UDC 334.021:658:69.009 DOI:

Econometric modeling of investment attractiveness of enterprises

K. Mamonov, V. Velychko, E. Grytskov, S. Haidenko, V. Prasol, Abolhacanzad Alireza

O.M. Beketov National University of Urban Economy in Kharkiv, Marshala Bazhanova Str., 17, 61002, Kharkiv, Ukraine
hcsms.07@gmail.com

Abstract

The trend of recent years is a decrease in the level of total energy consumption. Along with this, there is a permanent increase in the cost of energy, which affects the well-being of the population. In such circumstances, the urgent task is to ensure the investment attractiveness of fuel and energy companies.

The study aims at the development and implementation of an integrated approach to assessing the investment attractiveness of enterprises. To achieve this goal, the study solves the following tasks: determination of the investment attractiveness of fuel and energy enterprises; formation of directions for the development of an integrated approach to assessing the investment attractiveness of fuel and energy enterprises; implementation of an integrated approach to assessing the investment attractiveness of fuel and energy enterprises; development of directions for increasing investment attractiveness based on the application of the results of its assessment.

Econometric modeling tools are used to form a quantitative basis for decision-making. Causal relationships have been established between the factors influencing the investment attractiveness of enterprises with the use of econometric tools.

As a result of the study, it was proposed to determine the investment attractiveness of fuel and energy enterprises, as well as a reasonably integrated approach to assessing its level. The directions for increasing the investment attractiveness of fuel and energy enterprises are proposed. Ways to improve information and analytical support for determining the investment attractiveness of fuel and energy enterprises are identified.

Keywords: econometric modeling; investment attractiveness; enterprises; fuel and energy; integrated approach; assessment; information and analytical support.

Received: 22.09.2020 Edited: 18.11.2020 Approved for publication: 27.11.2020

Introduction

The increase in the efficiency enterprises operation in current business conditions, characterized by controversial processes in the economy, the negative influence of external and internal factors, a decrease in the pace of development of business entities, is of particular importance. The fuel and energy of companies provide the development of enterprises of other spheres of economy and influence the functioning of the state. Besides, the fuel and energy sector affects its social policies and security aspects.

The trend of recent years is a decrease in the level of total energy consumption. Along with this, there is a permanent increase in the cost of energy, which affects the well-being of the population. In such circumstances, the urgent task is to ensure the investment attractiveness of fuel and energy companies. To solve the presented problems, a quantitative basis for decision-making is formed on the basis of the use of econometric tools.

Materials and methods

The problems of formation of investment attractiveness of enterprises are investigated in: I. Gvozdetska [1], V. Hunko [2], M. Zinyuk [3], L. Leonova et al. [4], M. Lysenko [5], K. Mamonov et al. [6], A. Meshkov [7], S. Pankov [8], M. Stirsky [9], O. Trydid and K. Oryekhova [10], S. Yukhymchuk and S. Suprun [11]. However, the issues of determining and forming the investment attractiveness, considering the specifics of the functioning of fuel and energy enterprises and based on a quantitative appraisal basis, remain complexly unresolved.

Materials for carrying out the research are theoretical and methodological approaches to the determination and evaluation of investment attractiveness of fuel and energy enterprises, appropriate regulatory and legal sup-

port. Research methods are systematization and generalization (to form a theoretical basis for determining and evaluating the investment attractiveness of enterprises); integral method (for estimation of investment attractiveness of fuel and energy enterprises); expert assessments and analytical methods (to determine local indicators); hierarchy method (to evaluate weights that reflect the impact of systemic indicators on the integral factor of investment attractiveness of fuel and energy enterprises).

The study aims at the development and implementation of an integrated approach to assessing the investment attractiveness of fuel and energy enterprises. To achieve this goal, the study solves the following tasks:

• determination of the investment attractiveness of fuel and energy enterprises;

• formation of directions for the development of an integrated approach to assessing the investment attractiveness of fuel and energy enterprises;

• implementation of an integrated approach to assessing the investment attractiveness of fuel and energy enterprises;

• development of directions for increasing investment attractiveness based on the application of the results of its assessment.

To determine the influence of different factors on the investment attractiveness of enterprises, econometric tools are used as a set of modern methods and models of quantitative assessment.

