ECONOMETRIC MODELING OF THE PROCESS OF FINANCING INNOVATION AND INVESTMENT ACTIVITY IN ENTERPRISES

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Abstract

The economic crisis that a number of countries faced after the global pandemic forced enterprises to provide innovation and investment activity in the national economy by limiting the flow of cash flows in the production of goods and services. The way out of any country from the economic recession, as well as the construction of a modern innovative economy depends, first of all, on effective investments. In the context of the current global pandemic, which is still continuing in the world community, improving the financial mechanism for ensuring investment and innovation activity of enterprises is one of the most pressing problems. This article is devoted to econometric modeling of improving the financial mechanism for ensuring investment and innovation activities of enterprises. Based on the results, a scheme of sources and forms of financing the innovative activities of enterprises is proposed. The novelty of the presented scheme lies in a comprehensive approach that shows the sources of financing of innovative activities by types of ownership, levels of owners, attitude towards ownership, as well as forms of financing of innovative enterprises. In addition, on the basis of the study, an author's algorithm for financing innovation-active enterprises based on the issue of debt obligations is proposed. The developed algorithm makes it possible to use the most significant sources of funds from various spheres in financing the innovation process and thereby solve the problem of resource support for innovation activity. The novelty of this algorithm lies in the consistent involvement of various categories of potential investors in the investment process to finance innovative companies. The proposed financial tools are aimed at stimulating the innovative activity of enterprises.

Keywords: Investment projects, enterprises, financial flows, innovation, product innovation, model, fixed capital, correlation

INTRODUCTION

The share of direct investment in the world economy in 2020 will decrease by 35% compared to 2019. The quarantine cases applied due to the Covid-19 pandemic in the countries of the world have forced the suspension of many started investment projects, and multinational enterprises to work on new innovative types of investment projects. It should be noted that in developed countries, as a result of corporate restructuring and disruptions in financial flows between domestic firms, the share of foreign direct investment has declined on an upward trend of 58%. With such a sharp decline in foreign direct investment, there is a need to finance new investment projects in developed and developing countries. The number of newly announced investments in these countries also decreased by 42%, and the number of international agreements on financing projects important for infrastructure decreased by 14%. As a result of measures aimed at increasing investment activity at the international level, investments in new enterprises in developed countries decreased by 19%, and the level of financing of international projects increased by 8%. Investments in financing new projects have led to an increase in innovative production capacity and the formation of a modern market infrastructure [1].

International organizations such as the World Bank, the International Monetary Fund, and the United Nations Development Program, which are leading international financial institutions, pay special attention to scientific work aimed at improving investment guidance and methodological recommendations for building an innovative economy through the introduction of effective financing mechanisms in companies. These studies have been developed by reputable research centers, which have allowed to improve the mechanisms of formation of sources of financing of enterprises in accordance with the requirements set by international standards. However, the theoretical foundations of investment and innovation financing of enterprises operating in the economy, methods of analysis and evaluation of investment activity of enterprises, economic policy to ensure innovation and investment activity, sources and methods used in the analysis of the effectiveness of financing investment and investment activities, important issues related to ways to improve the mechanism of financing investment and innovation activities in enterprises have not yet been resolved.

LITERATURE REVIEW

The issue of improving the financial and credit mechanism to ensure investment and innovation activity in our country is becoming one of the most pressing issues. Some theoretical, methodological and practical aspects of investment, investment policy and investment environment have been implemented by a number of Uzbek economists [2].

Many foreign economists, including D.Bell and Y.Shumpeter, have made a worthy contribution to the issue of ensuring innovative economic growth and increasing innovative activity in the economy. CIS economists V. Logacheva and V.M. Gates also studied in their scientific researches. These economists explain innovative economic growth mainly in relation to human capital and the factor [3].

