Investment in innovative enterprises of the agro-industrial cluster of Republic of Crimea

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Abstract. According to the main macroeconomic indicators, of Republic of Crimea does not occupy a leading position, therefore, the competitiveness of the region is assessed as low. In modern conditions, in order for the region economy to move to a new, better state, it is necessary to pay more attention to innovation. In such conditions, the importance of high-tech industries of the agro-industrial as an important factor in ensuring economic growth increases. Cluster associations, due to their effective self-organization and the use of innovation by enterprises, have a significant impact on the financial stability of Republic of Crimea. The problem of low innovation activity in enterprises of the agro-industrial cluster the region is due to the low availability of investment resources. For the successful functioning of the economy and the development of new innovative projects, especially in the agro-industrial sphere, it is necessary to attract new investors. The problem of determining the relationship between risk and dividend income when investing in securities issuers is relevant. The article defines the interest of investors in direct investments in enterprises that are elements of the agro-industrial cluster in the region, by determining profitability and risk using the likelihood function.

1 Introduction

The economy of the Republic of Crimea and the city of Sevastopol has developed extensively during its stay in Ukraine [1]. The authors note that "Contemporary Russian economy is characterized by significant disbalances in regional development. So, the study of indicators of socio-economic development has become especially actual" [2]. Stable functioning of the economic system of the region, its problems and opportunities [3], depend on many factors, including from the innovative activity of economic agents [4]. "The paradigm of scientific and technological development emphasizes the need to rethink the basic principles of social capital of urban formations" [5].

The innovativeness of enterprises in the Republic of Crimea and the city of Sevastopol remains low - less than 4%. According to RIA Rating [6], the city of Sevastopol was in 64th place in 2019 in terms of socio-economic development (taking into account: the scale and efficiency of the economy, budget and social spheres); in terms of quality of life - at 55th (in 2016 - 29th place); In 2018, the region was 59th in terms of the index of scientific and technological development of Russian regions.

According to the Federal State Statistics Service in the section "Science and Innovation", the internal costs of research and development in Sevastopol in 2018 amounted to 826 million rubles. (0.08% of the total Russian), the number of researchers performing research and development - 1048 people. The latter indicator is alarming, since in 2015 there were 1288 researchers in the region. The number of organizations performing research and development from 12 in 2015 to 9 in 2018 also decreased [7, 8]. There are no real mechanisms of interaction between scientific, educational organizations and business. According to the World Economic Forum, this estimate is at a very low level - 3.1 points [9].

The business structures of the city of Republic of Crimea and the city of Sevastopol are developing inefficiently. The main reasons are: lack of own financial resources, poor access to borrowed sources of financing, low investment attractiveness of the region due to the sanctions regime. In Republic of Crimea and the city of Sevastopol, credit organizations are not ready to actively finance legal entities - residents and individual entrepreneurs. The cost of credit resources is constantly decreasing, which is associated with a decrease in the discount rate of the Central Bank of the Russian Federation, but they still remain too expensive for business entities - banking clients. In addition, it is advisable to use alternative financing mechanisms, such as financial leasing, initial placement of securities on the stock market, joint investment, investment risk insurance. It should not be forgotten that today, during the period of struggle in the country with the spread of coronavirus infection, the financial situation of individuals and legal entities has deteriorated sharply.

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The drop in revenue, the growth of counterparty defaults – all this will make it difficult for organizations to access cheaper bank loans. At the same time, for companies seriously affected by the crisis, interest rates on loans at some banks may even increase. One of the main challenges facing the region is its innovative development. For the successful functioning of the economy and the development of new innovative projects, especially in the agro-industrial sphere, it is necessary to attract new investors, therefore, the problem of determining the relationship between risk and dividend income when investing in securities issuers of Crimea and the city of Sevastopol is relevant.

