. http://www.itu.int/net4/ITU-D/idi/2016/index.html – 23.12.2017; Global metric for the environments. http://epi.yale.edu/

processes. Fortune of Ukraine depends on mastery of innovation development mechanisms: whether it will lean toward inclusion to the number of developed countries or whether it will remain a stagnating country on the margin of scientific and technological and social advance. It is related to common patterns of social development according to which the transition from primarily reproducing to innovation type of development takes place worldwide. The countries that realized it timely and organized their economic system according to this historical imperative enjoy a success, respect and honor, and the countries that failed to understand it have a problems, failing and hopelessness. Innovation is not only the key to dynamic development, well-being, personal success, but also is a way of provision of sovereignty of the country, its competitive ability in modern exceptionally challenging world"[18].

European Practices of Innovation Activity Financing

The governments pay more and more attention to increase in volumes and improvement of the efficiency of innovation investment in European Union in general, as well as in certain countries: in particular, in Great Britain, France and Germany. They proceed from the increasingly larger role of innovation factors in the accumulation of competitive ability of their national economies which share exceeds 60%. Programming tools and system of innovation localization deserve attention within this context.

European framework program “Horizon – 2020” is oriented to the development of scientific researches and innovation activity in EU. It was initiated in 2014 and includes three basic components:

- Framework programme for Research and Technical development;
- Competitiveness and Innovation Frame work Programme;
- European Institute of Innovation and Technologies.

Content of program “Horizon – 2020” is focused on the financing of three priority guidelines: development of the frontier science, provision of industrial leadership and acceptance of social challenges. The program was approved by Innovation Union of EU and has the financial parameters presented in table 2.

[18] Heits, V.M. ed. and in. *Innovatsiina Ukraina – 2020: Natsionalna dopovid*. NAN Ukrainy, K, 2019. [In Ukrainian].

Table 2 **BUDGET OF EUROPEAN PROGRAM «HORIZON — 2020» (2014–2020 yrs), billions of euro**[19]

No.	Financing streams	Amount	%
1.	Frontier science, including	24,4	31,0
1.1	Cutting-edge researches of leading EU groups on developments	13,1	16,6
1.2	Common researches of technologies of our age and the distant future	2,7	3,4
1.3	Activity according to program of Marie Skłodowska-Curie Actions within the context of creation of opportunities for career development	6,16	7,8
1.4	Development of research infrastructure, for the purpose of provision of access to world-class centres for the scientists	2,5	3,2
2.	Industrial leadership, including	17,0	21,6
2.1	Creation of new industrial technologies: information technologies, communication technologies, nanotechnologies, new materials, industrial technologies, space technologies	13,56	17,2
2.2	Access to hands-off financing (use of private credit financing and venture capital)	2,84	3,6
2.3	Financing of innovations in small and medium business	0,62	0,8
3.	Social challenges, including:	29,7	37,8
3.1	Health care, demographic changes, well-being	7,47	9,5
3.2	Food security, sustainable development of agriculture and forestry, investigation of water resources and bio-based economy	3,85	4,9
3.3	Safe, clean and efficient power economy	5,93	7,5
3.4	Efficient, green, integrated transport	6,34	8,1
3.5	Climatic changes, natural environment, efficient use of resources and raw materials	3,08	3,9
3.6	Inclusive, innovation and reflective communities	1,31	1,7
3.7	Community safety	1,7	2,2
4.	European Institute of Innovation and Technologies	2,7	3,4
5.	EAEC (European Atomic Energy Community) (2014-2018)	1,6	2,8
6.	Other streams	3,2	3,5
	Total	78,6	100,0

Analysis of data of the abovementioned table enables to make a variety of conclusions. Firstly, social sector ranks high in the amounts of financing at first sight – 29.7 billions of euros (37.8%). This attitude does not need special argumentation due to the fact that solution of humanitarian problems always has a priority character in EU innovation

[19] The Framework Programme for Research and Innovation. http://ec.europa.eu/programme/horizon2020/eh/what-horizon-2020

activity. However, if we look closely at the content of financing on the items of this section, we will find out that the range of items (power economy – 3.3, transport – 3.4, efficient use of resources and raw materials – 3.5, food security – 3.2) have obviously technical character. So, relying on the content of the financial innovation projects, they can be referred to the section "Frontier science" (31.0%) with good reason, and this section will take pride of place – 55.4% with due regard to presented considerations. Secondly, the amounts of financing of innovations at the expense of regional investment funds (non-corporate sector), annual average volume of which is equal to 11.2 billions of euro, impress[20]. Thirdly, program "Horizon – 2020" enables to participate in competitions for grants receiving not only for large study teams but also for small groups and even certain talented professionals with due regard to prescribed conditions of Marie Skłodowska-Curie Actions. It is related to the fact that the concept of the program "Horizon – 2020" consists in the increasing of level of perfection of scientific base and stable flow of world-class researches as the basic premises of long-term competitive ability of EU, due to support of challenging ideas, development of talented human potential, provision of access to priority facilities of research infrastructure for scientific researchers. All of this strengthens attraction of EU for the most ambitious researchers from other countries, including Ukraine, ever-greater number of which associate their research career with the use of expenses of various EU funds.

Fourthly, financing of program is oriented not only to the support of certain innovation projects, but also to the creation of favorable conditions for carrying out of innovation activity by means of development of research infrastructure and expansion of access to world-class centres (1.4), hands-off financing (2.2), inclusion into inclusive, innovation and reflective communities (1.6).