Results

Considering the indicators, which form the investment attractiveness of fuel and energy enterprises, a generalized model for assessing the integral indicator has been developed:

$$I_{ipp} = \sum_{i=1}^{n} \prod k_{vi} * I_i, \qquad (1)$$

where I_{ipp} – is the integrated indicator of the investment attractiveness of fuel and energy enterprises, rel. units; k_{vi} – are the weight coefficients characterizing the values of indicators forming the investment attractiveness, rel. units; I_i – are the indicators forming investment attractiveness, rel. units; i – is the indicator number; n – is the number of indicators.

The assessment of local indicators that form investment attractiveness is carried out using analytical and expert analysis methods with the formulas of the arithmetic mean and geometric mean. The assessment of integrated indicators, which form the investment attractiveness of fuel and energy enterprises, is carried out based on the proposed models using local indicators and ranking coefficients.

For indicators when the assessment was carried out based on the application of the expert assessment method, concordance coefficients are applied with the determination of the following: deviations of the sum of ranks from their average amount; the number of parameters and observations; the sum of ranks; rank values; the number of related ranks in the group; related rank groups; the number of groups of related ranks.

The determination of weight coefficients characterizing the values of indicators, as well as their mutual influence in the system for assessing the investment attractiveness of fuel and energy enterprises, is carried out based on the hierarchy analysis method developed by T. Saati. This method consists of decomposing the problem into simpler components with the definition of pairwise comparisons and a phased assessment of priorities and components.

In general, the model for determining the weights for the indicators, which determine the investment attractiveness of fuel and energy companies, is as follows:

$$k_{vi} = \frac{V_{Ii}}{\sum_{i=1}^{n} V_{Ii}}. \qquad (2)$$

The next step in forming an integrated approach to assessing the investment attractiveness of fuel and energy companies is to determine the appropriate integrated criterion. Its values vary from 0 to 9 and characterize the levels of investment attractiveness. Based on the results of determining the integrated criterion of investment attractiveness of fuel and energy enterprises, the methodological recommendations are developed for its increase, and the directions for improving the information and analytical support for investment attractiveness are justified. Summarizing the above, a scheme for the formation of an integrated approach to assessing the investment attractiveness of fuel and energy enterprises is proposed (Fig. 1).

Thus, to improve information and analytical support, an integrated approach to assessing the investment attractiveness of fuel and energy enterprises was proposed, based on a set of interrelated stages and the application of analytical, financial analysis, expert evaluation, and hierarchy analysis methods, which allowed to determine methodological tools for increasing the investment attractiveness.

As a result of the weighting coefficient assessment, it was determined that at energy enterprises, the most significant influence on investment attractiveness is carried out by an integrated indicator that identifies the property status, liquidity, financial stability, business activity, and profitability. Besides, it should be pointed out that a generalizing indicator determining spatial characteristics and an integral indicator of the investment state of fuel and energy enterprises are essential in the formation of investment attractiveness.

The models for assessing the integral indicator of investment attractiveness of fuel and energy enterprises based on certain weighting factors have been developed:

PJSC "Kyivoblenergo":

$$I_{ipp} = 0.332 * I_1 + 0.15 * I_2 + 0.167 * I_3 + \\ + 0.194 * I_4 + 0.116 * I_5 + 0.04 * I_6, \qquad (3)$$

