UDC 338.1

Zghurska O.
Doctor of Economics, Associate Professor,
Educational and Scientific Institute of Management and Entrepreneurship,
the Department of Entrepreneurship, Trade and Stock Exchange,
State University of Telecommunications, Kyiv, Ukraine;
e-mail: oksana.zgurska@ukr.net; ORCID ID: 0000-0003-3878-3007
Dymenko R.
Doctor of Economics, Associate Professor,
Associate Professor of the Department of Management and Public Welfare,
Banking University, Lviv, Ukraine;
e-mail: drainc@ukr.net; ORCID ID: 0000-0002-6980-8038
Larina Y.
Doctor of Economics, Professor,
Professor of the Department of Marketing,
Kyiv National Economic University named after Vadym Hetman, Ukraine;
e-mail: larin.sla@gmail.com; ORCID ID: 0000-0002-2712-7824
Fedorchenko A.
Doctor of Economics, Professor,
Head of Marketing Department,
Kyiv National Economic University named after Vadim Hetman, Ukraine;
e-mail: a_fedorchenko@hotmail.com; ORCID ID: 0000-0001-5133-1908
Zalizko V.
Doctor of Economics, Professor,
Taras Shevchenko National University of Kyiv,Ukraine;
e-mail: zwd@ukr.net; ORCID ID: 0000-0001-5362-8270
Kubiv S.
Ph. D. in Economics, Associated Professor,
Military Diplomatic Academy named after Yevheniy Bereznyak, Kyiv, Ukraine;
ORCID ID: 0000-0002-1110-2024

STRATEGIC FORECAST OF MULTIFACTORIAL IMPACT ON THE EFFICIENCY OF DIVERSIFIED ENTERPRISES

Abstract. The purpose of the present scientific research is to perform a strategic forecast of multifactorial impact on the efficiency of diversified enterprises, construction of a multifactorial linear regression model of strategic forecast of profitability level of the studied enterprises, as well as a multifactorial model of logistic regression of strategic forecast of low profitability risks as a result of implementation of innovative strategies of diversified enterprises' development of in the long run.

To achieve this purpose, the main criteria were ranked (Kruskal — Wallis ranking criteria (KWC) to assess the differences between the medians of different samples ($c > 2$), where KWC is a nonparametric alternative to the *F*-criterion in the one-factor analysis of variance. If the conditions necessary for the application of the *F*-criterion in multivariate variance-regression analysis are met, the KWC has the same influence. To build the models, the method of construction of multifactor models of logistic regression with step-by-step inclusion/exclusion of features was used (Stepwise with the inclusion threshold $p < 0.1$ and the exclusion threshold $p > 0.2$).

The research was conducted on the basis of data from the State Statistics Committee and on the basis of data analysis of the surveyed agro-industrial enterprises.

Strategic forecast of the results of multifactorial impact on the efficiency of diversified enterprises was made, based on the formation of a rational management structure of innovative strategies for the development of diversified agro-industrial enterprises. The obtained results allowed to obtain the median indicators of the general set of research objects and a clear bifurcation picture of the strategic development of enterprises for the future.

ISSN 2306-4994 (print); ISSN 2310-8770 (online)

A methodical approach to the implementation of strategic forecasting of multifactorial impact on the efficiency of diversified enterprises, based on the development of strategic guidelines for diversified enterprises taking into account the system of restraining factors of innovative development. This allowed to establish that selection and development of innovative strategies assessment of compliance of internal capabilities of the enterprise (potential of innovative development) with external (market opportunities and threats), with regard to the pace of scientific and technological progress and the resulting change in the elements of micro- and macrosystems of the infrastructure of the enterprise.

The multifactorial analysis and construction of the multifactor model of linear regression of strategic forecast of agro-industrial enterprises' profitability, as well as the multifactorial model of logistic regression of strategic forecast of low profitability risks probability have proved the usefulness of implementation of innovative strategies of competitiveness on domestic and foreign markets.

Keywords: agro-industrial enterprise, diversified enterprise, innovative development strategy, optimal strategic decision, strategic forecast.

JEL Classification C53, O13, O12

Formulas: 4; fig.: 9; tabl.: 4; bibl.: 33.

Згурська О. М.
доктор економічних наук, доцент,
Навчально-науковий інститут менеджменту та підприємництва,
кафедра підприємництва, торгівлі та біржової діяльності,
Державний університет телекомунікацій, Київ, Україна;
e-mail: oksana.zgurska@ukr.net; ORCID ID: 0000-0003-3878-3007

Дименко Р. А.
доктор економічних наук, доцент,
доцент кафедри менеджменту та соціального забезпечення,
Університет банківської справи, Львів, Україна;
e-mail: drainc@ukr.net; ORCID ID: 0000-0002-6980-8038

Ларіна Я. С.
доктор економічних наук, професор,
професор кафедри маркетингу,
Київський національний економічний університет імені Вадима Гетьмана, Україна;
e-mail: larin.sla@gmail.com; ORCID ID: 0000-0002-2712-7824

Федорченко А. В.
доктор економічних наук, професор,
завідувач кафедри маркетингу,
Київський національний економічний університет імені Вадима Гетьмана, Україна;
e-mail: a_fedorchenko@hotmail.com; ORCID ID: 0000-0001-5133-1908

Залізко В. Д.
доктор економічних наук, професор,
Київський національний університет імені Тараса Шевченка, Україна;
e-mail: zwd@ukr.net; ORCID ID: 0000-0001-5362-8270

Кубів С. І.
кандидат економічних наук, доцент,
Воєнно-дипломатична академія імені Євгенія Березняка, Київ, Україна;
ORCID ID: 0000-0002-1110-2024

СТРАТЕГІЧНИЙ ПРОГНОЗ БАГАТОФАКТОРНОГО ВПЛИВУ НА ЕФЕКТИВНІСТЬ ДИВЕРСИФІКОВАНИХ ПІДПРИЄМСТВ

Анотація. Метою цього наукового дослідження є виконання стратегічного прогнозу багатофакторного впливу на ефективність диверсифікованих підприємств, побудова багатофакторної моделі лінійної регресії стратегічного прогнозу рівня рентабельності

досліджуваних підприємств, а також багатофакторної моделі логістичного регресу стратегічного прогнозу низьких ризиків прибутковості в результаті впровадження інноваційних стратегій розвитку диверсифікованих підприємств у довгостроковій перспективі.

Для досягнення цієї мети було ранжировано основні критерії (критерії ранжирування Крускала — Уолліса (KWC) для оцінки відмінностей між медіанами різних зразків ($c > 2$), де KWC є непараметричною альтернативою F-критерію в однофакторному дисперсійному аналізі. Якщо виконуються умови, необхідні для застосування F-критерію в багатовимірному дисперсійно-регресійному аналізі, такий самий вплив справляє і KWC. Для побудови моделей застосовується метод побудови багатофакторних моделей логістичної регресії з кроком — використовувалось поетапне включення / виключення ознак (поетапно з порогом включення $p < 0,1$ та порогом виключення $p > 0,2$).

