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## APPLIED ASPECTS IN FORMATION AND APPLICATION OF DIAGNOSTICS TOOLKIT FOR ENTERPRISE INNOVATION SECURITY

*The article presents the model for determining the level of innovation security of an enterprise by the recommended indices-indicators. The method developed is based on the estimation of the destabilizing factors impact on the quantitative measurement of the innovation security level taking into account the deviations of the presented indices-indicators from their normative values.*

**Keywords:** diagnostics; indices-indicators; innovation security; innovative activities; enterprise.

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## ПРИКЛАДНІ АСПЕКТИ ФОРМУВАННЯ ТА ВИКОРИСТАННЯ АПАРАТУ ДІАГНОСТИКИ ІННОВАЦІЙНОЇ ЗАХИЩЕНОСТІ ПІДПРИЄМСТВА

*У статті представлено модель розрахунку діагностованого рівня інноваційної захищеності підприємства з рекомендованими показниками-індикаторами. Розроблено метод діагностики на основі оцінювання впливу дестабілізуючих чинників на кількісний вимір рівня інноваційної захищеності підприємства через врахування відхилень введених основних груп показників-індикаторів від їх нормативних значень.*

**Ключові слова:** діагностика; показники-індикатори; інноваційна захищеність; інноваційна діяльність; підприємство.

**Форм. 4. Табл. 1. Рис. 1. Літ. 10.**

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## ПРИКЛАДНЫЕ АСПЕКТЫ ФОРМИРОВАНИЯ И ИСПОЛЬЗОВАНИЯ АППАРАТА ДИАГНОСТИКИ ИННОВАЦИОННОЙ ЗАЩИЩЕННОСТИ ПРЕДПРИЯТИЯ

*В статье представлена модель расчета диагностированного уровня инновационной защищенности предприятия с рекомендованными показателями-индикаторами. Разработан метод диагностики на основе оценки влияния дестабилизирующих факторов на количественное измерение уровня инновационной защищенности предприятия через учет отклонений введенных основных групп показателей-индикаторов от их нормативных значений.*

**Ключевые слова:** диагностика; показатели-индикаторы; инновационная защищенность; инновационная деятельность; предприятие.

**Problem statement.** Internal economic protection of industrial enterprises in the aspect of ensuring their general economic security will depend, in particular, on innovative security that according to the results of the research is one of the main constituents of economic protection of any business entity under market conditions in order to keep high competitiveness of finished products at the allowed value of expenses and pertaining the optimal correlation between borrowed and own funds.

In general, innovative security of an enterprise is the condition of protecting the innovative activity of business from the threatening factors of internal and external environments that correct the current financial and economic results of quality esti-

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mation of its total innovative and production development and affect directly operational activity keeping the acceptable level of competitiveness. In this regard there arises a problem of introducing an effective toolkit for diagnostics and quantitative measurement of the current stage of innovative security of an enterprise for its further control and effective management.

**Recent researches and publications analysis.** Such scholars as I.V. Alekseyev and I.V. Khoma (2011), S.M. Illyashenko and Y.S. Shipulina (2010), O.O. Lapko (1999), P.P. Mykytyuk (2007; 2009), F.Y. Poklonskyi and Ya.O. Archykova (2010), S.M. Shkarlet (2007), P.M. Zavlin and A.V. Vasylyev (1998) and many others studied the issues of innovations, innovative activity, innovative processes at industrial enterprises and management of innovative development. However, most of these researches did not diagnose quantitatively the level of innovative security as the constituent part of an integrated economic security of enterprise. This reveals the necessity for new researches in this direction.

**Unresolved issues.** Despite the existing basis of scientific elaborations in the field of analysis of innovative activity of business entities, the diagnostics of innovative security of enterprises as one of the main constituent of economic protection of business entities remains insufficiently studied.

**The research objective** is the elaboration of applied aspects in the formation and use of diagnostics toolkit for innovative security of an industrial enterprise.

