4.6 Forecasting in the analysis of stimulation of investment, credit and innovative attractiveness of agricultural business entities

Development of mechanisms for financing and stimulating investment, credit and innovation attractiveness is adequate to the development of the adaptive status of agricultural business entities. Credit, investment and innovation attractiveness of agricultural business entities depends on factors that are determined by functional and sectoral features. The importance of the study of stimulation of credit, investment and innovation attractiveness is to substantiate the need to implement research projects to stimulate the credit, investment and innovation attractiveness of agricultural business entities of Ukraine.

Studying the features of forecasting in the analysis of stimulation of investment, credit and innovation attractiveness of agricultural business entities in the process of adaptation to the market, the results of research by scientists were taken into account Dolhosheia N.O. [241], Kisil M.I. [242], Koltunovych O.S. [243], Kulish V.A. [249], Liakhovych L.A. [244], Loiko V.V. [245], Lupenko Yu.O. [246, 247], Malik M.Yo. [246, 248], Mamchur, V. A. [248], Osetskyi V.L. [249], Shpykuliak O.H. [246], Skotnikova L.P. [250], Uhrimova I.V. [250], Zakharchuk O.V. [247] and others. The results of forecasting developments in the analysis of stimulation of credit, investment and innovation attractiveness of agricultural business entities allow us to state the passivity of the research design of a mechanism for stimulating credit, investment and innovation attractiveness of enterprises in the process of adaptation to market interactions. The national innovation system has no reproductive investment mechanisms. Investments are characterized by a weak innovative orientation. Diagnostics of the adaptive state of agricultural business entities reveals the possibility of taking into account the position of imitation and innovative relations in the strategic design of the processes of adaptation. Adequate formalization of the expected value of the investment gives an accurate assessment of the projected income from the implementation of the investment project at the enterprise.

The purpose of writing the article is to identify and substantiate the need for forecasting and implementation of research projects to stimulate the credit, investment

and innovation attractiveness of agricultural business entities in the context of competitive and cooperative interactions in Ukraine. The achievement of the goal was facilitated by general scientific methods: methods of empirical research (measurement, comparison, observation and modeling), methods of theoretical research (analysis and synthesis).

A necessary (but not sufficient) condition for the development of a forecast assessment of mechanisms for stimulating credit attractiveness is a change in the system of credit collateral from the standpoint of improving the mechanisms for carrying out credit operations and non-bank credit collateral, credit infrastructure and guaranteeing the repayment of loans, the transfer of non-market forms of credit collateral to market ones, tools for implementing credit and information support.

One of the key issues of stimulating credit attractiveness is the assessment of expected income. Let's assume that the expected increase in inflation will be 5%. The entrepreneur, in order to protect himself from the effects of inflationary diffusions, acquires a portfolio of liabilities with a variance of 2,25. Then, in the next 30 years, the expected real income of the enterprise will be (-1,07%), and the probability of obtaining a negative income is approximately 2/3.

Lenders and analysts want to have an accurate idea of the estimated value of an investment, its variance, and its probabilistic distribution. The most advanced ways to determine the estimated value of investments and the variance of income have not yet found application in the calculations of analysts-entrepreneurs or creditors of Ukraine. Let's determine the functional dependencies of the estimated cost of investments and the variance of income in a formalized form.

The following equalities with respect to annual income (logarithmically normally distributed make sense $N\left(\mu,\sigma^2\right)$):

$$\log\left(\frac{S_t}{S_{t-1}}\right)=\mu+\sigma\cdot Z;\ \log X_{t-1,t}=\log\left(\frac{S_t}{S_{t-1}}\right);\ X_{t-1,t}=\frac{S_t}{S_{t-1}}=1+R_{t-1,t}\ .$$

It follows that $X_{t-1,t} = \frac{S_t}{S_{t-1}} = \exp(\mu + \sigma \cdot Z)$, where is $X_{t-1,t} = \frac{S_t}{S_{t-1}} = 1 + R_{t-1,t}$ – annual income; $R_{t-1,t} = \frac{S_t - S_{t-1}}{S_{t-1}}$ – annual rate of income; t – year during the survey period; $\log X_{t-1,t}$ – an annual continuously drawn up rate of income.