The researches of economists of the country N.Rakhmatov and A.Mirzaev emphasize the issues of development of innovative activity in the economy of Uzbekistan, directions and issues of innovative management of enterprises. However, the issues of financial and credit mechanisms have been neglected in achieving investment and innovation activity [4].

Our research analyzes the study and application of aspects of the global financial market that will serve to further increase the investment and innovation activity of our country. In this context, the issue of econometric modeling of the process of financing innovation and investment activity in enterprises has a special place.

METHODOLOGY

In the introductory part of our study, the quarantine cases caused by the Covid-19 pandemic in the world forced many investment projects to stop, multinational enterprises to work on new innovative investment projects, as well as the essence of investment and innovation reforms in our country. In the analysis of the literature it is planned to state the theoretical and scientific views on improving the financial and credit mechanism of investment and innovation activity in the country. In the analysis part, based on statistical data, models for evaluating the innovative activity of enterprises are developed, analysis is carried out on a selective basis, in the discussion part, the existing problems and shortcomings are identified and practical recommendations for their solution are developed. Opinions were expressed on the continuation of investment and innovation policy in the country.

Elements of systematic approach, graph, induction and deduction, analysis and synthesis, comparison and grouping methods were used in the research. Statistical data on econometric modeling of the process of financing innovation and investment activity in enterprises of the country are obtained from official sources.

ANALYSIS AND RESULTS

In the current process of globalization, the economic activity of any business entity is directly related to the investment process. The economic development of enterprises depends on a number of factors, first of all, the main factor determining efficiency is the attraction of

investment. This is evidenced by the fact that the structural changes taking place in Uzbekistan in the next decades of the XXI century are mainly aimed at increasing the efficiency of investment activities.

The above-mentioned circumstances have created a need to increase large-scale investment activity in the country, to conduct targeted research on the analysis of investment activity in the activities of business entities and to systematically study the scientific and theoretical basis of this process. The goal is to liberalize business, create favorable conditions for foreign and domestic investors. First of all, it is necessary to form a long-term investment mechanism that is economically, legally and organizationally perfect. This, in turn, means that the methodology of investment activity analysis in enterprises needs to be radically reconsidered and systematically studied. Any analysis is a process that requires debate and discussion. Economic analysis is a set of methods that describe the economic relations of a particular business entity and create an opportunity to clearly define these areas of activity and draw conclusions. Economic analysis consists of identifying and solving problems that arise in a number of economic relations, setting targets and eliminating the identified problems, effectively using specific methods, techniques, directions in the analysis of this process. Such an approach is based on the unity of analysis and synthesis of real-life scientific research methods [5].

It is known that in recent years, many scientific studies have developed econometric models to improve the efficiency of enterprises on the basis of innovative management in enterprises. Based on the models, the factors influencing the innovation and investment processes in enterprises and their effectiveness are analyzed.

The first hypotheses about the possibility of increasing the efficiency of enterprises as a result of innovative activities belong to K. Freeman, who, according to his ideas, any innovative activity in enterprises has a direct impact on the efficiency of the enterprise.

If the profits from the production of innovative products in enterprises are directed to investments in fixed capital, the result of this activity will affect the income and profits of enterprises. We can also see this process in the algorithm presented in the figure 1.