Дослідження проводилось на основі даних Держкомстату і на основі аналізу даних обстежуваних агропромислових підприємств.

Складено стратегічний прогноз результатів багатофакторного впливу на ефективність диверсифікованих підприємств, заснований на формуванні раціональної структури управління інноваційними стратегіями розвитку диверсифікованих агропромислових підприємств. Отримані результати дозволили отримати медіанні показники загальної сукупності об'єктів дослідження та чітку роздвоєну картину стратегічного розвитку підприємств на майбутнє.

Методичний підхід до реалізації стратегічного прогнозування багатофакторного впливу на ефективність диверсифікованих підприємств заснований на розробленні стратегічних настанов для диверсифікованих підприємств з урахуванням системи стримувальних факторів інноваційного розвитку. Це дозволило встановити, що при виборі та розробленні інноваційних стратегій проводиться оцінка відповідності внутрішніх можливостей підприємства (потенціалу інноваційного розвитку) зовнішнім (ринкові можливості та загрози) з урахуванням темпів науково-технічного прогресу та наслідків зміни в мікро- та макросистемах інфраструктури підприємства.

Багатофакторний аналіз і побудова багатофакторної моделі лінійної регресії стратегічного прогнозу прибутковості агропромислових підприємств, а також багатофакторна модель логістичної регресії стратегічного прогнозу ймовірності ризиків низької прибутковості засвідчили корисність реалізації інноваційних стратегій на конкурентоспроможність на внутрішньому і зовнішньому ринках.

Ключові слова: агропромислове підприємство, багатопрофільне підприємство, стратегія інноваційного розвитку, оптимальне стратегічне рішення, стратегічний прогноз.

Формул: 4; рис.: 9; табл.: 4; бібл.: 33.

Introduction. With the rapid spread of global economic globalization and intellectualization of all spheres of socio-economic development, the latest technologies become the dominant material and technological component, which determines the high level of modern production and sales, the form and content of effective organizational and management structure, and the dynamics of strengthening the competitive advantages of domestic agro-industrial enterprises in domestic and foreign markets.

Formation and further innovation and information reorientation of diversified enterprises are in accordance with market conditions of the information society, which in turn dictate the need to ensure vital value and quality indicators of products — one of the main criteria for recognition of national agro-industrial producers in world markets. The development of strategies for the successful development ofdiversified agro-industrial enterprises in a Euro-oriented economy requires the implementation of priority areas of development and identification of potentially new opportunities to ensure competitive advantages in both domestic and foreign markets.In this regard, today there is an objective need to implement a strategic forecast of multifactorial impact on the

ISSN 2306-4994 (print); ISSN 2310-8770 (online)

efficiency of diversified enterprises in the direction of intensification of innovative processes to ensure successful development in the long run.

Literature Review. In today's conditions vectors of strategic orientation of enterprises are aimed at finding a compromise between industry directions, which is based on the maximum possible use of the strengths of diversifiedenterprises based on the diagnosis of micro- and macrosystemsof organizational and management infrastructure to expand production of quality competitive products.

The importance of the issue of innovative agro-industrial management as a complex strategic system is significantly increasing: system in which the processes of determining the content, formation of structure, organization, methods and forms of development and implementation of strategies ofdiversified enterprises are provided with strategic information alternatives of a holistic process of functioning and development.

Theoretical and methodological aspects of diversification of enterprises were laid down by the following well-known scientists: Chandler D., Hwang H. (2015), González-Pernía J. L., Peña-Legazkue I., Vendrell-Herrero F. (2012), Hoskisson R. E., Hitt M. A. (1990), Li X. R. and Kami R. (2010), Liebenberg A. P., Sommer D. W. (2008), Lohwasser T. S., Wagner D., Van Essen M., Lander M. W., Marano V. (2019), Montgomery C. A. (1994). The problem of choosing the direction and methods of diversificationenterprises engaged in such foreign scholars as: Sakhartov A. V. (2017), Wan W. P., Hoskisson R. E., Short J.P., Yiu D. W.(2011).

Patterns of innovation, including in the field of domestic agro-industrial production and promising areas of development on the basis of organizational and economic management of innovations studied by such well-known scientists as Anderson N., Potocnik K., Zhou J. (2014), Capaldo A., Lavie D., Petruzzelli A. M. (2014), Foss N. J., Saebi T. (2016), Gaur A. S., Pattnaik C., Singh D., Lee J. Y. (2019), Jha A. K., Bose I. (2016), Kogan L., Papanikolaou D., Seru A., Stoffman N. (2017), Lee J., Kim M. (2014), Liou R.-S., Chao M. C.-H., Yang M. (2016), Terjesen S., Patel P. P. (2015) and other.

Analysis of published works on the topic of the study showed thatwell-known authors consider diversification processes as one of the areas of strategiclong-termdevelopment of enterprises. Most well-known scientists consider the development of innovative strategies by means of financial risks management in the process of formation and development of agro-industrial enterprises. Familiarization with the works of foreign scientists convinces that the process of strategic forecasting of the exogenous and endogenous factors influence on the efficiency of diversified enterprises is provided by innovative approaches to the general management of their economic activity. At the same time, for the modern development of the economy, the implementation of the strategic forecast of multifactorial impact on the diversified enterprises efficiency becomes especially important. This is explained by the fact that the effectively implemented strategic process in the direction of diversified enterprises efficiency provides selection and optimal projects profiling taking into account risk situations and their comprehensive assessment, as well as identifies strategic directions of effective enterprise development in the long run.

Methodology and Data. The strategic forecast of multifactorial impact on the efficiency of diversified enterprises (level of profitability) was made by ranking the main criteria (Kruskal — Wallis ranking criterion (KWC) to assess the differences between the medians of different samples ($c > 2$). KWC is a non-parametric alternative to the *F*-criterion in the one-factor analysis of variance. If the conditions necessary for the application of the *F*-criterion in one-way analysis of variance-regression are met, the KWC has the same power (Sakhartov A. V., 2017).

Ranking KWCs are used to test the hypothesis that ranks from independent samples extracted from general populations have the same medians. In other words, the null and alternative hypotheses are defined as follows:

$$H0: M1 = M2 = ... = Mc. \quad (1)$$

H1: not all Mj (j = 1, 2, ..., c) are the same.

In this regard, it is necessary to know the ranks calculated for all samples, and the general populations from which they are extracted, must have the same behavior and type. In order to apply the KWC, it essential first of all to replace the observations in the samples with their combined ranks. The first rank corresponds to the smallest observation, and the n rank — to the largest one ($n = n_1 + n_2 + ... + n_c$). If some values are repeated, they are assigned the average value of their ranks.