Fifthly, it's important to stress the special financing of innovation projects for small and medium business (2.3) that have a substantial potential. Entry of these participants into international markets with appropriate new products and technologies is used as a criterion of the efficiency of innovation investment for such companies.

Sixthly, the program includes the measures of institutional character, in particular, financing of European Institute of Innovation and Technologies (3.4), EAEC (European Atomic Energy Community) (3.5), European Research Council (1.1), Marie Skłodowska-Curie Actions (1.3).

[20] Lukianenko, D.G. and T. Beridze ed. *Strategic Priorities for Developing Ukraine and Georgia: Innovation and Partnership: Monograph*. Batumy; BNTO 2018.

The experience of financial localization of innovation activity in the countries of European Community also deserves attention. This experience is based on clustering of innovation potential of 190 EU regions divided into four groups[21]:

– innovation leaders that have a high integrative index of innovativeness exceeding an average level of EU by more than 20%;

– powerful innovators whose index exceeds the average index in EU by 10-20%;

– moderate innovators that have the index below average in EU no more than by 50%;

– weak innovators – regions with integrative index of innovativeness lower then by 50% in comparison with average index in EU.

The idea of identification of actual attitudes of regions in the innovation competition consists in the fact that the regions of the first two groups would receive public support in the financing of innovation activity within their territories. Composition of these regions holds steady within the last two decades and includes 36 regions: the Netherlands, Belgium, Denmark, Northern Germany, Southern Great Britain, Austria, Italy, Southern France, Sweden, Finland, Luxembourg, Norway, Slovenia etc.

Method of innovation localization is not only of scientific, but also of practical interest for Ukraine. This is because the contribution of various regions into national innovation development is different in our country. Therefore, public support of this development has to rest on the availability of real potential.

Models of Innovations Financing

Innovative companies encounter the substantial difficulties in the course of fund raising for innovations financing. Taking into account that some projects may become high-yield, and others may end up with significant losses for the company, hope to get high profits from innovation is always relatable to significant risks. It is important to bear in mind within this context that the financing of innovation activity has the essential features at each of its four stages. The companies try to avoid out-of-pocket expenses and to use public funds at the initial stage (stage of seeding) when one carries out the preliminary investigations and the developments of selling idea or business conception focused on determination of its technical feasibility, market potential and economic viability. The stage of project launching includes prototyping of product, primary market research and initiation of business formal organization. The companies use capital resources or

[21] Hollanders, M. *Regional Innovation Scoreboard, 2016*. Brussels: Publications Office of the European Union, 2016.

mutual venture capital funs beside state funding sources at this stage. Moreover, they find business angels. Funding sources remain as they are at the previous stage when the product commercialization on a small scale and growth occur at the stage of growth. Loaned funds become the mostly major funding sources at the stage of expansion which is characterized by substantial growth of business scales.

Fig. 1 shows the money flow at various stages of innovation development, as well as the most logical sources of innovations financing at every stage. So, money flow varies on J-curve, spiraling downward at the initial stage in connection with investment of essential financial resources required for proof of business concept ("valley of death"). If the company succeeds in overcoming of the "valley of death" business starts to develop and achieves the stages of growth and expansion. The company needs even more extensive financial resources at these stages. However these resources may be received with the help of more traditional financial mediators by reason of tangibility of the results of its activity. Let's consider the process of financing at every specified stage in further details.

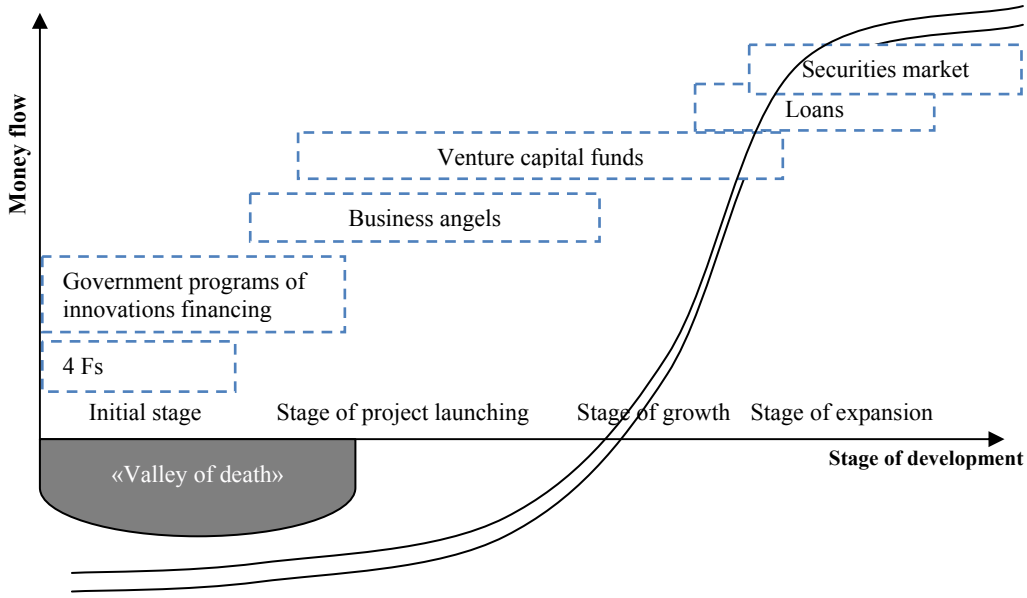

Fig. 1. Money Flow and Financing Sources at Various Stages of Innovations Development[22]

[22] A Practical Guide to Early-Stage Financing Policy Options and Instruments for Financing Innovation. United Nations Economic Commission for Europe, 2009.