Here it is possible to calculate various points. Since the logarithm of the *n*-year income level $\log(1 + R_{0,n})$ normally distributed and $[\log(1 + R_{0,n}) - \mu] : \left(\sigma / \sqrt{n}\right)$ is a random normal variable, then the probability that $R_{0,n}$ lies between any two quantities a, b is:

$$\Phi\left[\frac{\log(1+b)-\mu}{\sigma/\sqrt{n}}\right] - \Phi\left[\frac{\log(1+a)-\mu}{\sigma/\sqrt{n}}\right],$$

where is Φ – the cumulative probability distribution of a random normal variable. Let's define the interval for $R_{0,n}$, covering the probability, for example, by 95% as follows:

$$prob: \left[\mu - 1{,}96\,\sigma/\sqrt{n} < \log(1 + R_{0,n}) < \mu + 1{,}96\,\sigma/\sqrt{n}\right] = 0{,}95$$

$$prob: \left[\exp\left(\mu - 1{,}96\,\sigma/\sqrt{n}\right) - 1 < R_{0,n} < \exp\left(\mu + 1{,}96\,\sigma/\sqrt{n}\right) - 1\right] = 0{,}95.$$

Thus, 95% the probability interval of the *n*-level income rate is set by boundaries $\left[\exp\left(\mu - 1{,}96\,\sigma/\sqrt{n}\right) - 1, \quad \exp\left(\mu + 1{,}96\,\sigma/\sqrt{n}\right) - 1\right]$.

Most investors prefer to rely on income forecasts from professional analysts than on their own. Since the weight of analysts' activities in the process of adaptation of agricultural business entities to the market environment increases, the assessment of their ability to accurately and correctly predict the expected income is often updated.

Of undoubted interest are the results of the assessment of the ability of financial analysts to foresee income in firms in France, Germany, Japan, the Netherlands, Switzerland, the United Kingdom and the United States. The main evaluation criterion is the accuracy and correctness of forecasts. The analysis can take into account forecasts for a one-year financial period based on FY1 IBES (International Accounting Data Printing). But we should not forget about the main international problem – the

presence of a wide variety of accounting practices and openness standards in different countries.

By calculating the total financial openness index Saudagaran, Biddle allows you to classify countries by levels. U.S. businesses have the highest level. This is followed by enterprises in Canada, great Britain and the Netherlands. Next in line are the enterprises of France, Japan, Germany and Switzerland. Professional analysts successfully predict profits for firms in countries with a high level of accounting transparency (USA, Canada and the UK). If the requirements for accounting transparency are less stringent, then the accuracy and correctness of forecasting are distorted (Japan, Germany, Switzerland). Differences in levels of accounting openness in different national jurisdictions affect the effectiveness of forecasting. Return on investment for agribusiness entities in Ukraine is more difficult to predict exactly for the lender.

Optimization choice of an investment project refers to the tasks of expert evaluation, placement, integrated combination of algorithmic structure and subject knowledge. The implementation of traditional methods of analysis here is ineffective and ineffective. The most reasonable is the use of a genetic decision algorithm. The genetic algorithm is a mathematical simulation of an adaptive process, which has the following advantages: the ability to identify new structures of the neighborhood; coding of elements and determining the distance between them; minimizing the time of finding a solution or the speed of coverage; use of the inheritance operator; purification of the optimality of the choice by problem-oriented methods; ordering decisions by an attractiveness expert; the priority of the "killer instinct".

The implementation of a genetic algorithm allows you to combine situations for the survival of an agricultural business entity in conditions of uncertainty of the market environment. The main source of financing investment activities in a market economy is own funds. But the state of chronic institutional instability leads to the fact that it is impossible to survive only at the expense of one's own funds. In a situation of constant lack of financial resources, financing of investment projects is carried out at the

expense of borrowed funds. Therefore, it is extremely important to optimally combine the borrowed and own funds used, and to attract capital on the most favorable terms.

The effectiveness of the activities of agricultural business entities is determined by stimulating not only credit and investment attractiveness, but also innovative. Innovative development of formations of the agrarian sector of Ukraine is fixed by regulatory and legislative grounds. Competitive interactions are an effective mechanism for reproducing innovative potential; a generator of business incentives; a source of innovation; the possibility for agricultural enterprises as economic agents of free choice of maneuver in the market environment according to the "norms and rules of the market game"; reflection not only of the forms of influence of the market environment, but also of the economic interests of business entities.

