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ASSESSMENT OF THE LEVEL OF ECONOMIC SECURITY OF INNOVATIVE ENTERPRISES: ECONOMIC AND LEGAL ASPECT

Abstract. Ukraine's desire to integrate into the international economic space poses significant obstacles to innovative enterprises due to the destabilizing impact of globalization. Among the most important are financial, economic and political instability, risks of insolvency and reduced financial stability, which leads to the inability to meet external and internal challenges and ensure the optimal level of economic security. Under such conditions, the need to effectively counteract the destabilizing factors and ensure high rates of efficiency and profitability, which can be achieved through innovation and improvement of financial relations. Innovative activity, despite its high cost and significant level of risk, is one of the priorities of the enterprise. The activities of innovative enterprises attract the attention of economic agents, so ensuring the proper level of their economic security is no less important. Given that there is still no single unified and legally established method of calculating the level of economic security of enterprises, it is important to find the most acceptable and rational methods of calculating the level of security of enterprises, as well as developing a legal mechanism for their consolidation, which is the focus of scientists and practitioners for a long time. However, the problem has not yet been resolved.

The article examines the main approaches to assessing the level of economic security of innovative enterprises and identifies the importance of the factor of innovation and legal regulation of financial relations with other economic agents. The main indicators of economic security of the enterprise are systematized and their classification into macroeconomic, financial, foreign economic, investment, scientific and technological, as well as production is performed. The method

of assessment the level of economic security of an innovative enterprise using the Solow model is substantiated and proposed.

Keywords: innovations, Solow model, indicators of economic security of the enterprise, integrated indicator of the level of economic security of the enterprise.

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ОЦІНЮВАННЯ РІВНЯ ЕКОНОМІЧНОЇ БЕЗПЕКИ ІННОВАЦІЙНИХ ПІДПРИЄМСТВ: ЕКОНОМІКО-ПРАВОВИЙ АСПЕКТ

Анотація. Прагнення України інтегруватися до міжнародного економічного простору ставлять перед інноваційними підприємствами значні перешкоди, пов'язані з дестабілізуючим впливом процесів глобалізації. Серед найвагоміших варто виокремити фінансово-економічну й політичну нестабільність, ризики неплатоспроможності й зниження фінансової стійкості, що призводить до неможливості протидіяти зовнішнім і внутрішнім викликам та забезпечити оптимальний рівень економічної безпеки. За таких умов загострюється необхідність ефективної протидії дестабілізуючим чинникам і забезпечення високих показників рентабельності та прибутковості, що можна досягнути завдяки інноваціям і вдосконаленню фінансових правовідносин. Інноваційна діяльність, незважаючи на її високу вартість і суттєвий рівень ризиковості, є одним із пріоритетних напрямів функціонування підприємства. Діяльність інноваційних підприємств привертає увагу економічних агентів, тому забезпечення належного рівня їхньої економічної безпеки є не менш важливим завданням. Зважаючи на те, що єдиної уніфікованої й законодавчо закріпленої методики розрахунку рівня економічної безпеки підприємств досі немає, то вагомого значення набуває пошук найбільш прийнятних і раціональних методів розрахунку рівня безпеки підприємств, а також розроблення правового механізму їх закріплення, що

перебуває в центрі уваги науковців і практиків упродовж тривалого часу. Однак визначена проблема досі не розв'язана.

Проведено дослідження основних підходів щодо оцінювання рівня економічної безпеки інноваційних підприємств і визначено важливість у них фактору інновацій і правового регулювання фінансових відносин з іншими економічними агентами. Систематизовано основні індикатори економічної безпеки підприємства і проведено їхню класифікація на макроекономічні, фінансові, зовнішньоекономічні, інвестиційні, науково-технологічні та виробничі. Обґрунтовано і запропоновано метод оцінювання рівня економічної безпеки інноваційного підприємства з використанням моделі Солоу.