As a rule, financing is effected by means of internal resources of the company at the initial stage of innovations development, so called 4Fs (founders' own funds, funds from family, friends and «fools») — own resources of the founder, as well as the resources of family, friends and fans. Government programs of innovations encouragement are the substitutes of financing at the initial stage; public grants are the most common among them. However, we have to keep in mind the political and bureaucratic character of such programs that not always coincide with business-oriented solutions of the company. In order to overcome this barrier, it is important that person who makes decisions on provision of financial support would be as close to applicant as possible both geographically and in the context of experience and views. Program SBIR (Small Business Innovation Research) in the USA, as well as program START in Russia are quite well-known. Program SBIR was initiated in 1982 in response to loss of competitive ability of economy of the USA in the world, as well as for the purpose of encouragement of the development of small innovative and high-technology companies. Such companies as Apple, Compaq, and Intel got the financing back in their days by the means of program SBIR. Provided that the company participates in program, it gets the financing at an early stage of its development in an amount up to $850 thousands in two steps: at the first stage $100 thousands are allocated to the company for 6 months for the purpose of assessment of project prospects; at the second stage $750 thousands are allocated for the purpose of project and prototype development. Upon completion of stage 2 the companies usually refer to venture funds for continuation of innovation initiatives financing. Russian program START was initiated in 2004 for the purpose of encouragement of development of hiving off from the universities and survey institutes. This program, like program SBIR, funds the projects in several steps (3 stages): during the first year of project development up to $40 thousand are funded for the purpose of conviction of private investors in potential of the company; financing is provided during the second and third year of participation in program only upon condition of participation of private investor on the principles 50/50.

The following mechanisms of innovations support by state are widely used in addition to direct or indirect (through government agencies) appropriation of budgetary funds to research establishments and universities in the form of financing of transaction expenses in accordance with the estimate, as well as provision of grants and placement of government orders for performance of researches and developments: provision of various tax advantages to the enterprises performing researches and developments; investment of budgetary funds

into the capital of venture funds and other specialized financial institutions participating in the implementation of innovation projects; allocation of soft government loans and credit guarantees (insurances) to innovators; performance of target government procurement of innovative products and services; financing of establishment of business incubators, technology parks and other innovation activity infrastructure facilities. The examples of government programs on provision of soft loans and guarantees to small and medium innovative companies, as well as the government programs of grants for researches and developments are presented in table 3.

Table 3 **GOVERNMENT PROGRAMS ON PROVISION OF SOFT LOANS AND GUARANTEES TO INNOVATIVE COMPANIES AND GOVERNMENT PROGRAMS OF GRANTS FOR RESEARCHES AND DEVELOPMENTS[23]**

Country	Name of program	Basic conditions of program
Programs on provision of soft loans and guarantees		
Great Britain	Enterprise Finance Guarantee. The program is implemented by the agency Capital for Enterprise Limited	Provision of credit guarantees in the amount up to 1 million of GBP and for a term of 10 years to the companies with annual turnover up to 25 millions of GBP. Guarantees cover up to 75% of the amount of credit and shall be paid by the companies at the rate 2% per annum charged on the amount of outstanding loan debt.
Germany	ERP Innovation Programme. The program is implemented by the bank KfW Mittelstandsbank	Provision of soft credits and subordinated loans to small companies stipulating exemption from payment of interests and payments on principal debt for the period from 2 to 7 years, issue of guarantees on credits of banks and investments of venture funds.
France	Programs of agency OSEO	Provision of soft loans to newly created companies, as well as guarantees on credits of banks, investments of venture funds and business angels in the amount up to 70% of invested sums
Spain	Programs of agency Centro para el Desarrollo Tecnologico Industrial	Provision of long-term interest-free loans in the amount from 150 thous. to 3 millions of euro, but not exceeding 60% of project cost, to promising technology companies.
Netherlands	SME Credit Guarantee Scheme	Provision of partial guarantees for bank credits in the amount up to 1 million of euro and for a term of 6 years to small and medium enterprises. Guarantees cover from 2 to 3.6% from the amount of credit.
Finland	Programs of agency of financing of technologies and innovations Tekes	Provision of unsecured loans for a term up to 10 years in the amount up to 100 thous. euro, but not exceeding 80% of project cost to new technology companies. Foreseen five-year exemption period; loan rate corresponds to basic rate but not lower than 4% per annum.

[23] Eroshkyn A. "Mekhanyzmy hosudarstvennoi podderzhky ynnovatsyi: zarubezhnыi opyt". *Myrovaia ekonomyka y mezhdunarodnыe otnoshenyia* 10 (2011): 21-29. [In Russian].

