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IMPROVING THE SYSTEM OF PUBLIC SUPPORT AND MECHANISMS TO STIMULATE INNOVATION IN AGRICULTURE

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Abstract

In most countries and regions in the scientific community is increasingly a question about the level of economic development of the primary and secondary branches of national economy. Here the degree involvement in the innovation process is no less important aspect of sustainable development of small and medium-sized enterprises, in particular, engaged in agricultural production, which is now regarded as generators of the most innovative ideas, implementing successful innovation projects. But, most of the financing of innovative projects in the Republic of Moldova at the expense of public funds, and to a lesser extent with additional private or foreign investments. Therefore, is required a deep analysis of the composition and structure of the innovation environment in the country and develop a mechanism for enhancing innovation through the effective interaction of significant economic and political instruments. The article draws on statistical and economic research methods. The main methods of processing and analyzing statistical data are: economic grouping, comparison and analysis of variance. Research results indicate the need for the formation of venture investment in the innovation process through the development and adoption of the corresponding legal and regulatory framework, and the establishment of closer ties between private entrepreneurship and the scientific community.

Key words: *economic development, enhancing innovation, innovation projects, venture financing.*

INTRODUCTION

The innovation process is of vital importance for the socio-economic development of the country under the current conditions of economic globalization. Therefore, the economic development, the level of competitiveness and social welfare in the Republic of Moldova is highly dependent on the social ability to innovate.

In order to support the innovation process in Moldova there have been created certain prerequisites necessary for the innovation development by establishing and improving the legal framework that regulates innovation activity and ensures the strategic basis of the innovation concept and technology transfer as well as other accompanying activities. There have been established the corresponding mechanisms to implement innovation projects, to transfer and develop new technologies, products and services.

MATERIALS AND METHODS

The documentary basis of these studies is legislative and regulatory acts of the Republic of Moldova. To regulate the scientific, research and innovation activity there was adopted the Code on Science and Innovations of the Republic of Moldova no. 259-XV of July 15, 2004 [4]. A new vector in the development of the Innovation Policy of the Republic of Moldova was the Innovation Strategy 2013-2020 "Innovations for competitiveness" no. 952 of November 27, 2013 [6], developed to implement the Program on the Government Activity "European Integration: Freedom, Democracy, Welfare" 2013-2014 and the Plan on the Government Activity of the Republic of Moldova no. 289 of May 7, 2012 (Official Monitor no. 93-98, 2012, p. 330) [5]. The strategy defines the basic directions and factors of the innovation development of the Republic of Moldova till 2020. Hence, the main implementation objective of this document is to improve the economic, political and social competitiveness of the country at the international level.

The research methodology is based on the use of analytical and mathematical tools of analysis. To prove the ideas stated in the article there have been used the methods of dialectical, systematic, functional, static

(correlative and regressive) and comparative analysis.

RESULTS AND DISCUSSIONS

In 2004 there was established the Agency for Innovations and Technology Transfer, part of the Academy of Sciences of the Republic of Moldova, at the initial stage of the process of the national innovation system development in order to stimulate, coordinate and implement the necessary mechanisms and to use the corresponding tools in the field of innovations and technology transfer. The main objective of this institution is to be a link between the scientific environment, authorities and business - their engagement is necessary to make the innovation system function efficiently and to ensure the competitiveness of the country's economy at the international level [7].

The Agency is the significant part of the national innovation infrastructure that should play an important role in the innovation economy development, ensuring the country's competitiveness at the international market. Innovation infrastructure also includes hi-tech parks, innovation incubators, scientific and research centres and economic agents [8].

Table 1. The main performance indices of hi-tech parks (HTPs) and innovations incubators (InnIncs) in the Republic of Moldova in 2013