Ключові слова: інновації, модель Солоу, індикатори економічної безпеки підприємства, інтегральний показник рівня економічної безпеки підприємства.

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Introduction. The intensification and strengthening of the dominant influence of globalization, European integration and megaregionalization have contributed to the creation of an integrated international financial system, which mobilizes significant amounts of resources, additional opportunities and benefits necessary for the sustainable development of the world. At the present stage of social and economic development there is a situation which causes uneven and irrational distribution of access to these resources and existing spheres of influence, as a result of which some countries occupy leading positions, gaining access to resources, and most countries, including Ukraine, limited in such access, which slows down the pace of their social and economic development, prestige and image in the international arena.

Given these trends, there are internal destabilizing factors that negatively affect the development of the national economy and entrepreneurship, causing the need to adapt to unstable external and internal environment, timely response to financial, economic, legal and political shocks. At the same time, the priority under such conditions is to ensure an optimal level of economic security sufficient to effectively combat the impact of destructive factors, processes and phenomena on the basis of modernization of methods, forms and methods of doing business and taking into account the legal aspect of protection against challenges, threats and danger.

Innovation is highly risky, expensive and attracts the attention and interest of various economic agents. As a result, the entities that run it are more exposed to external and internal factors, so there is a need to protect their own interests, which can be achieved by ensuring a sufficient level of economic security and a high degree of legal protection. As we can see, the study of the problems of assessing and ensuring the economic security of economic entities in the field of innovation is extremely popular and relevant today.

Research analysis and target setting. Scientific views on assessing the level of economic security of enterprises are characterized by their versatility and diversity. Leading scientists-economists T. Vasylytsiv, T. Hladchenko, Ya. Kotliarevskyi, I. Mihus, L. Shemaieva made a significant contribution to the selection of the main approaches and methods of assessing the economic security of enterprises. Significant developments in the legal protection of the interests of enterprises in the system of ensuring their economic security are substantiated by V. Bachynen, H. Ivashchenko, V. Yakushyk. However, given the significant scientific achievements, the problem of assessing the level of economic security of innovative enterprises and the level of their legal protection remains unresolved, as a single approach and legally regulated methodology still does not exist.

The object of the article is to study the problematic aspects of assessing the level of economic security of innovative enterprises.

Results of the research. Increased manifestations of unfair competition, insufficient level of legislative and regulatory support of legal relations in the economic sphere, destabilizing influence of environmental factors of innovative enterprises necessitate timely identification of risks and threats to their activities, prudent actions to prevent, neutralize and counter destabilizing factors. Coordinated work of all mechanisms to ensure the optimal level of economic security will allow

companies to increase the efficiency of available resources, to ensure high performance. In view of this, legal protection and ensuring the economic security of innovative enterprises is a priority of their activities.

The issue of methodology of economic security of enterprises is given considerable attention and there are developments, the most complex of which are the studies of T. Vasylytsiv [1, p. 79—94], which in addition to a detailed justification of the categorical apparatus in the field of economic security of enterprises, distinguished systemic risks and threats to their economic security, developed, tested and proposed his own method of comprehensive assessment of economic security of enterprises based on a set of indicators — indicators of economic security, the list of which is classified depending on the components of the economic security system of the state, the calculation of the level of which is approved by the Guidelines for calculating the level of economic security of Ukraine [2]. At the same time, the researcher classifies indicators of economic security of the enterprise into macroeconomic, financial, foreign economic investment, and paying considerable attention to scientific, technological and production indicators, summarizes them into separate groups, which confirms the importance of innovation.

At the same time, L. Shemaeva and I. Mihus [3] emphasize the feasibility of using the model of end-to-end optimization of financial and material flows of the enterprise, attaching importance to the method of designing logistics solutions, the position of which is shared by S. Pokropivnyi [4] and T. Hladchenko [5].