Country	Name of program	Basic conditions of program
India	Programs of bank SIDBI and guarantee fund CGTMSE	Provision of soft loans, issue of guarantees on unsecured credits. Guarantees cover from 1 to 1.5% from the amount of credit
Brazil	Programa Juro Zero (Zero Interest Program) of the agency FINEP Programs Innovative Capital Facility and Technological Innovation of the bank BNDES	Provision of interest-free credits in the amount from 60 too 600 thous. of dollars to small innovative enterprises. Provision of long-term (up to 12-14 years) credits for implementation of innovation projects with interest rates from 0 to 4.5% to the companies, including small and medium enterprises.
Government programs of grants for R&D		
The USA	Small Business Innovation Research (SBIR), Small Business Technology Transfer (STTR) Advanced Technology Program (ATP)	Grants in the amount up to 100 thous. of dollars for a term up to 1 year at the stage of engineering definition of innovative proposition. Grants in the amount up to 750 thous. of dollars for a term fro 6 months to 2 years at the stage of innovation commercialization. Grants in the amount up to 2 millions of dollars for a term up to 3 years for covering of direct expenses related to innovation activity financing.
Great Britain	Grant for Research and Development	Grants in the amount from 20 to 250 thous. of GBP to the enterprises which number of staff members does not exceed 250 persons for the purpose of financing of preparatory stage of implementation of innovation projects for a term from 6 months to 3 years.
India	Technopreneur Promotion Programme (TePP) Small Business Innovation Research Initiative (SBIRI)	Grants for inventors and companies at the stage of seeding in the amount from 35 to 110 thous. of dollars covering from 50 to 90% of expenses to commercialization of groundbreaking idea. Grants in the amount up to 600 thous. of dollars covering up to 80% of cost of launch expenses to implementation of innovation projects in the field of biotechnologies.
Brazil	Primeira empresa (PRIME)	Grants in the amount up to 60 thous. of dollars for innovative companies existing on the market less than 2 years, for the purpose of financing of expenses related to payment of researches and developments, marketing and advisory services
China	Program Innofund	Grants for the formation of start-up capital of innovative companies or the financing of initial stage of implementation of innovation project in the amount up to 150 thous. of dollars, but not exceeding half of project cost

Country	Name of program	Basic conditions of program
Russia	Program START	Grants in the amount up to 40 thous. of dollars during the first year of project development for the purpose of conviction of private investors in potential of the company; financing is provided during the second and third year of participation in program only upon condition of participation of private investor on the principles 50/50.

Analysis of data of this table enables to make certain conclusions concerning general features and special aspects of public support of innovation activity in various countries. Firstly, soft loans are provided primarily to small and medium enterprises, promising technology or newly created companies. However, conditions of loans provision vary greatly in such a case. For example, the Great Britain establishes maximum limit of turnover equal to 25 millions of GBP, the amount of credit guarantees is equal to 1 million of GBP, term is equal to 10 years. In such a case the guarantees cover up to 75% of credit and shall be paid at the rate 2% per annum from outstanding loan debt. More flexible approaches are used in other countries which establish only the term of benefits provision depending on special aspects of innovation project. Secondly, interest rates are not high and range from 0% (Germany) to 4.5% (Brazil). Thirdly, special agencies (Great Britain, France, Spain, the Netherlands, Finland, and Brazil) or banks (Germany, India) are created in mentioned countries.

Government grants of R&D support characterized by greater variety also play a critical role. Firstly, this is the case of purposes of support. Various kinds of innovation activity are subject to financing in most of countries: technical processing of innovation proposition, direct expenses, and commercialization of innovations. However, an emphasis on support is put only at the initial stage in China and Russia. Secondly, support of certain kind of innovation activity in the countries – leaders in the innovation sector (the USA, Great Britain) is carried out due to certain program. Rest of the countries have a general program providing support of all kinds of activity that reduces the competence and efficiency of such support in some way, due to the fact that it is hard to asses the reasonability of inclusion of projects to the field of their activity for the employees of corresponding institutions. Thirdly, government grants are provided irrespectively of participation of private investors in the financing of innovation projects in all countries except for Russia.

The following may be separated from the internal sources of innovations financing by the company – experienced players:

undistributed profits; existing assets foreseen for other projects; deferral of payments.

Business angels are persons who make investments into promising enterprises as well as provide them with in-house network of contacts and experience. Investments are made by business angels in exchange for securities of the company, less often – in the form of loan that may be converted or in the form of guarantees. For many business angels the sources of income are the funds received from the sale of business established by them; for this very reason a dynamic business environment is an important factor of business angels appearance. As a rule, business angels invest from $30 thous. – $300 thous. to $1 – 2 millions (under condition of syndicated agreements involving several angels or angels investing through co-investment fund) [3, p. 21]. Agreements concluded by business angels are smaller than agreements concluded with contributions from traditional venture capital. However, they take place at earlier stages of innovative enterprise development. As a rule, business angels are the experienced accomplished businessmen striving to invest quite significant means to the projects that may change positively not only certain company, but the society in general, rather than to invest them into charitable actions. Business angles consider investment of capital to be risky, but rather promising private investment corresponding to their preferences and that is not subject to public disclosure. For this very reason there is no systematized statistics and reports on the activity of business angels. However, some examples become known to business and scientific community. One of such shining examples is related to the activity of one of famous American business angels, the founder of reform party Ross Perot (1930 year of birth) who ran for the presidency in 1992 and 1996 and moved into third place of honor, having provided victory of B. Clinton due to the fact that he deprived his competitors of substantial part of votes.