The proposed algorithm (figure 1) states that if the profit from the production of an innovative product increases and is directed to investments in fixed capital, the result of this activity will increase the production of enterprises, which in turn will stimulate costs for innovation.
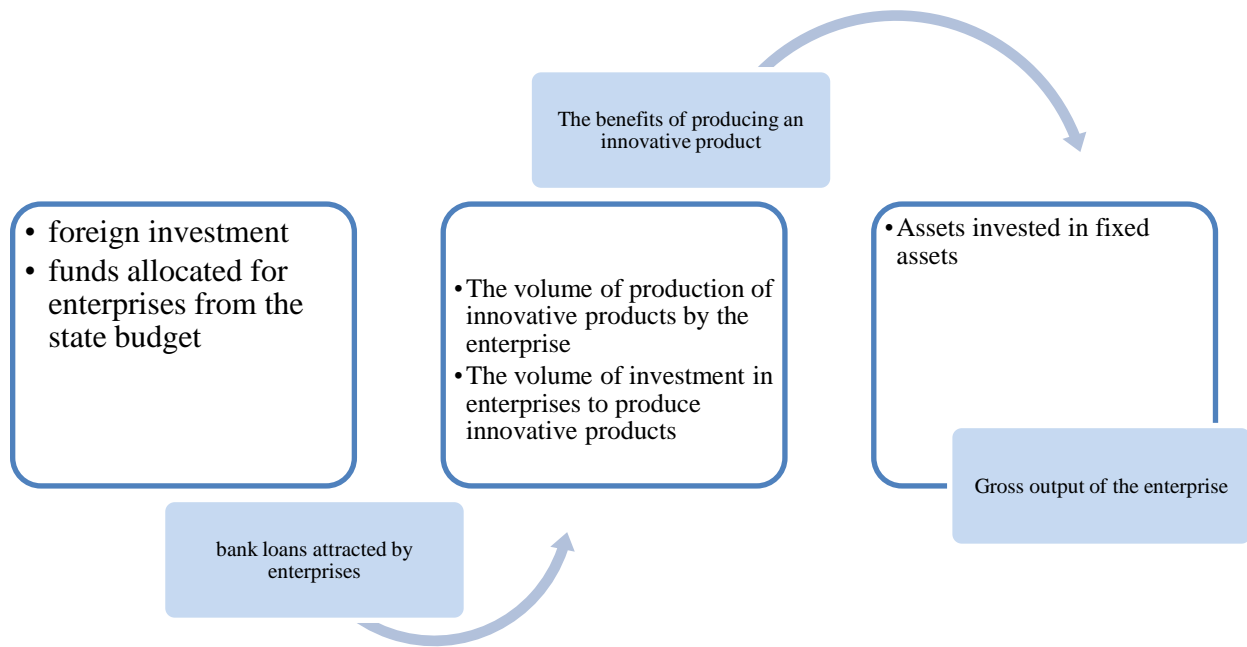
Figure 1. Algorithm of mass production processes of investment activity in enterprise [6].

In our opinion, in the economic modeling of innovative activity in enterprises it is possible to choose the amount of profit from the production of innovative products as a result indicator (y).

As a factor: The volume of production of innovative products by the enterprise is thousand soums. (x1); volume of investments in enterprises for the production of innovative products thousand soums (x2);

Based on the data of Khorezmdon Products Enterprise, we collected data for the model from 2015 to 2020.

Table 1 Model data

Years	The benefits of producing an innovative product	The volume of production of innovative products by the enterprise is thousand soums.	The volume of investments attracted to enterprises for the production of innovative products is one thousand soums
2015й.	14683,5	119561,3	32,8
2016 й.	16789,2	141564,7	64,9
2017 й.	21781,3	185423,2	168,3
2018й.	23654,7	269432,4	234,3
2019 й.	40511,1	569871,7	364,7
2020 й.	36465,4	486124,2	564,3

We examine the model result and factor characters for multicollinearity to examine how they behave in the model and to explore the interrelationships between them. To do this, we construct their correlation table.