The name of the HTP/InnInc	The number of IPs implemented within HTPs/InnInc	The number of working places		The total amount of wages within the project (Lei thou)	Investments (Lei thou)	including:		the cost of realized products (Lei thou)	including :	The number of residents	
		Total	*New*			*from the state budget (Lei thou)*	*from abroad (Lei thou)*		Export (Lei thou	Total	New
HTP "Academica" (together with InnInc Inovatorul)	6	166	14	1,047	422	18	0	23,833	2,500	15	-
HTP "Inagro"	-	-	-	-	-	-	-	-	-	13	1
HTP "Micronanoteh"	4	41	23	321.60	1,703.6	367.65	0	0	0	3	2
InnInc "Politehnica"	-	-	-	-	-	-	-	-	-	-	-
InnInc "Inventica-USM"	-	-	-	-	-	-	-	-	-	-	-
InnInc "Itech"	-	-	-	-	-	-	-	-	-	-	-
InnInc "Nord"	-	-	-	-	-	-	-	-	-	-	-
InnInc "Innocenter"	3	17	9	134.6	570.0	225.3	0	473.76	0	2	2
InnInc "Antreprenorul Inovativ"	0	61	44	544.2	2,636.8	1,123.6	0	2,646.0	0	6	3
Total	***13***	***285***	***90***	***2,047.4***	***5,332.4***	***1,734.55***	***0***	***26,952.76***	***2,500***	***39***	***8***

Source: developed by the author based on the AITT data.

At present there are 3 hi-tech parks and 7 innovation incubators in the Republic of Moldova, which improve the efficiency of research results implementation, provide consumers with competitive industrial products, work and services, based on innovation. They include 39 resident companies, selected on the competitive base and approved by the High Council for Science and Technology Development of the Academy of Sciences of the Republic of Moldova. In spite of the fact that there are 8 clusters within the innovation infrastructure of the Republic of Moldova, the first scientific and research cluster in the field of modern technologies "Elchim-Moldova" was established in 2013. Ten partners have concluded the association agreement: 4 universities, 3 scientific and research institutions, the factory "Topaz", AITT and the Academy of Sciences of the Republic of Moldova in order to ensure the cooperation between businessmen and scientists [1]. The cluster in the field of nanotechnologies and IT was founded in 2014 and is at the stage of development. This proves that scientists are interested in the improved innovation process in the country, but the business society should be more interested in the implementation of the corresponding partnership.

Yearly the Agency for Innovations and Technology Transfer of the Academy of

Sciences organizes a competition on innovation projects and technology transfer; the state funds up to 50% of the total project cost. Implementation of innovations or new technologies is the mandatory condition of project realization. The period of innovation and technology transfer project implementation is no more than 2 year. Research shows that the number of projects varies from year to year. In 2007 and 2010 there were registered the greatest numbers of implemented projects, but there was observed gradual reduction, which is related to the decreased funds of innovation projects, the unstable economic and political situation both in the country and abroad. There were selected 40 projects on innovations and technology transfer on the competitive base in 2013, 22 of them were funded (Lei Million 6.82 from the state budget and Lei million 9.58 from the private sector) and implemented.

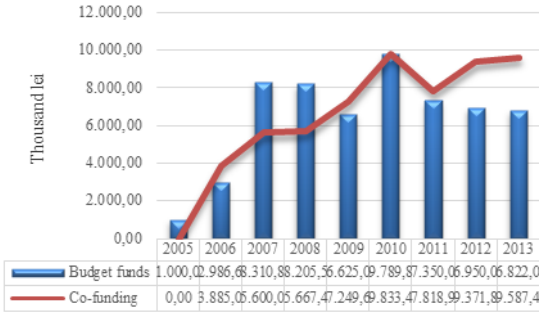

Fig. 1. The funding dynamics of innovation projects in 2005-2013
Source: developed by the author based on the AITT data.

The structural vision of the general situation regarding the funding of the innovation development of the country is formed based on the provided data. One can notice that the share of private funds was being gradually increased and reached its maximum value in 2010. At the same time, public funds for innovations and technology transfer are significantly decreased.
The structural dynamics of the number of funded projects industry-wise changes every year, depending on the existing conditions at the country's internal market.