R. Perot became the prominent entrepreneur – billionaire in the second half of the past century; he is the founder (1962) and the owner of well-known company on data processing EDS (Electronic Data Systems) that was sold to corporation General Motors at the price of $2.5 billions in 1984. He was a member of the Board of directors of other American corporation General Electric, one of leaders of world high-technology business during this period. At this particular time the company Apple found itself in a difficult financial position, and its chief executive, Steven Jobs, referred to the corporations AT&T, General Electric and even Coca Cola with suggestions about partnership. Of all the specified companies, only GE entertained a suggestion: it was R. Perot whom John Welch sent to the negotiations. Unfortunately, negotiations failed, and the financial position of Apple continued to

worsen, resulting in dismissal of S. Jobs from the post of president on May 31, 1985.

As it is known, S. Jobs established new company NEXT consisting of his five colleagues from Apple afterwards. New company also lacked the financial resources and tried to attract them with the help of display of documentary film about NEXT under the name of "The Entrepreneurs" on television. R. Perot watched this film that impressed him greatly, in particular, thanks to entrepreneurship of S. Jobs and his exuberant imagination. He remembered a young man he acquainted himself with during last-year due diligence of Apple as an investment project by GE and got in contact with S. Jobs on the next day. "If you will need investor one day, call me right now", R. Perot said to S. Jobs[24].

S. Jobs waited within a week with great impatience, in order not to show his interest. S. Jobs skillfully evaded questions about anticipated incomes and profits of NEXT during negotiations with R. Perot; instead of this his companion got a vivid description of concepts of establishment of new technologies, their influence on well-being of the society and corporate values. Actually, Perot proposed to S. Jobs a check not specifying the amount. Finally, S. Jobs proposed to R. Perot 16% share in the company at the price of $20 millions and he agreed. This Texan entrepreneur replied without doubt to the comments on his investment made in the emotion of the moment: "I invest money into quality". Such an attitude is typical for the most of business angels.

It is common practice to divide business angels into active and passive according to degree of involvement into management of company; and into newcomers and experienced according to availability of background investment experience. In these days more and more investments are made through networks of business angels pooling financial and information resources of business angels for the best assessment of potential investment projects, as well as involvement into syndicated agreements for the purpose of obtainment of access to various fields. Financing through corporate venture capital that means investment of funds into innovative enterprises by non-financial entities is an alternative to business angels. Tax exemptions, partnership involving public institutions with substantial financing of the latter, creation of administrative establishments facilitating the development of new ideas are the main ways of encouragement of large enterprises to invest funds into small innovative companies. So, the practice of public and private partnership providing common involvement of state and business into

[24] Yanh, D.S. and V.L. *Saimon. Ikona. Styv Dzhobs*. M.: ЭКSMO, 2010. [In Ukrainian]..

establishment and financing of venture funds is rather common. Means into such commingled (hybrid) funds may be allocated from budget of the stream. However, so called funds of funds are created for this purpose more often. Budgetary investments into private and government funds are usually made in the form of equity investments. However, other tools, particularly, long-term subordinated loans may be also used. Such loans are usually provided not at the moment of the fund organizations, but already during financing of certain innovation project by this fund that improves the efficiency of budgetary funds use substantially. Notwithstanding the fact that corporate venture capital financing is considered to be an exclusive right of developed countries of the world, recently more and more number initiatives of corporate venture capital financing is observed on the developing markets, in particular, in Asia. So, among 49 programs launched in 2010, 17 were initiated by American companies, and 19 were initiated by the companies from the developing markets (the other were European and Japan). Increase of the amounts of corporate venture capital financing funds also must be emphasized. If the fund Korea Telecom ($830 millions) was considered to be the biggest in 2010, then the fund of Chinese provider of online services Tencent, twice as large ($1.5 billions) became the biggest in 2011. Share of corporate venture capital financing in cumulative investment of venture capital reduces recently: this indicator reduced by 4% in the past five years in the USA; this indicator reduced in Israel by 7% and in Europe it reduced by 4%[25].

As the innovative companies grow, their financial needs also continue to grow, that requires access to larger capital sources. Financing by means of venture capital provides promising innovative enterprises with the capital that is professionally managed in return for enterprise shares. Venture capital financing company is an agent between institutional investors and potential innovative companies. As a rule, the venture capital financing company manages several funds of venture capital financing, uniting managers of venture capital financing company, institutional investors and prosperous persons. Notwithstanding the fact that the amounts of financing vary in different countries, the investment in the amount of $1 – 4 billions is typical. It's worth paying attention to the fact that venture capital financing funds may be public (managed by government agencies and using public funds for the financing) and private; national and international; dependent (subdivisions of the financial institutes) and independent. The funds of funds (not investing capital into

[25] Globalizing Venture Capital. Ernst&Young Global Venture Capital Insights and Trends Report, 2011: 39-42

enterprises but accumulating it for other venture capital financing funds dealing with investments) and indirect funds (groups of business angels accumulate certain part of capital of less active participants for investments into accompanying agreements) are also differentiated. Process of selection of projects by venture capital financing company is carried out in three steps: initial analysis of project; detailed assessment and final professional assessment of project (due diligence).