2 Theory

The dynamic development of Russian regions is largely ensured by the effective functioning of the economic and social spheres based on the use of innovations [11]. Cluster associations, due to their effective self-organization and the use of innovation by enterprises, have a significant impact on the financial stability of the regions. In 1998, M. Porter spoke about cluster structures and their impact on the economy, determining the composition of clusters, thereby determining their internal support role [12]. The team of authors [13] proposed an innovative sectoral approach to cluster formation based on identifying clustering priorities and assessing integration potential. Based on this approach, taking into account the existing competing regions in a particular industry, and also taking into account the current level of industry development in the regions, it is possible to identify promising areas in which the region has the opportunity to build its strategic competitiveness [13]. Cluster systems have undeniable advantages: reducing the likelihood of bankruptcy and increasing the resilience of individual enterprises to the effects of external and internal factors through pooling assets; expansion of the social sphere; increasing technological competitiveness through modernization of production; production of innovative high-quality and competitive products through the creation of a single financial and material and technical base [14].

The issues of ensuring the economic growth of regions based on the intensification of innovative activity are widely studied in economic science. O.V. Inshakov created the scientific school “Patterns of Evolution, Methods of Transformation and Strategic Modernization of Economic Systems”, which addresses the multidimensional problems of regional economies, including the cluster development of the Russian of the agro-industrial cluster in terms of technological platforms, economic resources, strategies for socio-economic development of regions and so on [15-17]. Scientific School A.G. Granberg [18] and his followers [13, 19-24] for more than thirty years they have been studying interregional intersectoral models and spatial development of the Russian economy. A.I. Tatarkin [25] pays special attention to self-development and self-sufficiency of territories.

It is in the cluster structures that enterprises that are interesting to investors in terms of investing in order to generate income are included. But, given the specificity of the economy of Republic of Crimea and the city of Sevastopol in modern conditions, there are certain risks of direct investment, which plays a decisive role for investors in making investment decisions.

Therefore, the aim of the article is to determine the interest of investors in direct investments in enterprises that are elements of the cluster structures, by determining profitability and risk.

Let us calculate the probability of an undesirable event by checking the statistical hypothesis. The basis for such a calculation, namely a calculation, not an estimate, is the exact distribution of the verification criterion and, more specifically, its probability distribution density. As it’s known, the area of a section under the curve of its graph is equal to the probability of a random value falling into this section. Thus, if we reliably set the boundaries of the region into which the random variable should fall, then we can determine the probability exactly.

We introduce the concept of investment risk, for this we consider the motives of the investor and his tasks. An investor can be considered as an entity having a certain capital and intending to invest it with the least risk. Moreover, to invest in such a way as to satisfy the sense of ownership and at the same time receives certain cash receipts from investments.

If to exclude unreliable banking institutions, then Investing in the banking sector is the least risky undertaking. But if an investor has the opportunity to invest free cash in the shares of a company paying dividends with higher returns than bank interest, then this possibility should be seriously studied. The great riskiness of such investments in relation to storing money in the bank is obvious and this is manifested in the fact that the risk of losing all money due to depreciation of shares is commensurate with the risk of losing money in the bank; and it can be neglected in comparison with the risk of incomplete receipt of funds as a result of a decrease in the level of dividend payments.

3 Research Methodology

We introduce an approach to calculating risk in terms of the statistical behavior of a random variable. In our case, a random variable is the size of dividend payouts per unit of investment. A random value may deviate from the expected or predetermined value, and the deviation value determines the degree of risk. The variance of a random variable, determined by the deviation measure relative to the mathematical expectation, determines this level. The greater the variance, the greater the likelihood that a random variable deviates from the expected value, and it is equally likely to deviate both upward when the investor expects excess profits and downward when losses or non-profit are inevitable.

The key to solving the problem is the null statistical hypothesis it consists in the fact that the variance of the

random amount of dividend payments on the securities of the first issuer is equal to the total variance of the entire group of joint-stock companies. As an alternative, consider the logical hypothesis that the variance of the first issuer is greater than the variance of the entire group of issuers.