The mechanism of functioning of innovative activity is carried out at the expense of state financing, loans, profits (remaining at the disposal of the enterprise), the issue of shares, corporate bonds. The level of innovative development is adequate to the level of adaptation to market conditions. The incentives for innovative activity are internal (ownership, preservation of economic balance and stability, increasing monopoly potential in the market niche) and external (especially tax economic incentives). The human factor is the main carrier of innovation.

Qualitative growth in stimulating innovative attractiveness is most favored by the implementation of non-traditional methods of analysis. Innovative change is driven by limited by-products, meaning it can be processed analytically using the Markov random fields technique. Preliminary results obtained through simulation experiments and the approximation of the "average field" make it possible to assess how alternative proposals in the sphere of maximizing technological change affect the market structure and average productivity growth rate of an economy with imperfect competition.

The heterogeneity and complexity of the economic environment does not allow entrepreneurs to form rational expectations both for the norms of behavior adopted by others, and for synchronization and the results of technological change; forces them to overcome their production and substantive limited rationality. The model of the

adaptive state of agricultural business entities in market conditions takes into account the assumptions of Neo-Schumpeterian and evolutionary models.

Agricultural business entities are characterized by two types of rationality: maximization of short-term profits; forecasting the behavior of competitors and their own technological capabilities. In order to survive in a competitive market, they are drawn into research activities. In modeling, we abstract from product innovation. Contributions to research and development have two alternative objectives: innovation and imitation.

Suppose that there are information imperfections in financial markets that restrain the number of investments in research and development. This means that investments can only be realized from profits. If the minimum amount of money that needs to be invested to carry out innovative activities is P^*, then the income space can be divided into three areas: bankruptcy, imitation, innovation. Agricultural business entities are pushed out of the market regardless of whether they imitate or innovate (that is, make contributions to determine their relative future credit and competitive), according to their current value of market profit. The size of the market profit of the enterprise is due to its competitive status in the operating environment. At the aggregate level, there is competitive endogenous growth, showing an increase in the average rate of productivity and total production capacity due to successful research and development.

Each enterprise is in a spatially organized cycle. Due to external signs operating with innovative and imitative actions, the economic structure of interaction can be represented as a two-dimensional cylinder. At any given time, only two levels of the cylinder, level t and level $t–1$, completely determine the structure of the economy. This structure distinguishes a system that satisfies Markovian Bertrand-Nash. The heterogeneity of technologies in itself imperceptibly affects the market structure of a long equilibrium and takes into account the degree of polymorphism (initially characterizing the market), propagating decisions about long-term equilibrium development. This outcome is interesting, but it is characterized by static representations.

Suppose that every enterprise in its economic activity develops "by trial and error". Then the reproductive function confirming survival in the market environment of the enterprise with a developed adaptation of the economic mechanism of functioning is proved by the fact that the level of change in the competitiveness of the enterprise is determined by the relative changes in the market share of the enterprise. Whenever consumers prefer diversity to homogeneity, then cost-reducing technological progress is necessary for Schumpeterian competition to lead the market to monopoly.

Suppose that an enterprise, following certain procedures in introducing innovation and imitation, invested all the profits of the last period in research and "crossed its fingers". Contributions to research are modeled as uncertain actions, the result of which is controlled by a two-level stochastic process. The probability that the company's investments will be successful primarily depends on the local situation in the operating environment. Provided that the profit in the period *t-1* was higher than the threshold value π^*, the company is part of a two-level innovative lottery.

Let $\varsigma_j(t)$ – Boolean is a random variable that determines the success of enterprise j in innovative research. It is set to 1, if a new technology has been discovered; and 0 otherwise. Probability $\varsigma_j(t)$ to be 1 is defined as follows:

$$\mu_j(t) = P_r\{\varsigma_j(t)=1\} = \frac{\exp\cdot\left(\xi_1\cdot\pi_j(t-1)+\xi_2\cdot\sum_{i\in N(j)}\varsigma_j(t-1)\right)}{1+\exp\cdot\left(\xi_1\cdot\pi_j(t-1)+\xi_2\cdot\sum_{i\in N(j)}\varsigma_j(t-1)\right)},$$

where is ξ_1 – internal impact on innovation; ξ_2 – external influence on innovation; j – enterprise; t – time of spatial organization in the cycle.