As to the world region-wise venture capital investments within the period of 2005 – 2016 yrs, the doubtless leadership of the USA (approximately 70% of global investments in every specified stage) must be emphasized. Investments of Europe, Canada and Israel reduce, while the investment of India show the moderate growth and China is in the way of getting the start of Europe and ranking next to the USA as the world centre of venture capital financing. Gradual growth of venture capital investments was observed with the specified period, except for 2009, when the decline up to $34.1 billions (table 4) took place. Notwithstanding increase in volumes of venture capital financing in Asia, it is important to note that 30-60% of funds are invested into already profitable companies, i.e. at later stages of companies' development, as opposed to the USA and Europe that encourage the investment at earlier stages of companies' development.

Table 4 **WORLD REGION-WISE VENTURE CAPITAL INVESTMENTS WITHIN THE PERIOD OF 2005–2016 yrs, $ billions**[26]

	2005	2006	2007	2008	2009	2010	2016
The USA	25	31	34,3	32,7	24,1	29,6	32,6
Europe	5,4	6,3	7,5	7,6	5,2	6,7	6,1
Israel	1,3	1,5	1,9	2,1	0,8	1,8	1,6
China	1,4	2,5	3,8	4,9	2,7	5,5	5,9
India	0,2	0,6	0,9	1,7	0,8	1,1	1,5
Canada	0,6	0,8	0,9	0,8	0,5	0,9	1
Total	33,9	42,7	49,3	49,8	34,1	45,6	48,7

Such instruments as bank loans and accumulation of funds on the securities market (IPO or transactions on the secondary market) are also

[26] Globalizing Venture Capital. Ernst&Young Global Venture Capital Insights and Trends Report, 2018.: 10.

suitable for financing at the final stages of innovation development. Taking into account that it is necessary to have a collateral or a clean record in order to get a bank loan (newcomers usually lack it), this instrument of financing seems to be rather problematic for innovative enterprises.

So, both internal and external financing sources (table 5) may be used for innovations development. As to internal resources we have to pay attention to own resources of the founder, as well as his family, friends and fans for the company – new player and to undistributed profits, existing assets provided for other projects and deferral of payments for experienced players. Programs of government financing, financing by means of public and private capital, as well as obtainment of bank loans are differentiated among external sources.

Table 5 **SOURCES OF FINANCING OF INNOVATION INITIATIVES OF THE COMPANIES**[27]

Internal sources	External sources
– 4Fs (own funds of the founder, funds of his family, friends, fans); – undistributed profits; – existing assets provided for other project; – deferral of payments	– venture capital financing (business angels, corporate venture capital financing, financing by venture capital companies); – government programs of innovations financing; – accumulation of funds on the securities market; – bank loan

Special Aspects of Innovation Investment in Ukraine

Ukraine is among the countries where rather branchy legal and regulatory framework of innovation activity financing is created. 565 various decisions of public authorities, including 147 Acts of Ukraine, 75 Decrees of the President of Ukraine[28], 343 Orders of the Cabinet of Ministers of Ukraine were made in this sector during the years of independence. It is important to note the strategic role of two Acts of Ukraine among the specified decisions: “On the innovation activity” dd. July 02, 2002 and “On the scientific and scientific and technological activities” dd. December 05, 2012. The Order of the Cabinet Ministers of Ukraine "On the approval of Concept of national innovation system development” no. 680-p dd. June 17, 2009 deserves attention among executive decisions. It specifies that the volumes of financing by means of state budget of technological innovations increased by 19 times from 7.7 millions of UAH to 144.8 millions of UAH, and the annual volume

[27] Author's development.
[28] Haidutskyi, P.I. *Nezabutni reformy v Ukraini*. K.: TOV «DKS-tsentr», 2017. [In Ukrainian].

of performed academic papers and research and development increased by 3.4 times from 1978 millions of UA to 6700 millions of UAH within 2000 – 2007 yrs[29]. In particular year 2007 the maximum of innovation investment in Ukraine was attained in comparable prices. Nevertheless, none of specified documents provided for clear system of innovation investment.

Recent establishment of National Council of Ukraine in the matters of development of science and technologies by the government under direct management of Prime Minister of Ukraine deserves attention within this context. This is the very authority that has to deal with the matters of innovation investment. V.B. Hroisman assigned a task before researchers during his speech at the first meeting of this council on January 06, 2018: "Show me brand new model of management and financing of science – and I will be ready to meet the requirements of Ukrainian science"[30]. The Regulation on the National fund of researches was adopted at this meeting. This Regulation provides for the use of brand new instrument of science financing in the form of its basic and competitive security: 60% – basic financing, 40% – competitive financing.

Considering the problem of innovation financing at macrolevel it is important to take into account the insufficient means. As a matter of fact, it is hard to expect proper financing of innovation activity under small scales of gross domestic product in Ukraine. It reduced by 35% during the years of independence and it was equal to 2.6 thous. of US dollars per head of population in 2017. According to data of the World Bank, it is the worst result across the globe within the last 24 years. As the financing of innovations over the last years, it was equal to 0.5 – 0.7% from GDP[31]. It is exceedingly difficult to identify priority areas of researches and developments financing under such conditions. In such a case it is reasonable to take into account the experience of foreign countries, in particular, the financing structures according to fields of study presented in table 6.

As the presented table shows, the structure of research financing seems to be rather various. Due to the fact there is a lack of data related to Ukraine in the table, it is possible to compare national practice with Russia with a certain suggestion. So, which conclusions shall we made as a result of analysis of presented data?