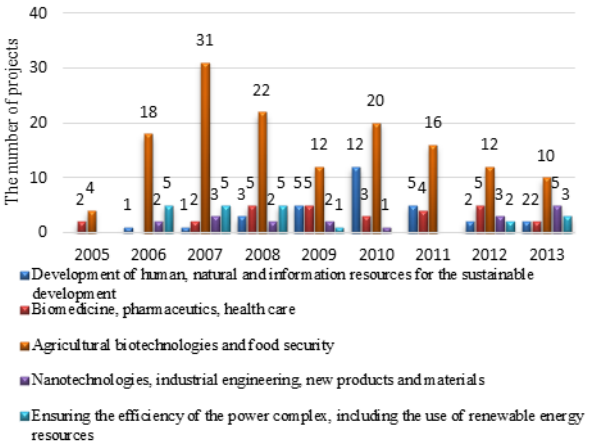

Fig. 2. The dynamics of implemented innovation projects industry-wise in 2005-2013, units.
Source: developed by the author based on the AITT data.

The number of projects in agriculture has significantly decreased over the past 4 years since 2010, which is the consequence of the decreased public funds and agriculture is the branch of the economy that directly depends on public funds. At the same time one can notice the increased number of projects on nanotechnologies, industrial engineering, new products and materials. Taking into account that there were no projects in this field in 2011, their number increased to 5 in 2013.

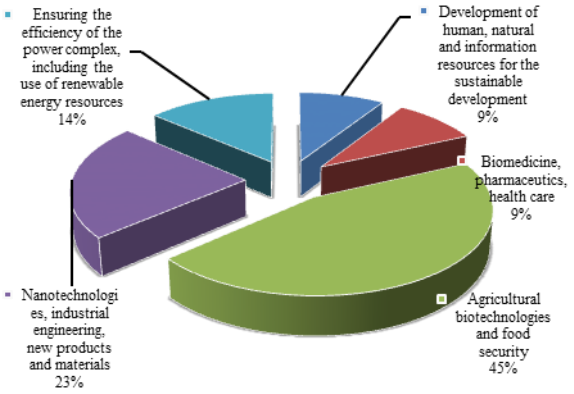

Fig. 3. The funding structure of innovation projects industry-wise in the Republic of Moldova in 2013
Source: Own determination.

The biggest share of innovation and technological projects funding is observed in agriculture, where the average funding is more than 50% of the total funded projects in 2005-2013. In 2013 there were allocated 45% of the total funds for the projects in this field.
The next strategic development in 2013 is

"Nanotechnologies, industrial engineering, new products and materials", then goes the direction "Ensuring the efficiency of the power complex and power security, including the use of renewable energy resources", afterwards – the direction "Biomedicine, pharmaceutics, health care" and the least funded direction is "Development of human, natural and information resources for the sustainable development".

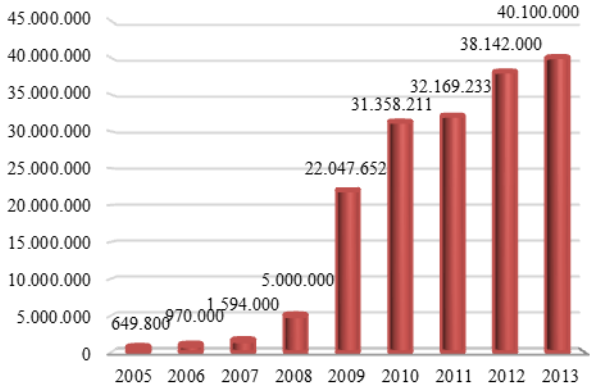

Fig. 4. The volume of realized innovation products in 2005-2013 by innovation projects and technology transfer.
Source: Own calculation.

Funding and project implementation result in innovation products that are introduced into the market; they influence the level of social and economic development of the country. Despite the decreased public funds in 2010-2013, the rate of production and implementation of innovation products is constantly increasing in the country during the studied period. At the same time external funding of the innovation activity is yearly increased, though the state's engagement in this activity funding is still more stable in the Republic of Moldova.

One should measure the interconnection between the funding of innovation processes as a result of the project implementation and the amount of revenues received from innovation products sale to determine the earnings gain from investments.