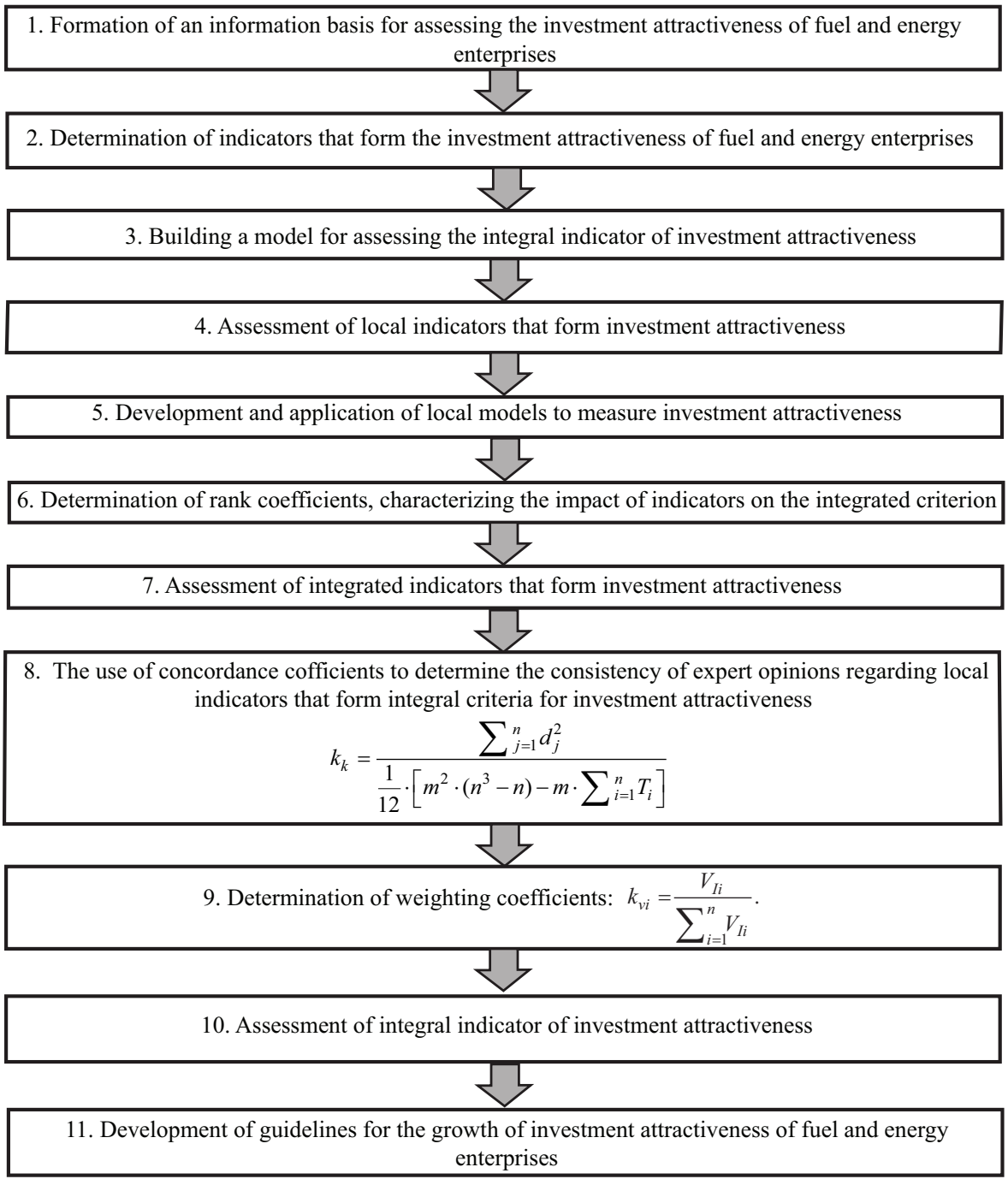

Fig. 1. Scheme for the formation of an integrated approach to assessing the investment attractiveness of fuel and energy enterprises

JSC "Kharkivoblenergo":

$$I_{ipp} = 0.329 * I_1 + 0.11 * I_2 + 0.215 * I_3 + \\ + 0.198 * I_4 + 0.103 * I_5 + 0.045 * I_6, \quad (4)$$

PJSC "EC Odesaoblenergo":

$$I_{ipp} = 0.299 * I_1 + 0.12 * I_2 + 0.19 * I_3 + \\ + 0.219 * I_4 + 0.121 * I_5 + 0.054 * I_6, \quad (5)$$

PJSC "Lvivoblenergo":

$$I_{ipp} = 0.321 * I_1 + 0.08 * I_2 + 0.238 * I_3 + \\ + 0.209 * I_4 + 0.077 * I_5 + 0.074 * I_6, \quad (6)$$

PJSC "Chernihivoblenergo":

$$I_{ipp} = 0.352 * I_1 + 0.08 * I_2 + 0.184 * I_3 + \\ + 0.188 * I_4 + 0.09 * I_5 + 0.11 * I_6. \quad (7)$$

The proposed models and the values of investment attractiveness indicators made it possible to determine the corresponding integrated criterion (Table 1).

As a result of assessing the integrated indicator of the investment attractiveness of fuel and energy enterprises, it was determined that the highest value was observed at PJSC "EC Odesaoblenergo", which is due to the growth in the financial condition of the enterprise, and the advantages in locating its facilities. The lowest value of the integral indicator was observed

Table 1

The assessment results of an integrated indicator of investment attractiveness, rel. units (developed by the author)

Enterprises	The values of the indicator						Integrated indicator I_{ipp}
	I_1	I_2	I_3	I_4	I_5	I_6	
PJSC "Kyivoblenergo"	1.12	0.19	0.69	0.04	0.16	0.03	2.23
JSC "Kharkivoblenergo"	1.46	0.14	0.59	0.04	0.15	0.04	2.42
PJSC "EC Odesaoblenergo"	2.08	0.15	0.47	0.05	0.15	0.04	2.93
PJSC "Lvivoblenergo"	1.89	0.1	0.68	0.05	0.09	0.06	2.87
PJSC "Chernihivoblenergo"	0.82	0.1	0.27	0.04	0.1	0.09	1.42

at PJSC "Chernihivoblenergo", which is due to a decrease in financial condition. In general, all fuel and energy enterprises have a relatively high level of investment attractiveness.