[29] "Uriadovyi kur'ier" no. 114 (2009): 2. [In Ukrainian].
[30] Surzhyk, L. "Daite model finansuvannia nauky i ya…". *ZN., UA 2* (2018): 3. [In Ukrainian].
[31] Unkovska, T. Nova ekonomichna stratehiia dlia Ukrainy. *ZN., UA 7* (2017): 7. [In Ukrainian].

Table 6 **DISTRIBUTION OF FINANCING OF SCIENTIFIC AND RESEARCH DEVELOPMENTS ACCORDING TO FIELDS OF STUDY IN CERTAIN COUNTRIES IN 2016, %**[32]

Scientific sectors	Korea	FRG	Italy	Turkey	Spain	Russia	Great Britain
Natural	15	28	38	47	22	44	38
Engineering	63	44	40	23	25	17	17
Medical	3	2	8	7	30	18	17
Agricultural	9	21	4	5	14	11	13
Social	9	2	3	4	5	6	13
Human	1	3	7	4	4	4	2
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Firstly, engineering sciences dominate in research financing (Korea, FRG, Italy and Spain). The experience of South Korea is especially impressive as it spends 63% from all expenses to financing of this sector. It is no surprise at all that this country takes pride of place in the world innovation development. For example, South Korea ranks 4th in the world among 120 countries according to the number of patents, while Ukraine ranks only 24th under virtually the same number of inhabitants[33]. Arrearage of Russia and the Great Britain according to this indicator that have only 17% comes under notice at the same time. Ukraine has much the same indicator, so the abovementioned newly created National Council of Ukraine in the matters of development of science and technologies has to deal with this particular problem. Otherwise Ukraine may face a threat of further intensification of technological inferiority. The fact is that Ukraine is in the next-to-last place according to integral index of innovations of European countries – 0.206, getting the start of only Bulgaria – 0.172, under average index in EU equal to 0.544, not to mention Switzerland – 0.828, Sweden – 0.757, Germany – 0.697 and other innovative leaders[34].

Secondly, it is interesting to note the leading positions of Turkey – 47%, and Russia – 44% in the financing of natural sciences. If for Russia this position is caused by the need to study a huge area, the

[32] Akaev, M.A., Markusova, V.A., Moskaleva, O.V. and V.V. Pysliakov. *Rukovodstvo po naukometryy: ydykatory razvytyia nauky y tekhnolohyi: [monohrafyia]*. Ekaterynburh: Yzd-vo Ural, 2017. [In Russian].

[33] Luk'ianenko, D.G. ed. *Paradyhma kreatyvnoho menedzhmentu v hlobalnii ekonomitsi: monohrafiia*. K.: KNEU, 2016. [In Ukrainian].

[34] Heits, V.M. edc. and in. *Innovatsiina Ukraina – 2020: Natsionalna dopovid*. NAN Ukrainy, K, 2019. [In Ukrainian].

desire to maintain positions in space exploration and military-industrial complex, then Turkey has made serious progress in this sector. Finally, thirdly, the leading positions of the Great Britain in social sciences (13%) seem to be quite logical, which makes it possible for the country to achieve the European Human Development Indicator's highest indicator of 0.767. In this regard, it is appropriate to note that this indicator is also convincing for Ukraine – 0.551, which allowed our country to enter a group of active innovators.

If we consider the state of financing of innovation activity in general, and not just research developments, then it is advisable to use the indicator of financial support for innovations in the scoreboard of the European Union (Innovation Union Scoreboard). According to this indicator, Ukraine with an indicator of 0.101 gets the start of only Bulgaria – 0.057, and Macedonia – 0.072 and is part of a group of emerging innovation countries. It should be noted that the average value of this indicator in the EU is equal to 0.558, while in the countries – Innovation leaders it is respectively: Iceland – 0.969, Estonia – 0.794, Finland – 0.767, Sweden – 0.741, Denmark – 0.717, etc[35].

Proceeding from the extremely unfavorable situation regarding the financing of innovations in Ukraine, we will propose some ways of solving this problem in Ukraine and Georgia, which is also not among the innovative leaders.

First of all, state authorities and management, in particular, the National Council of Ukraine in the matters of development of science and technologies, headed by the head of government, must organize the development and approve the special concept of innovation activity financing in its broadest sense in accordance with the provisions of the Law of Ukraine "On innovation activity". In this case, the forms and instruments of financing should be differentiated in three stages:

1) research stage (exploratory and scientific research activity);
2) production stage (implementation of developments, prototyping, release of innovative products);
3) commercial stage (increase of release of innovative products and their promotion both on the domestic and on global market).

Secondly, to take urgent measures to increase the volumes of corporate financing of innovation activity, primarily in large companies, transnational corporations with branches in Ukraine, in particular, Coca-Cola, Nestle, and others. After all, world experience convincingly

[35] Heits, V.M. edc. and in. *Innovatsiina Ukraina – 2020: Natsionalna dopovid*. NAN Ukrainy, K, 2019. [In Ukrainian].

shows that it is corporate sources that predominate in the innovative investment.

Thirdly, to modernize the system of state support for research activities drastically on the basis of the transition from funding organizations, primarily the academic sector, to the design investment of advanced development.