**Key research findings.** Nowadays the level of innovative security of any enterprise is of primary importance, since in comparison with the levels of other constituent parts of economic protection it is very hard to control and manage. This is due to the fact that all intermediate parameters that affect the calculation of this indicator are not fixed in financial statements of enterprises and, in most cases refer to the information of internal character that is not always available to side users. However, the quantitative measurement of the level of innovative security accurately shows the progress of innovative process at an enterprise as a complex of phases, stages, actions connected with the initiation, elaboration and manufacturing of products, technologies, that have new properties and more effectively meet existing needs. The constituent part of innovative process is the innovative activity that combines science, techniques and innovations in entrepreneurial activity. Innovative activity is a complex of practical actions aimed at the use of scientific and technical results to get new or improve the existing products, technologies, management methods etc. (the Law of Ukraine "On innovative activity", N40-IV, 4.07.2002; Mykytyuk, 2007, 2009). Through another interpretation we can consider innovative activity as the process of creation, introduction and dissemination of innovations (Illyashenko and Shipulina, 2010).

Effective innovative activity at an industrial enterprise is possible primarily due to the participation of innovative infrastructure offering a wide range of services. According to the Law of Ukraine "On innovative activity" (N40-IV, 4.07.2002), innovative infrastructure is the set of enterprises and organizations, institutions, their unions, associations of any form of ownership providing services on innovative activity (financial, consulting, marketing, information and communicative, legal, educational etc.) to the relevant industrial enterprise in order to successfully implement at it innovative projects with the beforehand prepared innovative processes covering all

stages of an innovative cycle, from the origin of a scientific idea to the technical side of production and innovation consumption.

Additional stimulation of innovative measures at business structures intensify the innovative process, the level of innovative security of enterprise will increase its value several times as well, thus potentially influencing also the integrated level of economic security of enterprise, simplifying the system of control over the allowed range of its values.

Dynamics of the level of innovative protection of an enterprise depends on the direction and strength of innovative development of a business entity where innovative development is defined as "the process of management that relies on continuous search and use of new ways and areas of realization of enterprise potential in changing conditions of the external environment within the chosen mission and adopted motivation of activity and that is connected with the modification of existing and formation of new sales markets" (Illyashenko and Shipulina, 2010). That is, any innovation passes the way from a scientific idea to a specific product with the result of effective serial production. It is not always possible to predict the development of an innovative process at industrial enterprises since there is the influence of both unstable external environment (the type of market, character of competition, practice of state regulation, the level of education, organizational forms of interaction between science and production) and that of the internal environment of separate organizational and economic systems expressed through financial, material and technical resources, the use of latest technologies and progressive relationships with external environment (Mykytyuk, 2009).

Threats to economic security are always present since they are rapidly born within the extremely unstable market environment represented as a set of actual or potentially possible phenomena and the destabilizing factors that complicate or make impossible the realization of national interests in the economic sector (Pirozhkov et al., 2003).

The main threat to innovative security is the insufficient level of financing scientific and technical researches that form a platform of further innovative development critically depending on the dynamics of the outflow of scientists and highly skilled professionals abroad. The constant funding gap does not allow quickly update the equipment at industrial enterprises, thus causing a decrease in production of finished products, also the decrease in the level of competitiveness, primarily due to non-fulfillment of the criterion of effectiveness in technological processes. Thus, the insufficient development of infrastructure of scientific and technical potential of enterprise entails quite slow update of products of business entities that slows down the market promotion of a new product and postpones long awaited process of obtaining income.

It is known that the indicators of any constituent of economic security of enterprise are the most important indices defined by means of the criteria of economic stability, where the main criterion is the level of vulnerability of separate economic activity. For example, innovative area of enterprise activity is influenced by such criteria of assessment of innovation at different stages of inhouse innovative process as the level of financial expenses, the level of return on invested capital, scientific efficiency of enterprise regarding the set objectives, the degree of risk and uncertainty, the speed of information dissemination on innovative products, the compliance with existing

norms and values, the complexity of innovation, the degree of scientific character, the relative benefit from innovation for users, the place of innovation occurrence, the possibility for introduction of innovation in parts, the possibility to return to previous practice in case of failure, the level of enterprise staff propensity to innovation, the influence of innovation on interpersonal relations, the possibility of secret introduction of innovations, the possibility for further modification of an innovation, the possibility of innovation diffusion and so on (Mykytyuk, 2009).