H. Ivashchenko [6] highlights radically opposite views on this scientific category and argues that the disclosure of the essence of the concept of «safety» through «security» or «protection» of the interests of economic entities significantly narrows its content and does not fully cover the essence. At the same time, the researcher proposes to interpret security from the standpoint of controllability of living conditions and activities, which, in fact, shifts the established emphasis of this economic category to the legal aspect, which aims to reflect threats and dangers, their prevention and counteraction from a legal point of view. Given the dependence of economic security of enterprises on the macroeconomic situation in the country are characterized by the views of V. Bachynen [7, p. 163] and V. Yakushyk [8], who associate it with economic and legal regulation of relations and effective counteraction to the shadow sector of the economy and corruption and ensuring a high level of legal regulation of the financial and economic sphere.

Systematization of previous views on the study is characterized by the work of Ya. Kotlyarevskiy, O. Melnykov [9], who consider the economic security of the enterprise through the prism of innovation, as there is a replacement of the vector of information economy to digital economy, and the development and implementation of innovative technologies registration of relevant rights to them, which requires significant legal assistance.

In our opinion, it is impossible to limit the proposed methods of assessing the level of economic security of innovative enterprises, so we propose to use a method that considers the economic security of the enterprise as a single economic phenomenon and is based on the Solow model. safety at the enterprise is set by five variables: Y — the final product of production; L — available labor resources; K — production assets of the enterprise; I — the amount of investment in innovation; C — the volume of non-productive consumption. In this case, all variables are functions of time t , as they have the ability to change their values in different periods of time.

In order to calculate the level of economic security of an innovative enterprise based on the Solow model, consider the assumptions, namely:

1. Production and labor resources are used by innovative enterprises in full, but in Ukraine there is a partial use of resources, as well as the use of resources mobilized in the illegal sector of the economy, which must be taken into account when making calculations. Therefore, the annual final product Y at each point in time is a function of average annual funds and available labor: $Y = F(K, L)$. Thus, $F(K, L)$ is a productive function of the whole national economy.

2. The final product is used for non-production needs and investments: $Y = C + I$. The rate of accumulation p is the share of the final product used for investment. Hence, $I = p \cdot Y$, $C = (1 - p) \cdot Y$.

3. The rate of accumulation p is a constant value and $0 < p < 1$.

4. Investments in innovation activities are used to restore the funds used and for their growth.

Therefore, the use of funds occurs with a constant coefficient μ , $0 < \mu < 1$.

From the last assumption it follows that the increase is

$$\Delta K = K(t + \Delta t) - K(t) = pY\Delta t - \mu K\Delta t, \tag{1}$$

therefore

$$\frac{dK}{dt} = pY - \mu K. \tag{2}$$

The next assumption of the proposed model is as follows

5. The increase in labor resources is proportional to the coefficient of proportionality v to the available labor resources [10, p. 314–315], namely

$$\Delta L = vL\Delta t. \tag{3}$$

Hence, we obtain the differential equation

$$\frac{dL}{dt} = vL. \tag{4}$$

Thus, the Solow model is given by a system of equations

$$\begin{cases} C = (1 - p)Y; \\ Y = F(K, L); \\ \frac{dL}{dt} = vL; \\ \frac{dK}{dt} = pY - \mu K. \end{cases} \tag{5}$$

and the initial condition

$$K(0) = K_0, \tag{6}$$

$$L(0) = L_0 \tag{7}$$

The arbitrariness of the production function $F(K, L)$ has a complex effect on the Solow model and increases the difficulty of obtaining meaningful conclusions. Based on this, it is necessary to pay attention to the fact that the production functions, which are considered in the economic-mathematical modeling of economic processes, are linearly homogeneous, ie satisfy the condition [10–12]

$$F(\lambda K, \lambda L) = \lambda F(K, L). \tag{8}$$

Denoting the average productivity through $y = Y/L$ and the average capital through $k = K/L$, we will obtain the following:

$$y = \frac{Y}{L} = \frac{F(K, L)}{L} = F\left(\frac{K}{L}, 1\right) = F(k, 1). \tag{9}$$

will denote the last function through $f(k)$, ie $f(k) = F(k, 1)$ and $y = f(k)$. We find the derivative from k to t :

$$\frac{dk}{dt} = \frac{d}{dt} \left(\frac{K}{L} \right) = \frac{K'L - KL'}{L^2} = \frac{K'}{L} - K \cdot \frac{L'}{L^2} = \frac{\rho Y - \mu K}{K} - \frac{Kv}{L} = \rho y - (\mu + v)k. \tag{10}$$