Table 2 Correlation matrix

	y	x1	x2
y	1		
x1	0,993633	1	
x2	0,899904	0,88619	1

As can be seen from Table 2, there is no multicollinearity between the data. We can see this in the following case as well.
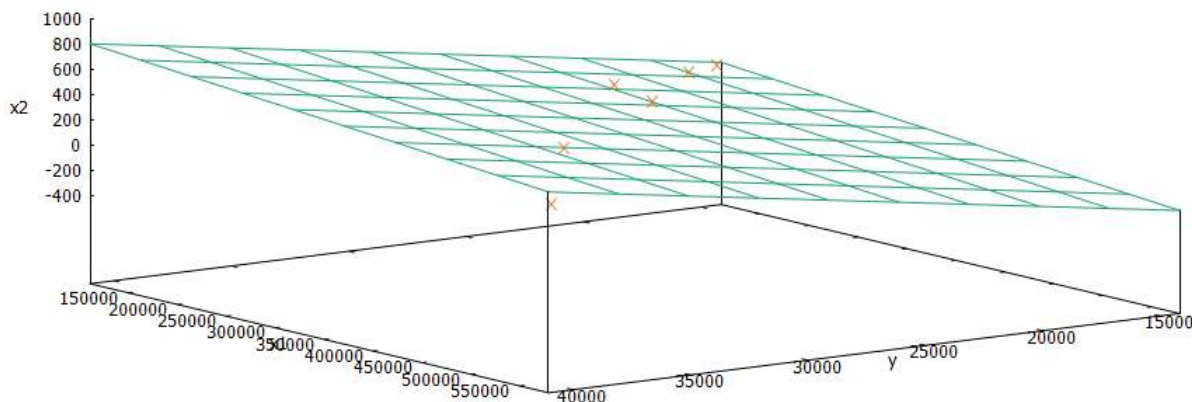

Figure 2. Location of model data in the coordinate plane

Figure 2 represents the presence of an optimal model between the data.

Now we move on to the second stage, the identification stage, where we develop several multivariate econometric models using the "smallest squares method" and determine the parameters of the econometric model to be constructed. The linear multi-factor econometric model looks like this:

$$Y = a_0 + a_1 x_1 + a_2 x_2 + \cdots + a_n x_n \qquad (2)$$

Where: y - the result factor; $x_1, x_2,..., x_n$ - Influencing factors.

(2) If we replace the model by a natural logarithm, then we get the following:

$$\ln(y) = \ln(a_0) + a_1 \ln(x_1) + a_2 \ln(x_2) + ... + a_n \ln(x_n). \qquad (3)$$

(3) in the model $\ln(y) = y'$, $\ln(a_0) = a_0'$, $\ln(x_1) = x_1'$, $\ln(x_2) = x_2'$,..., $\ln(x_n) = x_n'$

If we make the markings, then we will have the following appearance:

$$y' = a_0' + a_1 x_1' + a_2 x_2' + \ldots + a_n x_n'.$$
(4)

(4) The following system of normal equations is constructed to find the unknown parameters $\grave{a}_0, \grave{a}_1, \ldots, \grave{a}_n$ in the model.

$$\begin{cases} n\grave{a}_0 + \grave{a}_1 \sum x'_1 + \grave{a}_2 \sum x'_2 + \cdots \grave{a}_n \sum x'_n = \sum y' \\ \grave{a}_0 \sum x'_1 + \grave{a}_1 \sum x'^2_1 + \grave{a}_2 \sum x'_1 x'_2 + \cdots \grave{a}_n \sum x'_1 x'_n = \sum x'_1 y' \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ \grave{a}_0 \sum x'_n + \grave{a}_1 \sum x'_n x'_1 + \grave{a}_2 \sum x'_n x'_2 + \cdots \grave{a}_n \sum x'^2_n = \sum x'_n y' \end{cases}$$
(5)

If this system of normal equations (5) is solved analytically by several methods of mathematics, then the values of the unknown parameters are found.

Based on the statistics, more than a dozen models for evaluating innovative activities in enterprises have been developed, from which we have selected the following models. Analyzing the process, we achieved the following result (implemented in the STATA-19 program).

In some of the developed models, the parameters are also significant and the model is reliable, but the model has an autocorrelation condition. We use the Darbin-Watson (DW) criterion to test autocorrelation in the residuals of the resultant factor on the model. The calculated DW is compared with the DW in the table.