Indicators are always chosen from the viewpoint of comprehensive estimation of a certain problem so their thorough specification is not required. In our case, the indicator of innovative security of an enterprise can be calculated through the correlation between the volume of financing scientific and technical projects at the expense of own and borrowed funds (the total capitalization of an enterprise) and the gross profit. The indicator of innovative security at the state level is calculated similarly. It is known that for Ukraine the optimal threshold value of index of the level of expenses of scientific and technical activity must be no less than 2% of gross domestic profit. In Ukraine the destruction of the fundamental base for innovative activity was taking place for a long time, the expenses for financing science in the state budget for many years, according to (Lapko, 1999), did not exceed 0.4% of GDP, that was much less than in developed countries (Japan – 0.87%, USA – 0.56%, Sweden – 0.86%, Finland – 0.95%). This situation has now changed with a tendency to improve, however, the present structure of the use of scientific and technical potential at industrial enterprises still does not satisfy the needs of Ukraine's economy. During the years of independence only 5% were oriented on updating and 95% went on reproduction of production, although it is known that a decrease in funds on modernization of production potential worsens the condition of production complex, thus causing the increase of the share of imported high-tech products. This leads to the curtailment of domestic scientific and technical researches, slows down the growth of high-technology branches of all industries within the country and reduces the competitiveness of the national economy as a whole.

The enhancement of innovative activity of industrial enterprises in the system of general control of the level of economic security and, above all, through the level of innovative protection where the control system is a certain set of control measures that allows, under any circumstances, maintaining the acceptable level of security at a business entity is of a particular importance. This control system allows developing effective processes to ensure integrated economic security at an enterprise, that must contain multifunctional mechanism of ensuring economic security, the toolkit for diagnostics of the level of each of the constituent parts of economic security, particularly innovative constituent part and the system of effective measures that will enable us effectively influence the level of economic security of enterprise primarily through sustainable innovative activity.

For the quality control of the state of innovative security at an enterprise it is recommended first to include into the model all the parameters that influence the level of innovative protection (Alekseyev and Khoma, 2011):

$$R_{I3} = f(f_1(x_1, x_2, \dots, x_n, y_1, y_2, \dots, y_n), \dots, f_z(x_1, x_2, \dots, x_n, y_1, y_2, \dots, y_n)), \quad (1)$$

where  $f$  is the general functional dependency for calculating the level of innovative security of enterprise;  $f_i$  is the conversion function that sets the functional dependen-

cy between input and output (resultant) parameters of the  $i$ -th of their fixed quantity that affect the level of innovative security ( $i = \overline{1, z}$ );  $x_j, y_j$  – the groups of parameters, that may be functionally independent between each other in the case that elements from one group  $x_j$  or  $y_j$  are always functionally dependent between each other ( $j = \overline{1, n}$ ).

This model in general form allows us make a clear sample of the most important parameters that in future will be included in a fixed array of values for estimating the level of innovative security of an enterprise.

Accordingly, this array of functional dependencies will cover the most resultant financial and economic indices responsible for estimation of the current condition of innovative security of an enterprise. These include: the coefficient of innovative offer ( $k_{i_{pr}}$ ); the index of profitability of sold innovative products according to net income ( $R_{pin}^{pr}$ ) business entity will receive after the sale of manufactured innovative goods; the value of effectiveness from the introduction of innovations at an enterprise ( $e_k^i$ ); the coverage ratio of total expenses of innovative project as the expected value of integral effect from an implemented innovative project ( $k_{\sum B}^{IE}$ ); the total risk of the entire innovative project at an enterprise ( $R$ ), the level of inventive activity ( $r_{vd}$ ), the level of financing and crediting of the entire innovative activity of an entrepreneurial structure ( $r_{id}^{fk}$ ); the integral index of effectiveness of innovative activity ( $I_{id}^v$ ) or, as it also is called, the coefficient of actual productivity and the index of profitability of an innovative project ( $R_{ipr}$ ).

Then the recommended model for calculating the level of innovative security of an industrial enterprise with desirable trends of relevant indices-indicators will be:

$$R_{i3} \uparrow = f(k_{ipr} \uparrow, R_{pin}^P \uparrow, e_k^i \uparrow, k_{\sum B}^{IE} \uparrow, R \downarrow, r_{vd} \uparrow, r_{id}^{fk} \uparrow, I_{id}^v \uparrow, R_{ipr} \uparrow), \quad (2)$$

where  $\uparrow$  is the tendency to increase the index;  $\downarrow$  is the tendency to decrease the index.