The probability of success depends on the profit of the enterprise *j* during $(t-1)$ (an indicator of private effort) and from the intellectual and technological environment in which it is immersed (an indicator of limiting the by-products of cognition). If $\varsigma_j(t)=1$, then the productivity of the enterprise is expressed as follows:

$W(\varpi_j(t)) = \varpi_j(t-1)\cdot(1+\lambda)$, where is $\varpi_j(t)$ – technology parameter. Oligopolies' experiences an average increase in productivity equal to λ, which is the average of the Poisson random distribution with a variance equal to ν^2. Whenever profits are positive but not high enough to afford innovative research, the oligopolies' invests to implement the most competitive technology allowed during the $(t-1)$in the "spatial" environment of competitors. Time lag captures the presence of patents or other legal and technological barriers before the sudden diffusion of innovation. The process is described again as a two-level stochastic process. For forecasting purposes, we can safely say that, on average, the prospective rate of productivity growth due to the introduction of innovations will not be higher than the value $\left(d^{cw}[\beta,b]\right)\cdot\lambda\cdot\frac{n}{M}$. Proximity accuracy $d^{CW}(\beta,b) \geq d(\beta,b)$ grows as a dimensional degree of systemic increases. In the situation under consideration $d=2$; if $d \geq 4$, then the approximation value of the "average field" of the generalized Gibbs model is equal to the Curie-Weis model.

Further study of the action of this model on the material of specific enterprises allows, after testing in conditions of market instability, to present the mechanism of evolution of the agricultural sector and aggregate growth, and in private modification the mechanism of adaptive evolution of agricultural enterprises in the agribusiness system of Ukraine.

Enterprises strengthen organizational work in two main areas: innovation of production and innovation of services. For the innovation of production, "strengthening" means shortening production cycles. That is, in the production of basic products, the role of innovative processes in the sense of searching for new products should grow. The existing lack of financial resources in stimulating innovative attractiveness can be eliminated by various measures.

In the aspect of stimulating innovative attractiveness, researchers propose to focus the attention of the enterprise not on its own cost structure, but on professional reflection of the market environment; "acquire" intellectually gifted innovators with pronounced personal qualities for work in the enterprise; to develop an atmosphere of relative freedom and readiness for systematic rewards for the development of

innovations; use the system of constant reflection of the current situation in the development of the idea at all organizational levels; control the developer of the idea from the standpoint of innovative attractiveness for customers and budget limit for each project. Enterprises that constantly analyze the market situation combine the achievement of their own goals with the goals of survival in the environment and assess the abilities of competitors. Enterprises that analyze the cost structure and reduce the price do not achieve positive results in observing the "rules of the market game".

The formation and development of clusters makes it possible to intensify investment and innovation activities. Cluster structuring of economic relations is a form of market centralization, which creates conditions for accelerating the pace of attracting investment in the development of agricultural production; strengthening the system of adaptation of the economic mechanism of functioning of agricultural business entities to market conditions; increasing market capitalization; increasing the payment, credit and competitiveness of products (services) and the enterprise as a whole; prompt civilized integration into the world system of economic relations. Cluster structuring of economic relations is one of the forms of adaptation of the economic mechanism of functioning of agricultural business entities to competitive conditions; ensuring the integrity of the formation of on-farm, economic and market mechanisms of functioning; strengthening the adaptive status of agricultural business entities; increasing the market capitalization of agricultural business entities; increasing the competitiveness of products (services), enterprises and the country as a whole.

Thus, in the course of the study, it has been established that the use of forecasting methods in the analysis of stimulation of investment, credit and innovation attractiveness of agricultural business entities increases the efficiency of assessing credit, investment and innovation attractiveness, and adequately searches for ways to improve the processes of adaptation of the economic mechanism of the functioning of agricultural business entities to competition. It has been substantiated that the cluster adaptability of agrarian business entities is the ability of enterprises to survive in conditions of market instability, changing the structural and functional organization of socio-economic relations.