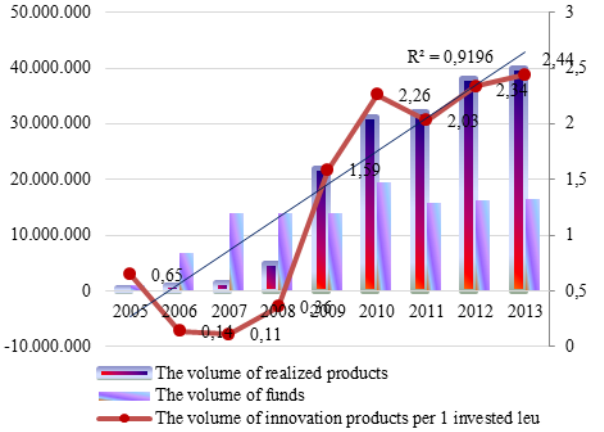

Fig. 5. The dynamics of public funds, output and realization of innovative products, MDL.
Source: Own calculation.

So, we have:

V – specific volume of innovation products;

$V^{(m)}$ – the most possible specific volume of innovation products;

$\frac{\partial V}{\partial t}$ – the increased specific volume of innovation products per unit of time (the intensity of innovation products growth through time).

It is not identified that the increased specific volume of innovation products per unit of time $\left(\frac{\partial V}{\partial t}\right)$ depends directly on the achieved specific volume of innovation products (V) and with the possible potential ($V^{(m)} - V$). Formally this dependence may be expressed as a differential equation with separable variables [3]:

$$\frac{\partial V}{\partial t} = AV\left(V^{(m)} - V\right) \quad (1)$$

To solve this equation one needs to find: $V = \frac{V^{(m)}}{1+\frac{V^{(m)}-V_0}{e^{AV^{(m)}t}V_0}}$;

$$P(x,y)\,dx + Q(x,y)\,dy = 0 \quad (2)$$

$$f_1(x)\cdot f_2(y)\,dx + \varphi_1(x)\cdot\varphi_2(y)\,dy = 0 \quad (3)$$

According to N. Kremer, if the equation (2) after transformation can be presented as the equation (3), then it is the equation of separable variables [2]. We exclude the points where the functions $\varphi_1(y) = 0$ and $f_2(y) = 0$. Then, by dividing both sides of equation (3) on $\varphi_1(y)f_2(y)$, we obtain the following equation:

$$\frac{f_1(x)}{\varphi_1(x)}dx + \frac{\varphi_2(y)}{f_2(y)}dy = 0 \quad (4)$$

The variables in this equation are reduced and

the general solution of the equation is the following:

$$\int \frac{f_1(x)}{\varphi_1(x)}dx + \int \frac{\varphi_2(y)}{f_2(y)}dy = C$$

We use this method to solve the differential equation (1), that is we are going to divide both parts of the equation by $V(V^m - V) \neq 0$:

Afterwards, we receive:

$$\frac{dV}{V(V^{(m)} - V)} = Adt \qquad (5)$$

where:

A- the proportionality coefficient.

Then we have to transform the left part of the differential equation (5):

$$\frac{1}{V^{(m)}} \cdot \left(\frac{dV}{V} + \frac{dV}{(V^{(m)} - V)}\right) \qquad (6)$$

The general integral of this differential equation is:

$$\int \frac{dV}{V} + \int \frac{dV}{V^{(m)}} = AV^{(m)} \int dt$$

The general solution of the differential equation:

$$\ln V - \ln |V^{(m)} - V| = AV^{(m)} t + C$$

Therefore: $\frac{V}{V^{(m)} - V} = e^{AV^{(m)}t} \cdot e^C$

Further we find the partial solution of the equation which complies with the initial conditions, that is if $t = 0$, V is defined as V_0:

$$\frac{V_0}{V^{(m)} - V_0} = e^{AV^{(m)} \cdot 0} \cdot e^C \Rightarrow e^C = \frac{V_0}{V^{(m)} - V_0};$$

Therefore:

$$\frac{V}{V^{(m)} - V} = e^{AV^{(m)} \cdot t} \cdot \frac{V_0}{V^{(m)} - V_0};$$

$$V = \frac{e^{AV^{(m)} \cdot t} \cdot \frac{V^{(m)} \cdot V_0}{V^{(m)} - V_0}}{1 + e^{AV^{(m)} \cdot t} \cdot \frac{V_0}{V^{(m)} - V_0}}; \qquad (7)$$