Discussions

This part is based on the results of the assessment of investment attractiveness of enterprises, its econometric modeling for the formation of quantitative information with appropriate accuracy and reliability and the development of a system for measuring the processes occurring in production and economic systems. This allowed to improve the system of metrological research to assess the investment attractiveness of construction companies.

According to the results of the study, the causal links between the factors influencing the investment attractiveness of enterprises with the use of econometric tools. The results of econometric modeling of factors influencing the investment attractiveness of enterprises are presented in Table 2.

As a result of modeling it is established that the generalizing factor that characterizes property condition, liquidity, financial stability, business activity, profitability by 91.1% causes changes of an integral indicator of investment attractiveness of the enterprises of a fuel and energy complex. A linear relationship has been established between the presented indicators. Thus, it is determined that the indicators of property status, liquidity, financial stability, business activity and profitability mostly determine the formation and use of investment attractiveness of fuel and energy companies. Therefore, the areas of improvement of information and analytical support are characterized by focusing on changes in property status, in the field of liquidity, financial stability, business activity, profitability. Moreover, this will form the basis and identify opportunities for sound management decisions.

Based on the study of the influence of the generalizing factor that determines the level of safety on the integrated indicator of investment attractiveness of fuel and energy enterprises, a low level of influence of the independent variable on the system indicator has been established. Unfortunately, in modern conditions, investment attractiveness largely does not depend on security trends and features. This reduces opportunities and creates conditions for unreasonable influence of different groups of stakeholders on fuel and energy companies and their investment attractiveness. Therefore, in modern conditions, the development of direc-

Table 2

The results of econometric modeling of factors influencing the investment attractiveness of enterprises, rel. from (developed by the author)

Factors	Econometric models	Coefficient of determination
The generalizing factor that characterizes the property status, liquidity, financial stability, business activity, profitability	$y = 1.113 * x + 0.733$	$R^2 = 0.911$
The generalizing factor that determines the level of safety	$y = -240.31 * x^2 + 71.092 * x - 2.575$	$R^2 = 0.21$
The generalizing factor that determines the spatial characteristics	$y = -17.76 * x^2 + 19.377 * x - 2.476$	$R^2 = 0.754$
The generalizing factor that characterizes the investment condition	$y = 87.667 * x + 1.483$	$R^2 = 0.62$
The generalizing factor that determines the investment infrastructure	$y = 554.45 * x^2 - 133.89 * x + 9.944$	$R^2 = 0.131$
The generalizing factor that characterizes the features of the functioning of the fuel and energy complex	$y = -1160.9 * x^2 + 125.82 * x - 0.5$	$R^2 = 0.913$

tions and improvement of information and analytical support aimed at the formation of security procedures and actions becomes especially important.

At a significant level is influenced by the generalizing factor that determines the spatial characteristics of the integrated indicator of investment attractiveness of the fuel and energy sector. This is due to the fact that the formation of investment attractiveness largely depends on the location of fuel and energy enterprises.

It should be noted that the influence of the systemic factor of the investment status on the integrated indicator of investment attractiveness of the fuel and energy complex is characterized by a linear indirect relationship. The growth of the system factor by 62% causes an increase in the integrated indicator and vice versa. As a result of modeling the generalizing factor that determines the investment infrastructure on the integrated indicator of investment attractiveness of the fuel and energy complex is characterized by low nonlinear impact. This is due to the underdevelopment of investment infrastructure, which negatively affects the functioning of fuel and energy companies.

The features of functioning of fuel and energy enterprises at a high level determine the formation of their investment attractiveness. Moreover, with the growth of information and analytical support of fuel and energy enterprises, their investment attractiveness will increase to the appropriate level, then there is a reduction. This is due to the need for security measures to control the formation and use of information and analytical support.