In practice there is still a general elaborated system of indices for assessment of innovations effectiveness that takes into account the final results of innovations realization both generally within the national economy, and including a number of market entities involved in the elaboration and manufacturing of innovative products for consumers. This system of indices for the assessment of general economic effectiveness of innovations contains the integral effect of innovations for developers, manufacturers, consumers and on the state level (budget) it may include the system of indices of operational effectiveness of innovations, the system of indices of their financial effectiveness, the system of indices of investment effectiveness of innovations and the system of indices of innovations budget effectiveness.

The systems of indices of operational effectiveness of innovations, financial effectiveness of innovations and investment effectiveness of innovations can establish the correlation interconnection between all major constituents of economic security of separately taken industrial enterprises, partially controlling the allowable error of general level in the economic protection of entrepreneurial structures.

The general system of indices for the assessment of economic effectiveness of innovations includes: 1) the general (integral) amount of net output (added value), including depreciation, created due to realization of innovation at a business entity; 2) the integral (general) increase of net output (including depreciation), obtained due

to the production, creation and use of innovation compared to its analog, counted for a year; 3) the general (integral) amount of net output created due to realization of innovation respectively in different spheres of production, creation and use of innovation; 4) the general (integral) increase in net output obtained due to production, creation and use of innovation; 5) the total amount of income obtained due to production, creation and use of innovation rate counting for a year; 6) the increase in total amount of income due to production, creation and use of innovation, counted for a year; 7) profitability of capital investments aimed at the creation, production and use of innovation rate, counted for a year; 8) the total increase in profitability of capital investments from the production, creation and use of innovation compared with the profitability of capital investments of an analogue, counted for a year; 9) the total volume of economic effect, calculated on the basis of net output, including depreciation, obtained in the areas of production, creation and use during the whole useful life of application of innovation; 10) the increase in economic effect by applying innovations in production, creation and use and calculated on the basis of net output, including depreciation in comparison with an analog; 11) the payback period of the total amount of capital investments aimed at production, creation and use of innovations; 12) the total amount of taxes to budget from realization of an innovation for the entire term of its creation, production and use, determined by summing the taxes received respectively from developers, producers and users of innovative products or services (Zavlin and Vasylyev, 1998; Ilyashenko and Shipulina, 2010; Mykytyuk, 2007, 2009).

Effective enhancement of innovative activity at industrial enterprises significantly affect the management of innovative protection, that is reflected primarily in the indices of assessment of the innovations effectiveness through their positive dynamics and allows us control within permissible limits the integral level of economic security of industrial enterprise. According to (Pirozhkov et al., 2003), to increase the level of innovative security of an enterprise it is necessary to form innovative and investment policies on the principles of obligatory combination of investments with innovations, to involve all possible sources of investments for innovative processes in order to achieve the increased level of expenses on science, research and technical works; to reduce taxes on profit of industrial enterprises by the amount of money spent on science and research, scientific and technical activity within innovative activities; to introduce state insurance of possible risks from innovative activity especially for various innovative projects at enterprises, to promote the development of innovative infrastructure, maximally adapted to work under market conditions including venture financing of technoparks, innovative and technological centers etc.; to reorient the use of scientific and technical capacities mainly on updating, rather than on reproduction of production; to integrate into the global scientific and technical space, to increase the level of intellectualization of domestic exports and to reduce the dependence of the country from the import of high technology goods; to widely introduce IT into scientific and technical activities of innovative enterprises etc.

High economic potential of an industrial enterprise in this situation maximally correlates with innovative security, allowing in the long term to keep its level quite high. Introduction of the applied method of diagnostics of the level of innovative security of enterprise allow deepening the diagnostics assessment of the production



structure according to the selected array of structural elements in terms of quantitative measurement of its degree of protection of innovative activity.

The applied aspect of diagnostics of innovative security of a business entity lies in estimation of the influence of destabilizing factors on the quantitative measurement of the level of innovative security of the studied enterprise by taking into account the deviations of major groups of indices-indicators from their normative values.