The analytical diagnostics used in the KWC is similar in magnitude to the group variation used to calculate the *F*-factor. Instead of comparing the average values of $\bar{X}j$ of all values of the sample from the groups with the total average value of $\bar{X}j$, in the KWC the average ranks of each of the groups are compared with the total rank calculated on the basis of all n observations. When these differences are squared, the *H*-statistic increases. On the other hand, if the effect of the experiment is not observed, the analytic *H* should theoretically be equal to zero. However, in practice, due to random changes, the *H* statistics will have a non-zero form, but a rather small value. The KWC is the tool used with a small difference between the median samples.

The calculation of the *H* criterion is performed according to the following formula:

$$H = \left[\frac{12}{n(n+1)}\right] \sum_{j=1}^{c} \frac{T_j^2}{n_j} - 3(n+1), \quad (2)$$

where *n* is the total number of observations in the pooled samples; n_j — the number of observations in the *j*-th sample ($j = 1, 2, \ldots, c$), T_j — the sum of the ranks of the *j*-th sample.

In order to identify the degree of relationship between the profitability of diversified enterprises with a set of significant indicators, as well as to determine the degree of influence of each of them, we used the method of building multiple linear regression models. The stepwise on/off feature (Stepwise with an inclusion threshold of $p < 0.1$ and an exclusion threshold of $p > 0.2$) was used to select profitability-related features.

Results and Discussion. Implementation of strategies for the development of diversified agro-industrial enterprises requires special control and evaluation of the effectiveness of strategic cooperation at all stages of its implementation and effective combination of production and customer demand with high quality products, increasing the effectiveness of diversification by establishing close partnerships in national and foreign markets; maximizing the current profit of enterprises (Foss N. J. & Saebi T., 2016).

The dynamics of the main financial and economic indicators of the studied diversified agro-industrial enterprises are shown in *Table 1* (2016—2020).

In order to make a strategic forecast of multifactorial impact on the efficiency of diversified enterprises, the key factors were taken into account, namely: a certain agro-industrial enterprise, innovative development strategies (implementation of information and communication technologies of precision agriculture, implementation of innovative programs with interactive database for efficiency of logistics solutions, introduction of platforms for automatic planning of production processes, implementation of GPS-surveillance and monitoring of fuel use; introduction of computer software; support facilities; database and information base, defined time period of activity and the level of risk of implementation of these strategies (Kogan L., Papanikolaou D., Seru A. & Stoffman N., 2017).

The analysis of the connection between the level of profitability of the enterprise and the factor feature — the implementation of an innovative strategy of strategic development, namely — the introduction of information and communication technologies of precision agriculture. The value of profitability of the surveyed enterprises is reflected for the period from 2016 to 2020. The results of the conducted analysis did not reveal a significant correlation between the level of profitability of the surveyed enterprises and the results of the implementation of strategic development strategies with the level of implementation of information and communication technologies in precision agriculture (the difference is not significant, $p = 0.415$ (according to the specified Kruskal — Wallis criterion).

ISSN 2306-4994 (print); ISSN 2310-8770 (online)

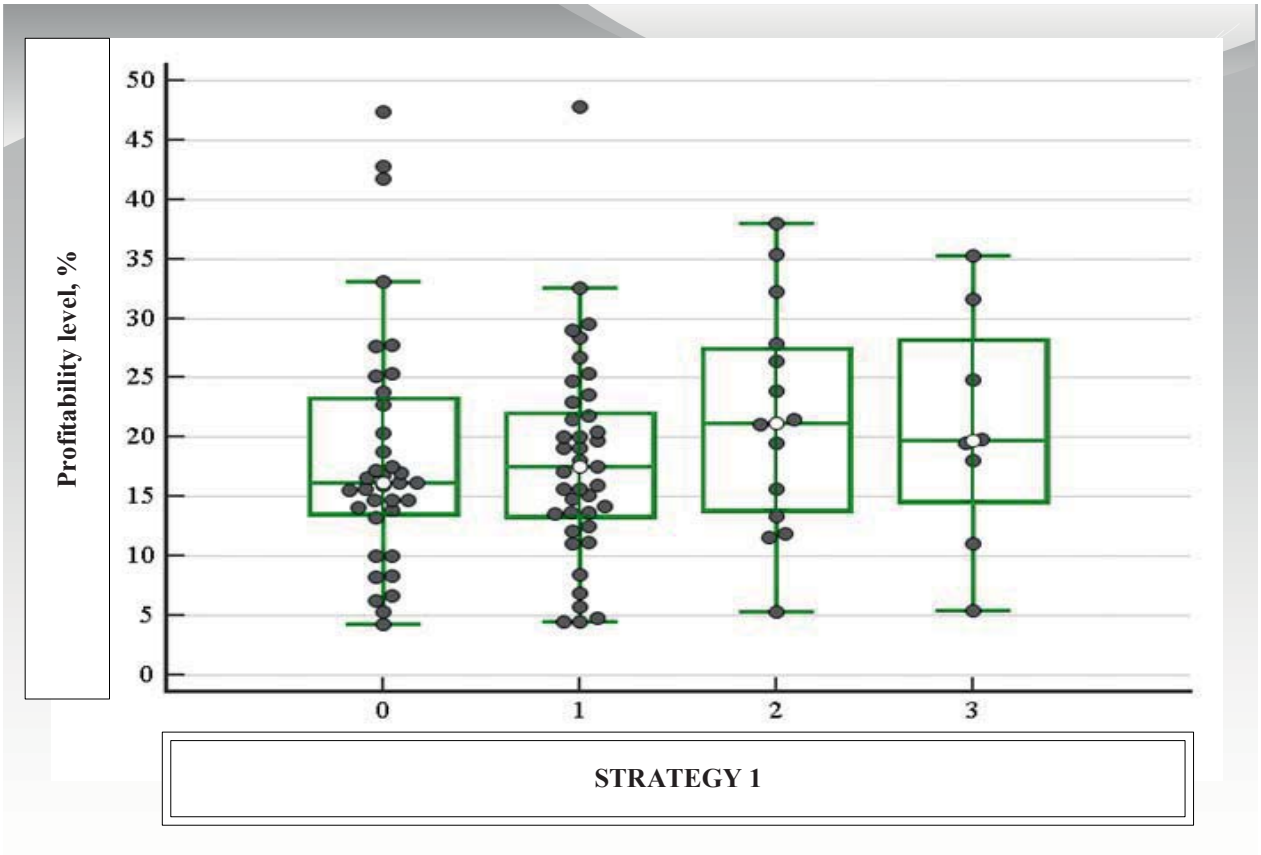
Table 1

The main financial and economic indicators of the studied diversified agro-industrial enterprises (2016—2020)