Now we will try to formulate the motivation of investors in the language of testing statistical hypotheses. If the assumption contained in the null hypothesis is true, then, taking this hypothesis, the investor does not risk anything: the quality of the securities does not differ from the average level in this group, and if the group itself does not belong to risky areas of business, then dealing with this issuer is possible, or at least no more risky than with any of this group.

If the null hypothesis is rejected, and the assumption contained in it is not true, then the investor will not contact the issuer and, thus, again avoids the risk. In the case when the null hypothesis is rejected, but the assumption contained in it is true, the investor makes the so-called type I error when testing the hypothesis, but again he does not risk at all, because he refuses to take active actions, which are the main sources of risk.

And only if the null hypothesis is accepted, that is, the investor decides to invest money, but in fact the alternative hypothesis is correct, then a type II error of the hypothesis test appears, and the probability of this error measures the risk of investment.

Thus, the risk of a financial transaction can be defined as the probability of a type II error when testing the hypothesis that the variance of a random variable characterizing the target financial indicator is uniform.

4 Results and Discussion

Find the probability of making the wrong decision based on statistical data.

If the null hypothesis is true, then the criterion for its verification has a distribution, the likelihood function of which can be expressed as follows

$$\prod_{k=1}^{n}\prod_{i=1}^{n_1} f\left(X \mid H_0\right) = \left(2\pi\sigma^2\right)^{-\frac{n+n_1}{2}} e^{-\frac{1}{2\sigma^2}\sum_{j=1}^{n+n_1}\left(x_j-a\right)^2}; \qquad (1)$$

where n and n_1 are the volumes of the corresponding samples; a is the mathematical expectation of a random variable X (income).

If the alternative hypothesis is true, then the likelihood function has the form

$$\prod_{i=1}^{n}\prod_{j=1}^{n_1} f\left(X \mid H_1\right) = \left(2\pi\sigma_1^{\,2}\right)^{-\frac{n_1}{2}} \left(2\pi\sigma^2\right)^{-\frac{n}{2}} e^{-\frac{1}{2\sigma^2}\sum_{j=1}^{n+n_1}\left(x_j-a\right)^2 - \frac{1}{2\sigma_1^2}\sum_{k=1}^{n_1}\left(x_k-a\right)^2}. \qquad (2)$$

In the case when the alternative hypothesis is true, the probability of the event "hypothesis H_1 is true" is greater than the probability of the event "hypothesis H_0 is true", and since these probabilities are determined by likelihood functions, then for them the relation

$$\left(2\pi\sigma_1^{\,2}\right)^{-\frac{n_1}{2}} \left(2\pi\sigma^2\right)^{-\frac{n}{2}} e^{-\frac{1}{2\sigma^2}\sum_{j=1}^{n=n_1}\left(x_j-a\right)^2 - \frac{1}{2\sigma_1^2}\sum_{k=1}^{n_1}\left(x_k-a\right)^2} \geq c\cdot\left(2\pi\sigma^2\right)^{-\frac{n+n_1}{2}} e^{-\frac{1}{2\sigma^2}\sum_{j=1}^{n=n_1}\left(x_j-a\right)^2};$$

where c is a constant defined by the type I error of hypothesis testing α (probability of rejection of the hypothesis H_0, when it is true). The constant is determined from the equation

$$F(c) = \alpha; \qquad (3)$$

where F is the criterion distribution function, in our case it is the Fisher distribution function.