Then, we transform the equation (7) by dividing on $e^{AV^{(m)} \cdot t} \cdot \frac{V_0}{V^{(m)} - V_0} \neq 0$:

$$V = \frac{V^{(m)}}{1 + \frac{1}{e^{AV^{(m)} \cdot t} \cdot \frac{V_0}{V^{(m)} - V_0}}} = \frac{V^{(m)}}{1 + \frac{V^{(m)} - V_0}{e^{AV^{(m)} \cdot t} \cdot V_0}}$$

The volume of innovation products per 1 invested leu in 2006 is V_0=0.14, that is if in 2006 the initial t=0, V= 0,14. So,

$V = \frac{V^{(m)}}{1 + \frac{V^{(m)} - 0.14}{0.14 \cdot e^{AV^{(m)} \cdot t}}}$; if $t \to \infty$ $V = V^{(m)} = 3$.

Further, we have to calculate the sums to find out the linear regression coefficient when determining the dependence degree of the innovation processes funding volume and the output of innovation products:

Table 2. The value calculation to determine the parameters of the linear regression equation

Years	The volume of funds X_i	The volume of realized products Y_i	X_i^2	$X_i Y_i$	Y_i^p
2005	0.1	0.65	0.01	0.065	7.64
2006	6.9	0.97	47.61	6.693	21.59
2007	13.9	1.59	193.21	22.101	35.96
2008	13.9	5.00	193.21	69.5	35.96
2009	13.9	22.05	193.21	306.5	35.96
2010	19.6	31.36	384.16	614.6	47.66
2011	15.8	32.17	249.64	508.3	39.86
2012	16.3	38.14	265.69	621.7	40.89
2013	16.4	40.10	268.96	657.6	41.09
	$\sum x_i = 116.8$	$\sum y_i = 172.03$	$\sum x_i^2 = 1,795.7$	$\sum xy = 2,807.06$	-

Source: Own calculation.

The empiric line of regression is identified as result of the following function:

$$Y^p = a_0 + a_1 x \qquad (8)$$

To define the parameters of the regression equation we calculate:

$$a_1 = \frac{n(\sum y_i x_i) - \sum y_i \sum x_i}{n(\sum x_i^2)}; \qquad (9)$$

$$a_1 = \frac{25,263.54 - 20,093.104}{16,161.3 - 13,642.24} = 2.052$$

$$a_0 = \frac{1}{n}(\sum y_i - a_1 \sum x_i); \qquad (10)$$

$$a_0 = 0.11 * (172.03 - 2.052 * 116.8) = 7.44$$

Thus, the sought regression dependence looks like: $y^p = 7.44 + 2.052x$

The correctness of the developed linear regression equation, if necessary, may allow us forecasting the level of production and costs in the innovation activity. Moreover, one should identify the value of the changed elasticity of the studies indicators based on the equation of correlated regression:

$$E_x\left(y^{(p)}\right) = \frac{dy^{(p)}}{dx} \cdot \frac{x}{y^p} = \frac{2.052x}{7.44 + 2.052x};$$

The given elasticity coefficient shows that if indicator x is increased by 1%, and then indicator $y^{(p)}$, will be increased by $\frac{2.052x}{7.44+2.052x}$ %.

To calculate the elasticity coefficient we should transform the equation:

$$\frac{2.052x}{7.44+2.052x} = 1 - \frac{2.052x}{7.44+2.052x} = E_x\left(y^{(p)}\right);$$

If x=0, then $E_x\left(y^{(p)}\right)$=1-1=0;

If $x \rightarrow 0$, then $E_x\left(y^{(p)}\right) \rightarrow 1$.

CONCLUSIONS

Conclusions of the author's study are the following:

Indicator $y^{(p)}$ relatively to the indicator x is not elastic, ie there is no alternatives for public funding of innovative production in the Republic of Moldova in this phase of economic development.

Based on the value recorded in 2013, we conclude the following: for every 1 leu invested by public funds for innovative projects and technology transfer it was obtained 2.4 lei of innovative products.

Comparing the output and sales of innovative products in 2013 and 2005, we can conclude that with the growing of innovative products, at the same time increases the interest of the private sector in the financing of innovative projects and as a result increases the innovative potential of the national economy.

It is necessary to encourage innovation in the country with the following measures:

-tax incentives for research, public funding of research in agricultural enterprises;

-promoting linkages between science and the public sector enterprises;

-the agreement with industry and agriculture on training through research.

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