		«Ukrland farming» Group of companies	«KERNEL» Group of companies	«MHP» Agro-holding	«NIBU-LON» Group of comp anies	«Astarta» Company	«Agropro-Speris» LLC	«Ukr-prominvest-Agro» LLC	«Prometheus» LLC	«UkrAgro Com» and «Hermes-Trading» Group of companies	«Agrotrade»
2016	Revenue, bln USD	2010,6	2168,9	1135,5	1280,5	875,2	242,0	234,2	135,0	124,5	112,3
	Cost, mln USD	1457,0	2052,1	981,5	1068,2	777,5	203,2	187,1	117,2	106,2	104,3
	EBIDTA	7012	215	352	220	118	56	59	25	25	12
	Profitability level, %	37,95	5,69	15,69	19,87	12,57	19,09	25,17	15,19	17,23	8,22
2017	Revenue, bln USD	2200,5	2230,9	1621,3	1573,0	958,9	222,0	236,6	146,0	137,7	125,8
	Cost,bln USD	1663,5	1999,3	1338,8	949,8	826,7	177,1	198,6	126,2	127,0	117,9
	EBIDTA	695	287	315	1387	155	71	59	36	19	11
	Profitability level, %	32,28	11,58	21,10	19,55	15,99	25,35	19,13	15,69	8,43	6,70
2018	Revenue, bln USD	2116,9	2764,0	1352,0	1671,3	689,4	287,0	217,2	187,0	154,7	149,8
	Cost, bln USD	1565,3	2625,3	1069,5	1504,3	606,4	239,0	185,4	151,3	136,1	143,6
	EBIDTA	7795	319	336	271	152	78	54	42	24	13
	Profitability level, %	35,24	5,28	26,41	11,10	13,69	20,08	17,15	23,60	13,67	4,32
2019	Revenue, bln USD	1980,0	2431,0	1421,0	1536,0	958,9	335,0	240,0	185,0	154,9	144,7
	Number of employees at the enterprise	32000	16000	27600	7000	13000	4000	4600	4900	1600	2100
	Cost, bln USD	1504,0	2306,8	1138,5	1301,0	856,7	262,0	198,0	149,3	129,4	138,1
	EBIDTA	642	226	248	282	157	85	64	42	41	16
	Profitability level, %	31,65	5,38	24,81	18,06	11,93	27,86	21,21	23,91	19,71	4,78
2020	Revenue, bln USD	1980,0	2431,0	1421,0	1536,0	958,9	335,0	240,0	185,0	154,9	144,7
	Number of employees at the enterprise	31000	15000	26600	7000	13000	3500	4100	4500	1000	1400
	Cost, bln USD	1244,0	2046,8	878,5			132,0	66,0	45,3	103,4	78,1
	EBIDTA	642	226	248	282	157	85	64	42	41	16
	Profitability level, %	49,50	7,80	32,34	22,60	14,70	55,35	63,12	78,54	24,66	9,20

Source: developed by authors.

The values of the dependence of the level of profitability of diversified enterprises on the level of implementation of information and communication technologies of precision agriculture for the studied diversified enterprises for 10 years, as well as the median value of the indicator and the first and third quartiles (minimum and maximum), are presented in *Fig.1.*



STRATEGY 1: Implementation of information and communication technologies of precision agriculture for the studied diversified enterprises

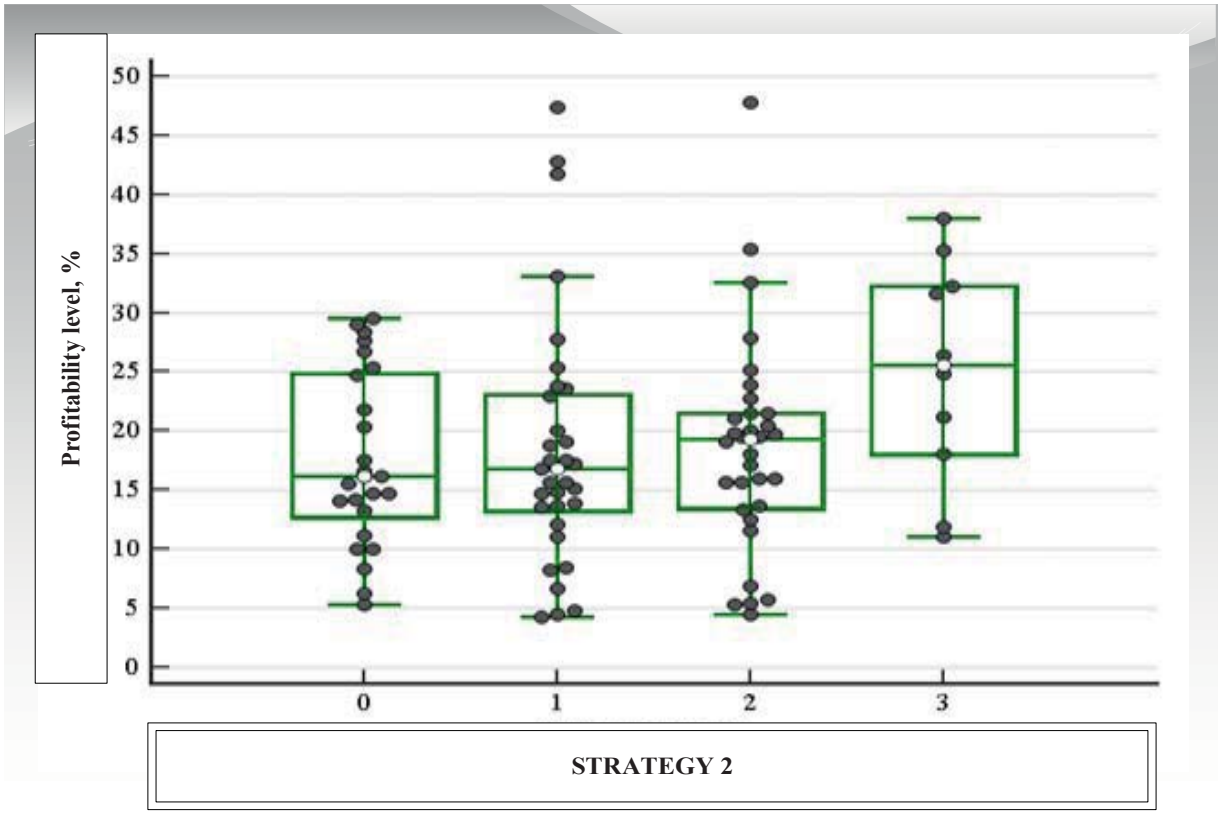
Fig. 1. **Forecasted profitability level of results of introduction of information and communication technologies of the precision agriculture**

Source: developed by authors.

The results of the analysis regarding the determined value of the profitability indicator of diversified enterprises depending on the level of implementation of innovative programs with an interactive database for the efficiency of logistics solutions (*Fig. 2*) did not reveal a significant relationship between the level of profitability of the studied enterprises (the difference is not significant, $p = 0.169$ according to the Kruskal — Wallis test). The median value of the indicator, the value of the first and third quartiles, minimum and maximum are presented.