Conclusions

It is proposed to implement directions for further strengthening the financial condition of fuel and energy enterprises by increasing indicators of property status, liquidity, financial stability, business activity, and profitability. Along with specific areas, it is proposed to improve information and analytical support to increase the investment attractiveness of fuel and energy enterprises by the following: the creation of a center for information and analytical support of investment activity, the functioning of which increases the level of communication between investors and fuel and energy enterprises, which are the main actors in the investment process, and which in turn leads to increased investment activity within the fuel and energy complex; the introduction of a hierarchical system of indicators for the integrated assessment of the investment attractiveness of fuel and energy enterprises, the use of which is proposed to be published using a specialized electronic resource (website), which will allow investors to increase the level of validity of management decisions on the choice of enterprises that act as investment objects.

For the formation of information and analytical support, a methodological approach to the express assessment of the activity of fuel and energy enterprises is implemented, which provides for the creation of groups of such enterprises depending on the results of determining indicators reflecting the use of their assets and financial position; allows to identify enterprises with the best, average and worst indicators, followed by their ranking using the value of the average serial number of the group; allows using the results of the express evaluation of the activity of fuel and energy enterprises as an additional criterion for the distribution of investment funds.

An important area of improvement of information and analytical support for the formation of investment attractiveness and decision-making is to establish causal links between systemic factors and the integrated indicator of investment attractiveness through the use of econometric modeling tools. This has improved the system of metrological measurements of investment attractiveness of economic entities.

Економетричне моделювання інвестиційної привабливості підприємств

К.А. Мамонов, В.А. Величко, Є.В. Грицьков, С.М. Гайденко, В.М. Прасол, Абольхаканзад Аліреза

Харківський національний університет міського господарства імені О.М. Бекетова, вул. Маршала Бажанова, 17, 61002, Харків, Україна
hcsms.07@gmail.com

Анотація

Тенденція останніх років – зниження рівня загального енергоспоживання. Поряд із цим відбувається постійне збільшення вартості енергії, що позначається на добробуті населення. В таких умовах актуальним завданням є забезпечення інвестиційної привабливості паливно-енергетичних компаній.

Метою дослідження є розробка та впровадження інтегрального підходу до оцінки інвестиційної привабливості підприємства. Для досягнення цієї мети в дослідженні вирішуються такі завдання: визначення інвестиційної привабливості підприємств паливно-енергетичного комплексу; формування напрямків розвитку інтегрального підходу

до оцінки інвестиційної привабливості підприємств паливно-енергетичного комплексу; впровадження інтегрального підходу до оцінки інвестиційної привабливості підприємств паливно-енергетичного комплексу; розробка напрямків підвищення інвестиційної привабливості на основі застосування результатів її оцінки.

У результаті дослідження було запропоновано визначити інвестиційну привабливість підприємств паливно-енергетичного комплексу, а також інтегральний підхід до оцінки її рівня. Пропонується реалізувати напрями відносно подальшого зміцнення фінансового стану паливно-енергетичних підприємств шляхом підвищення показників стану власності, ліквідності, фінансової стабільності, ділової активності та рентабельності.

Запропоновано напрями підвищення інвестиційної привабливості підприємств паливно-енергетичного комплексу. Визначено шляхи вдосконалення інформаційно-аналітичного забезпечення визначення інвестиційної привабливості підприємств паливно-енергетичного комплексу.

Важливим напрямом удосконалення інформаційно-аналітичного забезпечення формування інвестиційної привабливості та прийняття рішень є встановлення причинно-наслідкових зв'язків між системними чинниками та інтегральним показником інвестиційної привабливості шляхом застосування інструментів економетричного моделювання як сучасних методів і моделей кількісної оцінки.

Ключові слова: економетричне моделювання; інвестиційна привабливість підприємства; паливно-енергетичний комплекс; інтегральний підхід; оцінка; інформаційно-аналітичне забезпечення.

Эконометрическое моделирование инвестиционной привлекательности предприятий

К.А. Мамонов, В.А. Величко, Е.В. Грицков, С.Н. Гайденко, В.М. Прасол, Аболхаканзад Алиреза

Харьковский национальный университет городского хозяйства имени А.Н. Бекетова, ул. Маршала Бажанова, 17, 61002, Харьков, Украина
hcsms.07@gmail.com

Аннотация

Целью исследования является разработка и внедрение интегрального подхода к оценке инвестиционной привлекательности предприятия. Для достижения этой цели в исследовании решаются следующие задачи: определение инвестиционной привлекательности предприятий топливно-энергетического комплекса; формирование направлений развития комплексного подхода к оценке инвестиционной привлекательности предприятий топливно-энергетического комплекса; внедрение комплексного подхода к оценке инвестиционной привлекательности предприятий топливно-энергетического комплекса; разработка направлений повышения инвестиционной привлекательности на основе применения результатов ее оценки. В результате исследования было предложено определить инвестиционную привлекательность предприятий топливно-энергетического комплекса, а также интегрированный подход к оценке ее уровня. Предложены направления повышения инвестиционной привлекательности предприятий топливно-энергетического комплекса. Определены пути совершенствования информационно-аналитического обеспечения определения инвестиционной привлекательности предприятий топливно-энергетического комплекса.