After identical transformations and logarithmization of the last inequality, we obtain the boundary values of the critical region into which the hypothesis test criterion (dispersion ratio) should fall under the validity of H_1

$$\frac{\sigma_1^2}{\sigma^2} \geq 1 + \ln\left(c^{\frac{2}{n_1}} \cdot \frac{\sigma_1^2}{\sigma^2}\right). \qquad (4)$$

Denote

$$k_1 = 1 + \ln\left(c^{\frac{2}{n_1}} \cdot \frac{\sigma_1^2}{\sigma^2}\right); \qquad (5)$$

then the type II error β will be obtained as the area corresponding to the critical region, under the curve of the distribution density criterion

$$\beta = \int_0^{k_1} f_F(x)dx; \qquad (6)$$

where $f_F(x)$ is the Fisher distribution density.

We now indicate the sequence of actions for calculating the risk of investing:

a) criterion value $t^* = \frac{\hat{\sigma}_1^2}{\hat{\sigma}^2}$ is estimated, where $\hat{\sigma}^2$ & $\hat{\sigma}_1^2$ are estimates of the variances;

b) the critical value of the significance level α* is determined, at which the H_0 hypothesis can still be accepted

$$\alpha^* = \int_{t^*}^{\infty} f_F(x)dx \text{ or } \alpha^* = 1 - \int_0^{t^*} f_F(x)dx$$

c) the value c is calculated for the critical value α* using equation (3);

d) k_1 is calculated by equation (5);

e) the risk is determined by equation (6).

Consider the risk of investing in innovatively active of the agro-industrial enterprises in the Republic of

Crimea that introduce organizational, marketing and manufacturing innovations. First of all, a reservation should be made that at the moment there is not a single enterprise in Republic of Crimea whose stock returns can be commensurate with bank interest. In this sense, a risk analysis will be illustrative. The initial data and the result of calculating the risk are given in table 1.

Table 1. Dividend income of Republic of Crimea of the agro-industrial enterprises.

Joint stock companies	Dividend income 2016	Dividend income 2017	Dividend income 2018	Risk
"Alushta essential oil state farm-plant"	0.025781	3.028168	0.94578	0.870
PJSC "Burljuk"	0.035246	0.146197	0	0.002
PJSC"AF Chernomorets"	0	0.008456	0	0.068
PJSC "Krymmol oko"	0.078888	0	0	0.081
PJSC "Starokrym sky"	0	0.003641	0.078549	0.017
PJSC "Golden field"	0.004519	0.012496	0	0.049
PJSC "Crimean Fruit Company"	0.021459	0.009074	0.040003	0.093
PJSC "Primorsko e breeding enterprise"	5.354287	1.243687	0.032459	0.998
PJSC "State farm "Vesna"	0.195273	0.000428	0	0.097
PJSC "Victory"	0.456214	0.0452178	0.111314	0.344
PJSC "Amber"	0.001267	0.0245163	0.034627	0.101
PJSC "Berry"	0.000816	0.005167	0	0.099
PJSC "Wide"	0	0	0.546971	0.072
Source: Authors Data				

Without a doubt, the limited sampling of three years makes the risk analysis not entirely incorrect. But, unfortunately, currently systematized data on dividend payments for recent years in the Republic of Crimea are inaccessible. However, even on the basis of such data, absolute leaders can be distinguished - "Alushta essential oil state farm-plant" and PJSC "Primorskoe breeding enterprise". They reached almost one hundred percent risk. If we investigate the dynamics of their dividend income, then it is necessary to note their characteristic feature - the payment of dividends and their importance in comparison with other joint-stock companies of innovative orientation. And here the nature of risk is manifested - the higher the risk, the greater the possible income.

5 Conclusions

According to the main macroeconomic indicators, of Republic of Crimea does not occupy a leading position, therefore, the competitiveness of the region is assessed as low. The points of economic growth should be agro-industrial biotechnological cluster of Crimea and wine cluster, in which enterprises using innovative technologies will develop. Currently, Republic of Crimea is inferior to other regions in terms of the attractiveness of enterprises for investors, but it is innovatively active companies that are interesting in terms of generating additional income in the form of dividends, therefore the studies conducted in this article may be of interest to both potential investors and the companies themselves.

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