Fig. 3 shows the value of the profitability of diversified enterprises depending on the level of implementation of the digital platform for automatic planning of production processes. The analysis revealed a significant relationship between the profitability of the strategy of diversification of strategic development with the level of implementation of the digital platform for automatic planning of production processes (the difference is statistically significant, $p = 0.006$ by Kruskal — Wallis criterion). At the same time, an increase in profitability was revealed when assessing the indicator Strategy 3 = 3 points in comparison with cases when the value of the indicator Strategy 3 = 1 point ($p < 0.05$).

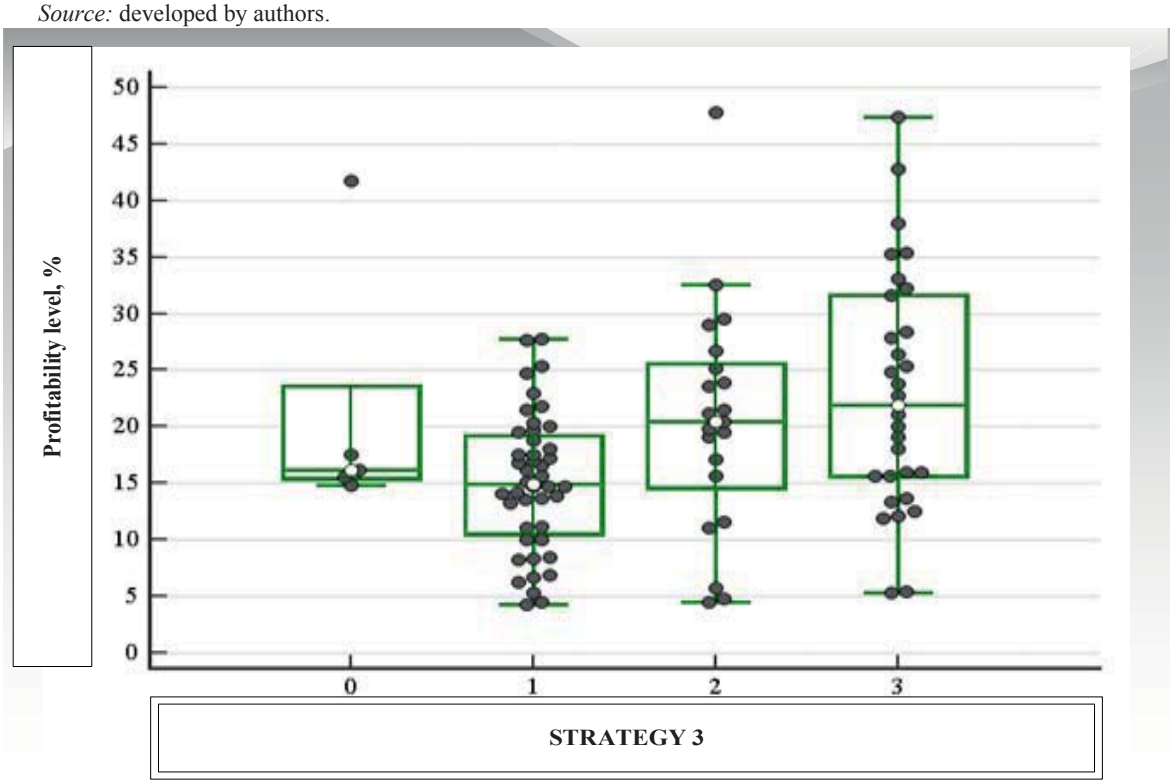
ISSN 2306-4994 (print); ISSN 2310-8770 (online)



STRATEGY 2: Implementation of innovative programs with an interactive database for the efficiency of logistics solutions

Fig. 2. **Forecasted profitability level of results of implementation of innovative programs with an interactive database for the efficiency of logistics solutions**

Source: developed by authors.



STRATEGY 3: The level of profitability of the results of introduction of a digital platform for automatic planning of production processes

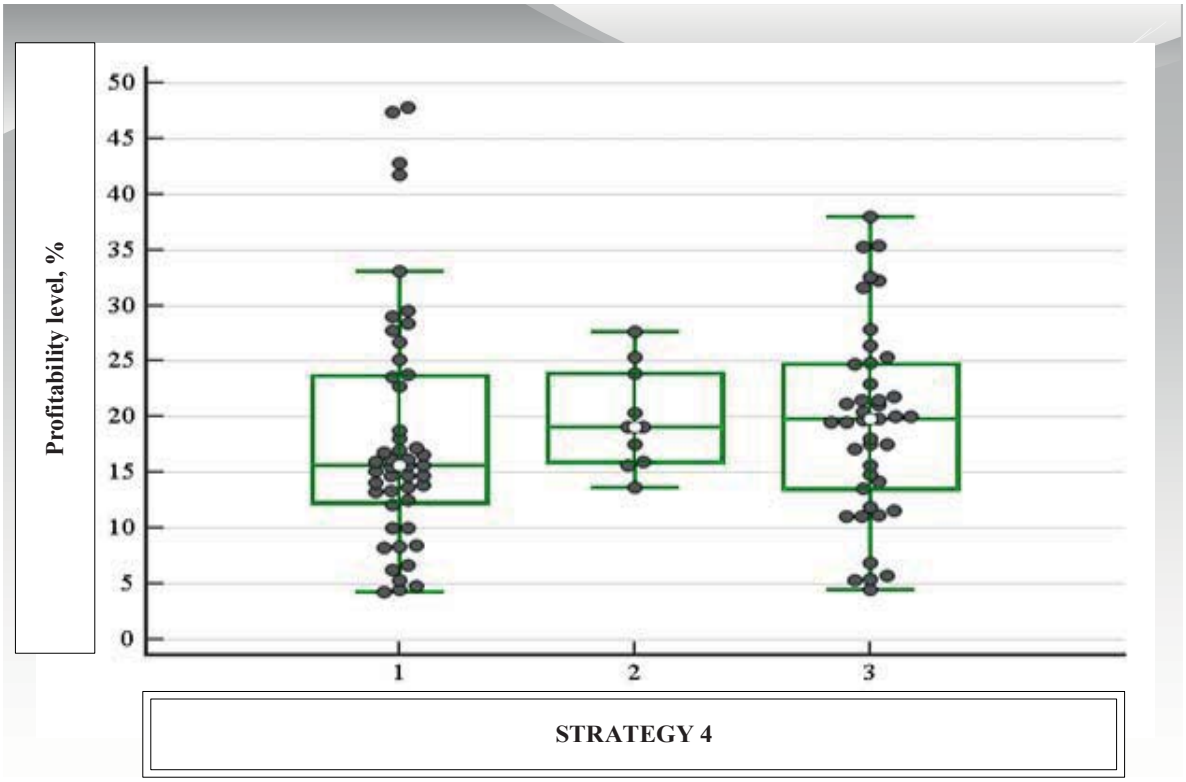
Fig. 3. **Forecast level of profitability of the results of introduction of a digital platform for automatic planning of production processes. The median value of the indicator, the value of the first and thirdquartiles, minimum and maximum are presented**

Source: developed by authors.