If there is no autocorrelation in the residuals of the resulting factor, then the value of the calculated DW criterion will be around 2. On some models, the value of the calculated DW criterion is 1.64. This indicates that there is no autocorrelation from the residual factor residues.

Once we have created an optimal model, we analyze the third stage, the verification stage. The importance of the structured model is examined.

Table 3 Results of the selected optimal model [7]

Variable	Model coefficients	Default errors	t-Student Criteria	P-value
Lnx1	0,85	0,02	38,93	0,0000
Lnx2	0,11	0,05	-2,17	0,0122
R^2- Determination coefficient	0,97	The average value of the dependent variable		10,08
Flattened R^2-Determination coefficient	0,95	The standard deviation of the dependent variable		0,40
Standard error of regression	0,54	Akayke's information model		15,19
The sum of the squares of the remains	1,47	Schwartz's information model		15,43
The value of the maximum similarity function	-4,599	Hannan-Quinn criter		13,59
F - Fisher criteria	31421,86	Dar.-Watson (DW) criterion		1,88
Prob (F - Fisher criteria)	0,000			

Typically, the determination coefficient [0; 1] takes values at the intersection. The closer the coefficient value is to 1, the stronger the correlation. In this case, the value of the coefficient of determination is 0.97, which means that there is a sufficiently strong correlation between these economic indicators in the model. In order to be able to compare the models with a different number of factors and not to affect these quantitative factors R2 statistics, a corrected coefficient of determination is usually used [8], ie:

$$R^2_{\text{текис}} = 1 - \frac{s^2}{s^2_y}$$

(6)

In this case, the fact that this flattened coefficient of determination is equal to 0.95 and its proximity to R2, the change in the number of factors influencing the model means that the values are accepted in the environment.

We use Fisher's F-criterion to determine the statistical significance of the constructed multi-factor econometric model and its relevance to the process under study. The actual value of the F-criterion is calculated using the following formula [9]:

$$F_{\text{хисоб}} = \frac{R^2}{1 - R^2} \cdot \frac{n - m - 1}{m},$$

(7)

Where: - coefficient of determination;

   - number of observations;

   - number of factors.

The actual value of the F-criterion is Fhisob = 31421.86. If the actual value is greater than the value in the table, then the constructed multi-factor econometric model is called statistically significant or adequate to the process under study. The table value of the F-criterion is Fjadval = 4.6777.

Fhisob >> Fjadval satisfies the condition, which is statistically significant because the calculated value of the F-criterion is greater than the value in the table, which can be used to forecast future periods.

Student's t-criterion is used to verify the reliability of multivariate econometric model parameters and correlation coefficients. In this case, their values are compared with the values of random errors [10].

When the probability of reliability and the degree of freedom d.f. = 6-2-1 = 3, the table value of the t-criterion is equal to the table = 2.1448. Since the values of all calculated t-criteria were greater than the table values, the model parameters were found to be adequate.

The selected model is reliable in terms of F-test, t-test, determination coefficient, DW criteria.

The analysis of the results obtained in Table 3 shows that we chose this model as the most optimal model because the third model was the most optimal among the developed models and all the assessments met the tests.

We created an empirical model as follows:

$$lny = \quad 0{,}85\ln x_1 + 0{,}11 ln x_2$$

According to the model, a one percent increase in the volume of production of innovative products (x1) by the enterprise leads to an increase in the volume of innovative activities in enterprises by 0.85 percent. This will lead to an increase in the volume of innovative activities in enterprises by 0.11%.

CONCLUSIONS AND SUGGESTIONS

In conclusion, it should be noted that the following measures are needed to finance investment and innovation activities in enterprises:

- The increase in the volume of production of innovative products at enterprises depends in many respects on the installation time of imported equipment and the increase in costs for various reasons;

- It is expedient to apply an investment discount of 10% of the cost of purchasing software under investment projects for the cost of new technological equipment, modernization of production, technical and technological re-equipment, creation of information systems, and this discount should be recognized as accelerated depreciation;

- Creation and security of information systems for innovative activities in the field of information and communication technologies for the implementation of innovative processes in enterprises;

- Renewal of existing production facilities and infrastructure at enterprises in a timely manner.