Fourthly, it is important to introduce tax incentives for innovation in the experience of foreign countries: Australia, Canada, the Netherlands, and others. The following can be used as the main forms of tax support for innovation investment: tax credits for innovative enterprises (delay in payment of taxes for the period of the innovation cycle); accelerated depreciation of the latest equipment, primarily of imported origin, computer technology, robotics and other fixed assets used in the innovative projects; raising coefficients of up to 1.5 to current costs of innovation activity in order to reduce the base for the calculation of profits on the company tax; reduction, including the complete exemption of individual innovation enterprises from some state and local taxes.

Fifthly, to involve bank lending for innovation activity, which has recently been actually destroyed as a result of false interest rate policy both on the part of the National Bank of Ukraine and on the part of the commercial banks. After all, without bank lending at the final commercial stage of the innovation cycle, it is virtually impossible to bring new products and technologies to the market. In this regard, it is advisable to return to the proposal of many specialists, in particular the authors of the National Report "Innovative Ukraine – 2020", to expand funding for innovation through the State Development Bank of Ukraine as the 1st level bank. As it is known, such a bank was officially created by the decision of the Cabinet of Ministers of Ukraine in 2003 (Order of the Cabinet of Ministers of Ukraine "Some Issues of Innovation Infrastructure Development in Ukraine and Areas of Activities of the Ukrainian State Innovation Company in 2003" dd. May 05, 2003, No. 655). However, the activities of this bank proved to be extremely ineffective, as it was not provided with a special status or proper resources, as was done in its time as to Ukreximbank. A special law shall be devoted to this bank in order to create a reliable base for long-term financing of competitive innovative projects[36].

Sixthly, the need to create new modern mechanisms for financing of innovation activities became imminent in Ukraine. These are the State Venture Fund, the formation of a special network of Ukrainian business

[36] Heits, V.M. edc. and in. *Innovatsiina Ukraina – 2020: Natsionalna dopovid*. NAN Ukrainy, K, 2019. [In Ukrainian].

angels that act successfully and mutually beneficially in developed countries, attracting funds from foreign investors by placing shares of domestic innovation companies on foreign stock exchanges, and developing a comprehensive State Program of Venture Capital Investment. The implementation of the proposed and other urgent regulatory and legal and organizational measures will enable to unlock the significant intellectual potential of Ukraine and Georgia in increasing the competitiveness of our countries at the expense of innovation factors.

Conclusion

The urgency of the problem of innovation activity financing is due to the fact that it has become a leading factor in increasing international competitiveness not only at the micro level, but also for national economies as a whole. However, innovative investment has a controversial intrinsic nature. On the one hand, the cost of innovation projects is extremely risky, because on average, the success rate of innovation does not exceed a quarter. On the other hand, as the practice of companies such as Apple, General Electric, Hewlett Packard, Dell, etc., has shown, well-timed funding of rather risky innovations allowed them to take leadership in the modern world business. Proceeding from this situation, researchers seek to invent the most reliable tools for assessing the promising innovation developments. Managers at different levels, especially top-level ones, try to combine these tools with their own experience, their intuition and colleagues' thoughts, in order to provide financing for such innovations that will strengthen the positions of companies on world markets.

Analysis of the development of the global economy has revealed rather strong correlation between different innovation indicators and the competitiveness of the national economy. Extremely close correlations exist between the global index of innovation and the information society index, on the one hand, and GDP per capita, the indices of economic efficiency, technological development, human development and, ultimately, global competitiveness, on the other. These relations are a powerful motivator for governments, especially developed countries, to increase the efficiency of innovation investment, an interesting experience of which is accumulated in the European Union.

The key feature of the experience of innovation development financing in the EU is, first of all, the use of long-term programs supporting this activity. First of all, this applies to the well-known European framework program “Horizon – 2020", which was launched in 2014 and includes the following components: Framework programme for

Research and Technical development; Competitiveness and Innovation Frame work Programme; European Institute of Innovation and Technologies. The second component of European innovation investment practices is related to the financial localization of innovation activities, when priorities for allocating funds to innovative projects are provided to those regions that dominate according to the integral indicator of innovativeness among the following regions: the Netherlands, Belgium, Finland, Luxembourg, North Germany, Southern Great Britain, Austria, Italy, Sweden, Norway, Slovenia, etc.

Models of investing into innovation projects are important in effective innovation development. The idea of such models is to combine certain sources of financing with the stages of implementation of these projects. With such an approach at the first initial stage with high risks, the main sources of funding are state programs, as well as a close environment of innovators (friends, relatives, family members and other fans). In the second stage, when launching a project and prototyping, so-called business angels and venture funds are involved in financing. At the stage of growth, when a company starts to generate profits, various industry and regional commercial sources of investment are used. Finally, at the final stage of the expansion of innovative products into domestic and foreign markets the bank loans and borrowings on the securities market are used.

The analysis of the financing environment in Ukraine and Georgia shows that the possibilities of innovative investment in our countries are extremely low. In order to make the investment and innovation climate better, it is advisable to take a number of urgent measures. Such measures include: rationalization of the structure of expenditures of funds according to the sectors of research in favor of engineering sciences, activation of the recently established National Council of Ukraine in the matters of development of science and technologies under the Cabinet of Ministers of Ukraine, increasing the volume of corporate investment, drastic modernization of state support for scientific and research activities, implementation of tax exemptions for enterprises that occupy leadership positions in the innovation activities, expansion of bank lending to innovation projects, implementation of new forms of support for innovation investment (creation of a network of business angels, attraction of the foreign investors, establishment of private innovation funds, etc.).

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