Fig. 4 represents the value of profitability of diversified enterprises depending on the level of implementation of the system of GPS-surveillance and monitoring of fuel use.

The analysis did not reveal connection between the profitability of the strategy of diversification of strategic development and the indicator of implementation of the system of GPS surveillance and monitoring of fuel use (the difference is not significant, $p = 0.246$ by Kruskal — Wallis criterion).

The median value of the indicator, the value of the first and third quartiles, minimum and maximum are presented.



STRATEGY 4: Introduction of system of GPS-supervision and monitoring of fuel use

Fig. 4. **Forecast level of profitability of results of introduction of system of GPS-supervision and monitoring of fuel use**

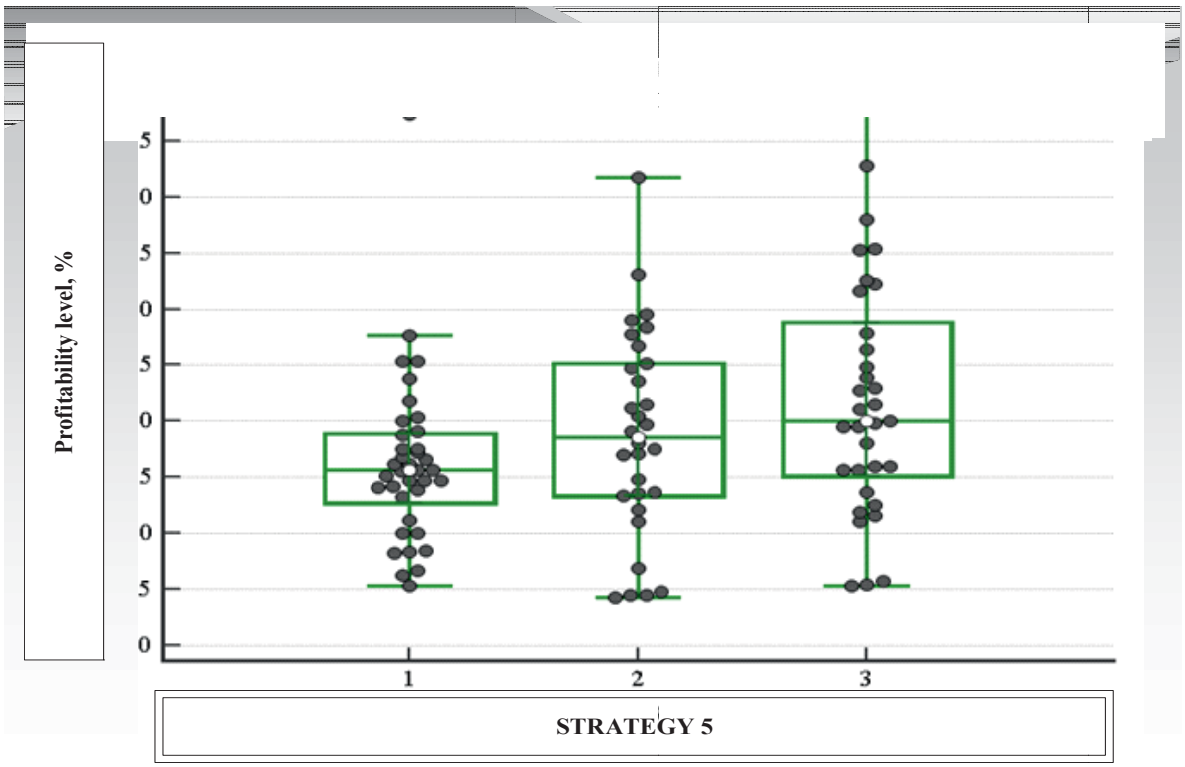
Source: developed by authors.

Fig. 5 shows the value of profitability of diversified enterprises depending on the level of implementation of computer software; facilities; databases and information.

The analysis showed the relationship between the level of profitability of diversified enterprises with the level of implementation of computer software; facilities; databases and information (the difference is statistically significant, $p = 0.042$ by the Kruskal — Wallis criterion). At the same time, an increase in profitability was revealed when estimating the Strategy 5 index = 3 points in comparison with cases when the value of the Strategy 5 index = 1 point ($p < 0.05$).

Fig. 6 shows the value of the profitability index depending on the year of observation.

ISSN 2306-4994 (print); ISSN 2310-8770 (online)



STRATEGY 5: Computer software implementation results; facilities; databases and information

Fig. 5. **Forecast level of profitability of computer software implementation results; facilities; databases and information**

Source: developed by authors.