Важным направлением совершенствования информационно-аналитического обеспечения формирования инвестиционной привлекательности и принятия решений является установление причинно-следственных связей между системными факторами и интегральным показателем инвестиционной привлекательности путем применения инструментов эконометрического моделирования как современных методов и моделей количественной оценки.

Ключевые слова: эконометрическое моделирование; инвестиционная привлекательность предприятия; топливно-энергетический комплекс; интегральный подход; оценка; информационно-аналитическое обеспечение.

References

1. Gvozdetska I.V. Kompleksna otsinka zaluchennia investytsii promyslovykh pidpryiemstv (na prykladi mashynobudivnykh pidpryiemstv) [Comprehensive assessment of the investment attraction of industrial enterprises (by the example of machine-building enterprises)]: thesis PhD. Khmelnytskyi, Khmelnytskyi National University, 2009 (in Ukrainian).
2. Hunko V. Faktory ta pokaznyky formuvannia investytsiinoi pryvablyvosti pidpryiemstv [Factors and indicators of forming enterprises' investment attractiveness]. *Financial Space*, 2013, no. 1, pp. 85–88 (in Ukrainian).
3. Zinyuk M.A. Metodika otsenki investitsionnoi privlekatelnosti predpriyatiya [Methods of enterprises' assessing the investment attractiveness].

Questions of Economic Sciences, 2005, no. 6, pp. 348–352 (in Russian).

4. Leonova L., Belyayev E., Belyayeva T. Protsedura otsinky investytsiinoi pryvablyvosti pidpryiemstv – vykonavtsiv kontraktiv [Procedure of the estimation of the investment attractiveness of enterprises – the executors of the contracts]. *Modern High Technologies*, 2007, no. 1, pp. 60–67 (in Ukrainian).
5. Lysenko M.D. Kompleksna otsinka investytsiinoi pryvablyvosti pidpryiemstv yak subiektiv rehionalnykh ta haluzevykh ekonomichnykh vidnosyn [Integrated assessment of investment attractiveness of enterprises as subjects of regional and of branch economic relations]: thesis PhD. Kharkiv, Kharkiv State University of Economics, 2003. 20 p. (in Ukrainian).
6. Mamonov K., Velychko V., Abolhacanzad Alireza. Rozroblennia intehralnoho pidkhodu do otsinky investytsiinoi pryvablyvosti palyvno-enerhetychnykh pidpryiemstv [Development of the integrated approach to estimation of the investment attractiveness of fuel and energy companies]. *Intellekt XXI*, 2018, no. 5, pp. 104–108. Available at: http://nbuv.gov.ua/UJRN/int_XXI_2018_5_23
7. Meshkov A.V. Otsinka i pidvyshchennia investytsiinoi pryvablyvosti pidpryiemstv [Assessment and increase of investment attraction of enterprises]: thesis PhD. Donetsk, 2004 (in Ukrainian).
8. Pankov S.A. Analiticheskie podhody k ocenke investicionnoj privlekatelnosti predpriyatiya [Analytical approaches to assessing the investment attractiveness of enterprises]. *Bulletin of the Khmelnytsky National University*, 2010, no. 2, pp. 65–68 (in Russian).
9. Stirsky M.V. Metodychni aspekty otsinky investytsiinoi pryvablyvosti rynku aktsii [Methodical aspects of estimation of investment attractiveness of the stock market]. *Finance of Ukraine*, 2002, no. 2, pp. 131–137 (in Ukrainian).
10. Trydid O.M., Oryekhova K.V. Metodychnyi pidkhid do otsinky investytsiinoi pryvablyvosti pidpryiemstva [Methodical approach to assessing the investment attractiveness of the enterprise]. *Nauka i Ekonomika*, 2009, vol. 3(15), pp. 79–87 (in Ukrainian).
11. Yukhymchuk S.V., Suprun S.D. Matrychna model otsinky investytsiinoi pryvablyvosti promyslovykh pidpryiemstv [Matrix model of estimation of investment attractiveness of industrial enterprises]. *Finance of Ukraine*, 2003, no. 1, pp. 3–12 (in Ukrainian).