RECOMMENDATIONS

This study is devoted to identifying problems and identifying possible options for improving existing approaches to providing financial resources for innovative activities of enterprises.

The main condition for the development of the state economy is the innovation-oriented activity of enterprises, their ability and readiness to apply the achievements of scientific and technological progress.

In conclusion, I would like to note that the identified indicators for managing the financial security of the innovative development program provide the formation of the main goals and objectives of managing the innovative activity of an enterprise in the context of the main objects

of management. The formulated tasks can be used to manage the financing of innovation activities of any enterprise.

REFERENCES

1. Report on world investments 2021 investments in a stable recovery review. 2021, United Nations. https://unctad.org/system/files/official-document/wir2021_overview_ru.pdf.

2. Shoxazamiy Sh.Sh. "Methodological bases and priorities of strategic development of the market of tsennyx paper in Uzbekistan". Abstract st. 1-42, T; 2011g,

3. Shoxazamiy Sh.Sh. Textbook "Financial market and securities" T .., TMI. 2012, bet-440 .;

4. Butikov L.I. "Problems of formation and functioning of the market of tsennyx paper in Uzbekistan". Abstract of diss. T., - 2008, p. 1-41,

5. Karimov N.G. "Problems of introduction of market mechanisms of financing of investments in the conditions of economic integration" Abstract of diss. T, - 2007, pp. 1-40,

6. Karimov N.G. and Khojimatov. R.X. Investment organization and financing: Textbook. –T .: TDIU, 2011, pp. 771-787;

7. Schumpeter J. Theorie der wirtschaftlichen Entwicklung - Berlin: Duncker & Humblot, 1912.

8. Drucker P. Innovation and Entrepreneurship. Practice and Principles. - London: Heinemann, 1984.

9. Vernadskiy, V. I. Biosphere and noosphere [Text] / B. I. Vernadskiy. - M.: Ayris-press, 2012. - 576 p.

10. Sheresheva, M.Yu. Correlation of the concepts of "information economy" and "knowledge economy" [Text] / M. Yu. Sheresheva // Bulletin of Moscow University. Series 6. Economy. - 2008. - No. 5. - S. 24-31.

11. Litvinova, V. V. Formuvannya ínnovatsíynoĭ ínfrastrukturi v Ukraĭní [Text] / B. V. Litvinova, V. Í. Políshchuk, B. O. Grabovskiy // Problems of scientific and technological innovation. - 2012. - № 4. - p. 18-22.

12. Shakirova F.B. Development of Uzbekistan's economy on the basis of innovative activity. // Eurasian international scientific journal Problems of modern economics, N 3 (55), 2015. // http://www.meconomy.ru/art.php.

13. Raxmatova N., Mirzaev A. Directions of innovative development of the economy // Market, money, credit. - Tashkent, 2013.-№4 (191) .– B.42-44.

14. Amonboev M. The main directions of modernization of production in the conditions of innovative management of corporate enterprises.-T .: TSU, 2011.-148 p.

15. Lyubushin N.P. Economic analysis: textbook. allowance - M.: UNITIDANA, 2012 .- 24 p.

16. Shamil M. Valitova, Almaz Kh. Khakimov // Innovative potential as a framework of innovative strategy for enterprise development // Procedia Economics and Finance 24 (2015) 716 - 721

17. DimitriosAsteriou and Stephen G. Hall. Applied econometrics. A modern approach using Eviews and Microfit. Revised edition. Palgrave Macmillan, New York, 2007. - r.397

18. Econometrics: Textbook. / Sub-ed. I. I. Eliseeva. - M.: Finance and statistics, 2003. - 51-53 p.