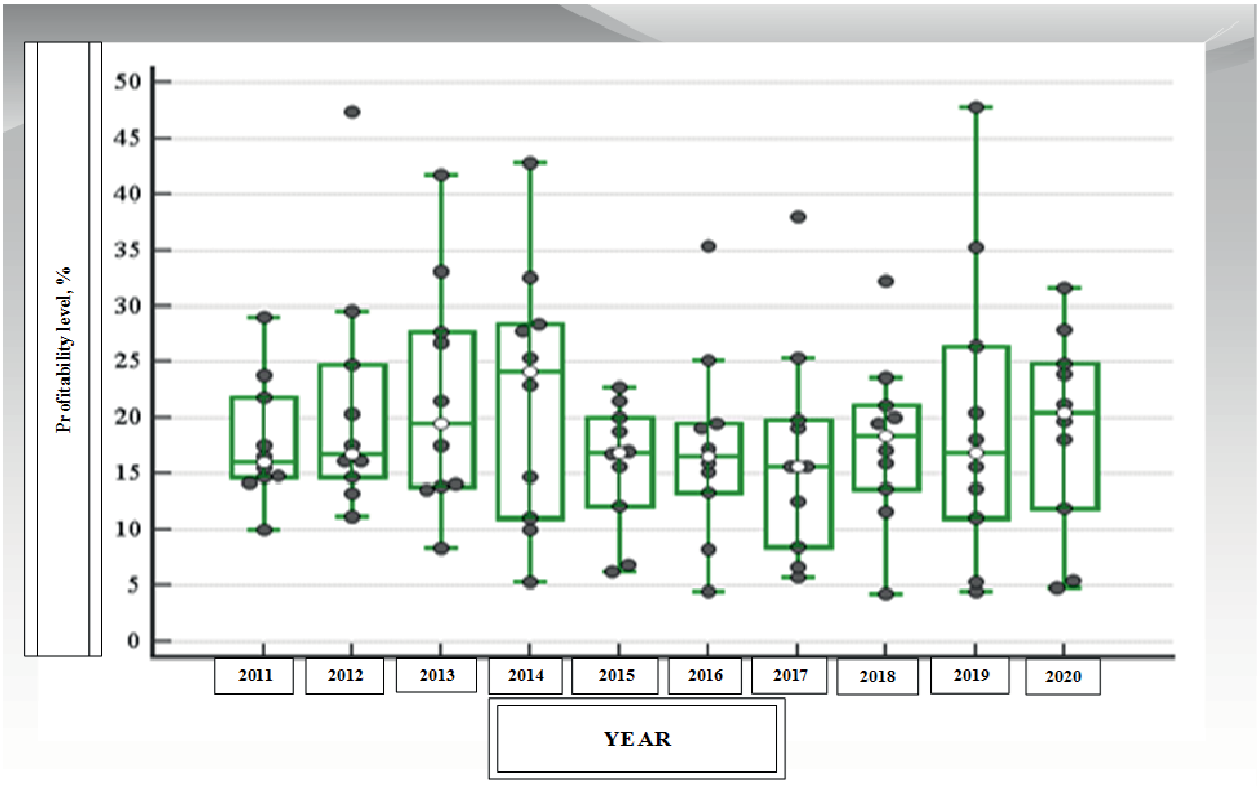


Fig. 6. **Value of profitability level index of diversified enterprises depending on the year of observation. The median value of the indicator, the value of the first and third quartiles, minimum and maximum are presented**

Source: developed by authors.

The analysis did not reveal a link between the profitability of the strategy of strategic development diversification of enterprises with the year of observation (the difference is not statistically significant, $p = 0.951$ according to the Kruskal — Wallis criterion). The results of the multiple regression of the studied diversified enterprises are shown in *Table 2* and *Fig. 7.*

Table 2

Dependence *Y*	**Level of profitability**
Method	Stepwise
Enter a variable if P <	0,1
Delete the variable if P >	0,3
Sample size	50
Coefficient (determining) R^2	0,4258
R^2 — adjusted	0,4014
Multiple correlation coefficient	0,6525
Adjusted standard deviation	5,9597

Regression equation

Independent variables	**Coefficient**	**Std. Error**	**t**	**P**	$r_{partial}$	$r_{semipartial}$	**VIF**
(Constant value)	18,8169						
Cost	–0,02632	0,005745	–4,581	< 0,0001	–0,5556	0,5063	13,049
Financial result	0,12810	0,023570	5,433	< 0,0001	0,6211	0,6005	13,049

Analysis of variation

Source	**Degrees of freedom**	**Sum of squares**	**Standard square deviation**
Regression	2	1237,8943	618,9471
Residual	47	1669,3462	35,5180
F-factor	17,4263		
Level of reliability	P < 0,0001		

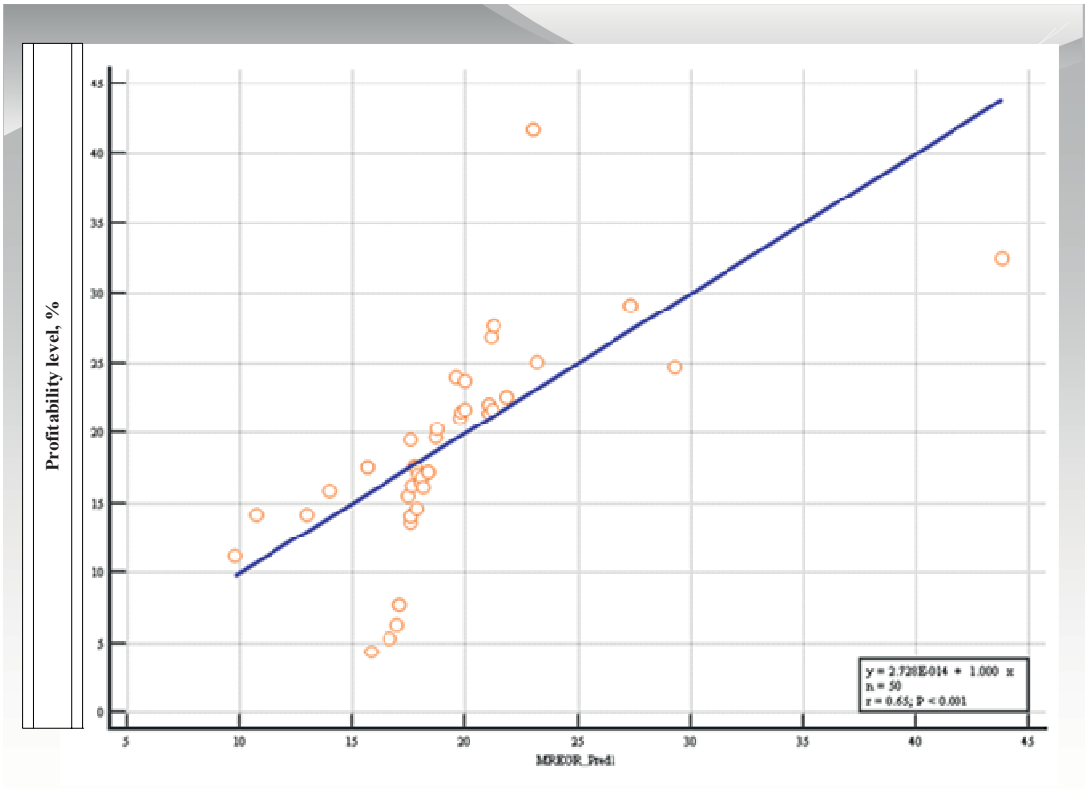


Fig. 7. **Bifurcation picture of strategic innovative development of agro-industrial enterprises as a result of implementation of innovative strategies of diversified enterprises' development**

Source: developed by authors.

ISSN 2306-4994 (print); ISSN 2310-8770 (online)

This method revealed a linear dependence of multiple regression, which is fully consistent with the concept of formation and innovative development strategies of the studied diversified enterprises (see *Fig. 7*).

In order to identify the relationship between the profitability of diversified enterprises and the set of significant indicators, the method of constructing multiple linear regression models was used, taking into account the degree of influence of each of the features. As factor features, the analysis was conducted for 6 indicators: Strategy 1 — Strategy 5 and the year of determination. The stepwise method (Stepwise with inclusion threshold $p < 0.1$ and exclusion threshold $p > 0.2$) was used to select profitability-related features. 3 significant features were identified: Innovative Strategy 2, Innovative Strategy 3 and Year. A three-factor model of linear regression is built on the selected set of features, the model is adequate (the value of $F = 8.9$ at $p < 0.001$).

Table 3 shows the coefficients of the three-factor model of multiple linear regression.