Consequently,

$$\frac{dk}{dt} = \rho f(k) - (\mu + v)k; \tag{11}$$

$$k(0) = k_0 = \frac{K_0}{L_0}. \tag{12}$$

For greater specification, let's assume that the production function in the Solow model is the Cobb — Douglas function:

$$F(K, L) = AK^\alpha L^{1-\alpha}. \tag{13}$$

In this case

$$f(k) = F(k, 1) = Ak^\alpha, \tag{14}$$

and the equation

$$\begin{aligned} \frac{dk}{dt} &= \rho f(k) - (\mu + \nu)k; \\ k(0) &= k_0 = \frac{K_0}{L_0}. \end{aligned} \tag{15}$$

takes the following form:

$$\begin{aligned} \frac{dk}{dt} &= \rho A k^\alpha - (\mu + \nu)k; \\ k(0) &= k_0. \end{aligned} \tag{16}$$

The last differential equation is an equation with detachable variables, which can be integrated according to the general scheme, but it is more rational to get its solution by making the substitution

$$k(t) = u(t)e^{-(\mu+\nu)t}, \tag{17}$$

where $u(t)$ is some function of t .

Therefore,

$$\frac{dk}{dt} = u'(t)e^{-(\mu+\nu)t} - (\mu + \nu) * e^{-(\mu+\nu)t}u(t) \tag{18}$$

and, substituting in the equation

$$\begin{aligned} \frac{dk}{dt} &= \rho A k^\alpha - (\mu + \nu)k; \\ k(0) &= k_0. \end{aligned} \tag{19}$$

we will get

$$\begin{aligned} u'(t) \cdot e^{-(\mu+\nu)t} - (\mu + \nu) * e^{-(\mu+\nu)t} \cdot u(t) &= \\ = \rho A (u(t))^\alpha e^{-\alpha(\mu+\nu)t} - (\mu + \nu) \cdot e^{-(\mu+\nu)t} \cdot u(t), \end{aligned} \tag{20}$$

or

$$\frac{du}{dt} = \rho A (u(t))^\alpha e^{-\alpha(\mu+\nu)t + (\mu+\nu)t}. \tag{21}$$

Thus, we've obtained the Cauchy problem

$$\begin{aligned} \frac{du}{dt} &= \rho A (u(t))^\alpha e^{(1-\alpha)(\mu+\nu)t}, \\ u(0) &= k(0). \end{aligned} \tag{22}$$

The solution of differential equation of this Cauchy problem

$$\frac{du}{u^\alpha} = \rho A e^{(1-\alpha)(\mu+\nu)t} dt, \tag{23}$$

and

$$\frac{u^{1-\alpha}}{1-\alpha} = \frac{\rho A}{(1-\alpha)(\mu+\nu)} e^{(1-\alpha)(\mu+\nu)t} + C. \tag{24}$$

We find the constant C from the initial condition $u(0) = k_0$.

$$C = \frac{k_0^{1-\alpha}}{1-\alpha} - \frac{\rho A}{(1-\alpha)(\mu+\nu)}. \tag{25}$$

That is why

$$u^{1-\alpha} = \frac{\rho A}{\mu+\nu} (e^{(1-\alpha)(\mu+\nu)t} - 1) + k_0^{1-\alpha}. \tag{26}$$

finally we get

$$u(t) = \left(\frac{\rho A}{\mu+\nu} (e^{(1-\alpha)(\mu+\nu)t} - 1) + k_0^{1-\alpha} \right)^{\frac{1}{1-\alpha}}. \tag{27}$$