In our case, the relative value of fixation of total destabilizing impact of factors ( $V_{in}$ ), which is reflected on the quantitative measurement of the level of innovative constituent of economic security of enterprise considering deviation of profile indices ( $|\Delta_j^{in}|$ ) can be calculated as follows:

$$V_{in} = \frac{|\Delta_1^{in}|}{N_1^{in}} + \frac{|\Delta_2^{in}|}{N_2^{in}} + \dots + \frac{|\Delta_k^{in}|}{N_k^{in}} = \sum_{j=1}^k \frac{|\Delta_j^{in}|}{N_j^{in}}, \quad (3)$$

where  $N_j^{in}$  are normative values of the recommended group of indices-indicators of  $j$ -th quantity, that participate in the process of diagnostics of the level of innovative security of an enterprise.

It is recommended to take all normative values of indices-indicators by their lowest allowable limit so as not to miss even the smallest danger, maximally forecasting the consequence of its actions on the condition of innovative security of enterprise through the integrated effect of destabilizing factors and the ability of a business entity to counter them. The economic content of the correlation  $\sum_j \frac{|\Delta_j^{in}|}{N_j^{in}}$  lies in the fact that in each case exactly the value of influence of destabilizing factor that adversely affects the condition of innovative security automatically reducing it by this value is calculated.

Then the level of innovative security of the enterprise  $R_{in}$  with the participation of the influence of the total destabilizing factors will be calculated:

$$R_{in} = L_r^V - V_{in} = L_r^V - \sum_{j=1}^k \frac{|\Delta_j^{in}|}{N_j^{in}}, \quad (4)$$

where  $R_{in}$  is the level of innovative security of the enterprise;  $L_r^V$  is the localized  $r$ -measurement scale (Figure 1) for measuring the level of innovative security of the enterprise taking into account the relative value of the total destabilizing influence of factors ( $L_r^V = 10$ ). Moreover, if the estimated total value of destabilizing influence of factors exceeds the value of conditionally accepted localized measurement scale of innovative security, the level of innovative security of business entity receives zero value;  $|\Delta_j^{in}|$  – the absolute deviations according to the module of estimated values of the recommended indices-indicators from their normative values that participate in the process of diagnostics of the condition of innovative security;  $N_j^{in}$  – the normative values of the recommended group of indices-indicators.

The input data for the example of calculation of the diagnosed level of innovative security of the enterprise are shown in Table 1.

The calculations show that for 3 studied periods the given business entity, in accordance with the suggested scale for measuring the level of innovative security, has had a high level of innovative protection. However, over the last year, its value dropped

by 1.237 units in relation to the previous year, thus requiring the increased control over its further dynamics.

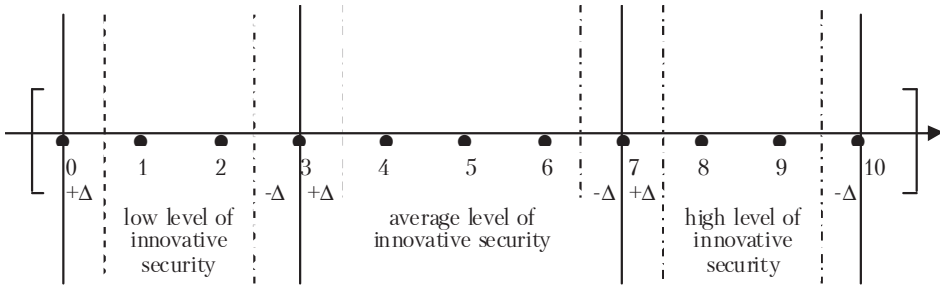


Figure 1. The localized measurement scale of innovative security of an enterprise, author's elaboration, in points

Table 1. Grouping the data for calculating the level of innovative security of enterprise by the indices-indicators, author's elaboration

N	Index title	Normative value $N^m$	Deviation from normative value $ \Delta $ by years			Value of total destabilizing influence on the level of innovative security by years		
			$n - 1$ year	$n$ year	$n + 1$ year	$n - 1$ year	$n$ year	$n + 1$ year
1.	Coefficient of innovative offer ( $k_{pr}$ )	$\geq 1$	0.285	0.290	0	1.855	1.002	2.239
2.	Profitability of sold innovative products according to net income ( $R_{pin}^p$ )	$\geq 0.02$	0.01952	0.0004	0.0207			
3.	Value of useful effectiveness ( $e_{\kappa}^i$ )	$> 1$	0.114	0.124	0.153			
4.	Ratio of total expenses of innovative project by real value of the integral effect ( $k_{\sum B}^{IE}$ )	$> 0$	0	0	0			
5.	Cumulative risk of underperformance stages throughout the innovation project ( $R$ )	$\leq 0.15$	0	0.02	0			
6.	Level of inventive activity ( $r_{id}$ )	$\geq 2$	0.96	0.87	0.74			
7.	Level of financing and crediting of the entire innovative activity ( $r_{id}^{fk}$ )	$\geq 1$	0	0	0.681			
8.	Integral index of effectiveness of innovative activity ( $I_{id}^v$ )	$\geq 1$	0	0	0			
9.	Profitability of innovative project by investments ( $R_{ipr}$ )	$\geq 0.1$	-	-	-			