The solution of the equation

$$\frac{dk}{dt} = \rho A k^\alpha - (\mu + \nu)k; \tag{28}$$

is a function

$$k(0) = k_0.$$

$$k(t) = u(t)e^{-(\mu+nu)t}. \tag{29}$$

The limit is calculated directly

$$\lim_{n \rightarrow \infty} k(t) = \left(\frac{\rho A}{\mu + \nu} \right)^{\frac{1}{1-\alpha}}. \tag{30}$$

Let's consider the stationary trajectory of the Solow Model (in which the capital-labor ratio k is constant and equal to the initial value k_0). Then

$$k(t) = \text{const} = k_0 \quad \text{and} \quad \frac{dk}{dt} = 0. \tag{31}$$

from equality

$$\frac{dk}{dt} = \rho f(k) - (\mu + \nu)k;$$

$$k(0) = k_0 = \frac{K_0}{L_0}. \tag{32}$$

it follows that

$$\frac{dk}{dt} = \rho f(k) - (\mu + \nu)k = 0. \tag{33}$$

Since in our case $f(k) = Ak^\alpha$, then

$$\rho Ak^\alpha = (\mu + \nu)k \tag{34}$$

the stationary value of capital-labor ratio for the Cobb — Douglas function is also equal to

$$\left[\frac{\rho A}{\mu + \nu} \right]^{\frac{1}{1-\alpha}}. \tag{35}$$

Therefore, at an arbitrary initial value k_0 the capital-labor ratio $k(t)$ coincides to the stationary value

$$\left(\frac{\rho A}{\mu + \nu} \right)^{\frac{1}{1-\alpha}}. \tag{36}$$

It is natural to assume that the model development will be successful when the value of the accumulation rate ρ is maximum. To do this, we differentiate the function of specific consumption

$$\lim_{n \rightarrow \infty} \frac{C(t)}{L(t)} = \lim_{n \rightarrow \infty} (1 - \rho)y(t) = (1 - \rho)A \left[\frac{\rho A}{\mu + \nu} \right]^{\frac{\alpha}{1-\alpha}}, \tag{37}$$

on ρ and equate the obtained function to zero

$$\left((1 - \rho)A \left[\frac{\rho A}{\mu + \nu} \right]^{\frac{\alpha}{1-\alpha}} \right)' = 0. \tag{38}$$

From here, after transformations, we find the point of maximum

$$\rho_0 = \alpha. \tag{39}$$

The obtained results give grounds for the conclusion that the hypothesis regarding the optimum rate of accumulation in the stationary mode, which should be equal to the coefficient of elasticity of funds in the economy of the enterprise is called the «golden rule» of economic growth. The calculations confirm the fulfillment of the «golden rule» for the Cobb — Douglas production function, and their comparison with the main parameters of economic security shows the dependence of security on economic growth factors (capital, labor, productivity, resources and innovation), and extensive factors are converted into risks and threats to the economic security of innovative enterprises.

We should note that the implementation of the «golden rule» of economic growth is a kind of indicator of the degree of development of the enterprise, its business activity and reputation. The introduction of innovations contributes to high efficiency and profitability due to the innovativeness of production, increasing productivity and preventing its shadowing, which is a stimulus to increase the level of economic security of the enterprise.

Conclusions. Thus, the research of problematic aspects of assessing the level of economic security of innovative enterprises suggests that the problem of unification of methodological tools for assessing the level of their economic security remains unresolved, as there is still no legislative definition and regulation. In order to improve the calculations of the level of economic security of innovative enterprises, we offer an alternative method based on the Solow model, the feasibility of which is due to the need to take into account the factor of innovation, as the replacement of innovative technologies of the employee has a positive impact on economic growth, which confirms the dominant role of scientific and technological progress, as well as strengthens economic security.

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