Continuation of Table 1

Calculated results	Years		
	<i>n</i> – 1 year	<i>n</i> year	<i>n</i> + 1 year
Level of innovative security	<b>8.145</b>	<b>8.998</b>	<b>7.761</b>

*n* – 1 year:

$$V_{in} = \frac{0.285}{1} + \frac{0.01952}{0.02} + \frac{0.1140}{1.0001} + \frac{0}{0.1} + \frac{0}{0.15} + \frac{0.96}{2} + \frac{0}{1} + \frac{0}{1} =$$

$$0.285 + 0.976 + 0.114 + 0 + 0 + 0.48 + 0 + 0 = 1.855;$$

$$R_{in} = 10 - 1.855 = 8.145.$$

*n* year:

$$V_{in} = \frac{0.290}{1} + \frac{0.0004}{0.02} + \frac{0.1240}{1.0001} + \frac{0}{0.1} + \frac{0.02}{0.15} + \frac{0.87}{2} + \frac{0}{1} + \frac{0}{1} =$$

$$= 0.290 + 0.02 + 0.124 + 0 + 0.133 + 0.435 + 0 + 0 = 1.002$$

$$R_{in} = 10 - 1.002 = 8.998.$$

*n* + 1 year:

$$V_{in} = \frac{0}{1} + \frac{0.0207}{0.02} + \frac{0.1530}{1.0001} + \frac{0}{0.1} + \frac{0}{0.15} + \frac{0.74}{2} + \frac{0.681}{1} + \frac{0}{1} =$$

$$= 0 + 1.035 + 0.153 + 0 + 0 + 0.37 + 0.681 + 0 = 2.239;$$

$$R_{in} = 10 - 2.239 = 7.761.$$

Having considered the applied aspects in the formation and use of the diagnostics toolkit of innovative security on the example of industrial enterprise we can make such **conclusions**:

1. The dynamics of the level of innovative protection of enterprise will always depend on the direction and current strength of innovative development of a business entity.

2. For qualitative control over the state of innovative security of an enterprise it is recommended to include all the parameters that influence the level of innovative protection into the model of array of functional dependencies with previous obligatory establishment of desirable tendencies of the introduced indices-indicators that will ease the process of diagnostics in the future.

3. The suggested method of diagnostics of innovative security of a business entity must lie in the holistic estimation of influence of destabilizing factors on the quantitative measurement of the level of innovative security of an enterprise accurately fixing all deviations of major groups of the introduced indices-indicators from their recommended normative values.

The perspectives for further exploration in the given direction of research is the establishment of correlation dependencies between a diagnosed value of innovative security of an enterprise and the integrated level of general economic security of a business entity.

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## КНИЖКОВИЙ СВІТ



### СУЧАСНА ЕКОНОМІЧНА ТА ЮРИДИЧНА ОСВІТА ПРЕСТИЖНИЙ ВИЩИЙ НАВЧАЛЬНИЙ ЗАКЛАД **НАЦІОНАЛЬНА АКАДЕМІЯ УПРАВЛІННЯ**

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**Сучасні проблеми розвитку національної економіки і шляхи їх розв'язання: Колективна наукова монографія / За наук. ред. д.е.н., проф. М.М. Єрмошенка. — К.: Національна академія управління, 2008. — 452 с. Ціна без доставки — 50 грн.**

У монографії розглядаються теоретичні і практичні проблеми розвитку економіки України, пропонуються шляхи їх розв'язання з метою зростання її конкурентоспроможності та ефективності.

Буде корисною для аспірантів, викладачів вищих навчальних закладів, практичних працівників.