Table 3

Coefficients of the 3-factor model of linear regression of forecasting the level of profitability of the studied enterprises

Factor feature	Model coefficient, $b \pm m$	The level of significance of the coefficient's difference from 0, p	Partial correlation index, $r_{partial}$
Strategy 2	3,86 ± 1,51	0,012	0,252
Strategy 3	3,77 ± 1,12	0,001	0,325
Year	–1,86 ± 0,48	< 0,001	–0,369

Source: quality developed by authors.

Thus, it was found (see *Table 3*) that when standardized by other factors, an increase in the score of Strategy 2 by 1-point leads to an increase ($p = 0.012$) of the profitability level of diversified enterprises, in average by 3.86 ± 1.51%. When standardized by other factors, an increase in the score of Strategy 3 by 1-point leads to an increase ($p < 0.001$) in the level of profitability in average by 3.77 ± 1.12%.

In turn, the model of construction of linear regression can be expressed by formula 1:

$$\text{Rent} = 3742{,}6 + 3{,}86 \cdot X1 + 3{,}77 \cdot X2 - 1{,}86 \cdot X3, \quad (3)$$

where Rent is he level of profitability of diversified enterprises (%);

$X1$ — the value of the level of implementation of innovative programs with an interactive database for the efficiency of the company's logistics solutions (in points);

$X2$ — the value of the level of implementation of the digital platform for automatic planning of production processes (in points);

$X3$ — the year of forecasting.

Fig. 8 graphically shows the correlation field for the three-factor model for forecasting the level of profitability of the studied agro-industrial enterprises as a result of the introduction of innovative development strategies for the long term.

The value of the determination indicator of the model $R^2_{adj} = 0.19$, which indicates the relationship between the indicators of innovative strategy 2, innovative strategy 3 and the year of the study.

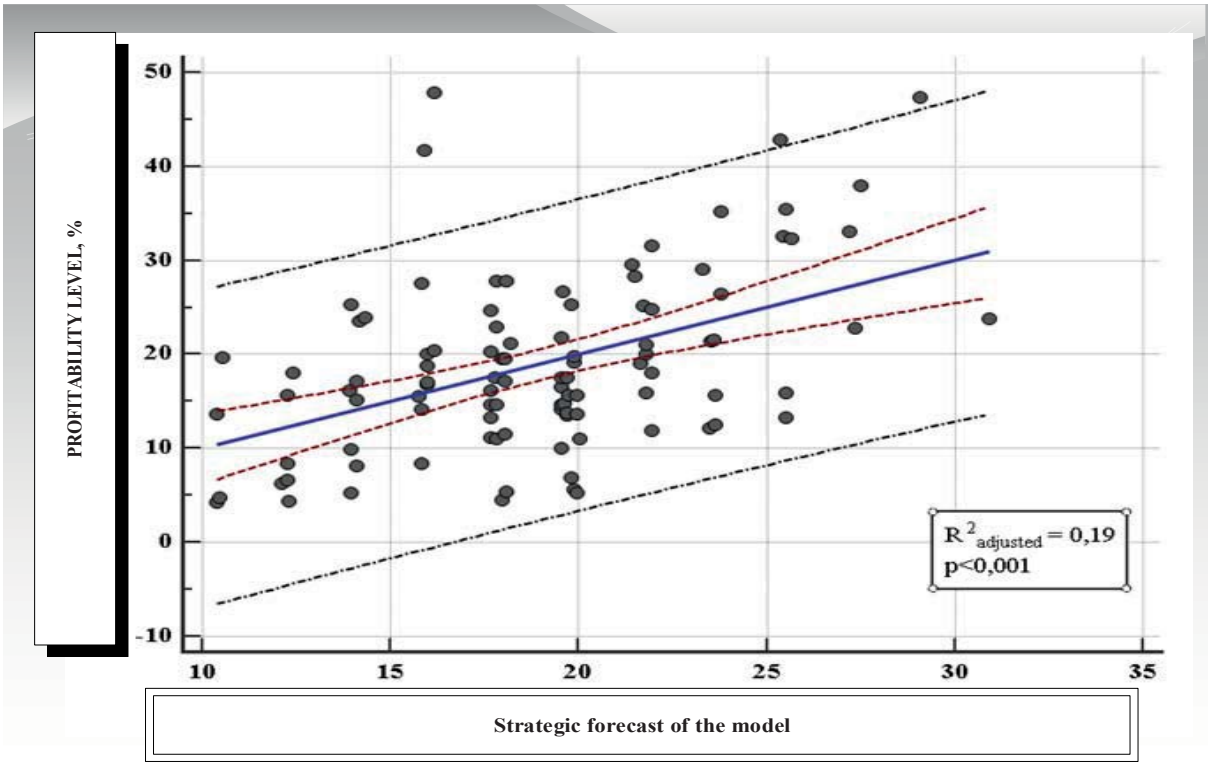


Fig. 8. **Correlation field for a three-factor model for forecasting the level of profitability of the studied agro-industrial enterprises as a result of the implementation of innovative development strategies for the long term (Dotted line indicates 95% CI of the regression line, dashed line — 95% CI of the strategic forecast of the model)**

Source: developed by authors.

The multifactorial model of linear regression revealed a relationship between the level of profitability and the results of such strategies for the development of diversified enterprises as: innovative strategy 2, innovative strategy 3, and the year of the study. However, the linear model can't take into account the specifics of each of the analyzed enterprises, which may be related to the level of its profitability. To take this impact into account, the method of constructing multifactor models of logistic regression was used to analyze the relationship between the level of profitability of diversified enterprises and factorial features.

To compare the reliability of the study results to identify the relationship between the level of profitability of the studied enterprises with a set of key factors and the degree of influence of each of them, the method of constructing models of multiple linear regression was used. For the selection of profitability-related features the stepwise method (Stepwise with inclusion threshold $p < 0.1$ and exclusion threshold $p > 0.2$) was used. 4 key features were identified: the studied enterprise, innovative development strategies and the year of the research. The effective feature was the following: probability of low profitability of the development strategy implementation in a diversified enterprise in the relevant study period (year of observation — variable *Y*). The level of profitability was considered low (variable $Y = 1$) in the case when its value was below 17.5% (median value of the profitability level for the studied enterprises for 10 years of observation); profitability was not considered low (variable $Y = 0$) in the case when its value was higher than 17.5%.

Based on the key factorial indicators, namely: a certain agro-industrial enterprise, innovative development strategies, defined time period of activity and the level of risk of implementation of these strategies, the method of stepwise inclusion/exclusion of features was used (Stepwise with inclusion threshold $p < 0.1$ and exclusion threshold $p > 0.2$) (*Table 4*). Taking into account the selected set of features, a four-factor model of logistic regression was constructed, which is adequate (the value of the indicator $\chi^2 = 39.4$ at $p < 0.001$).

ISSN 2306-4994 (print); ISSN 2310-8770 (online)

Table 4

Coefficients of the 4-factor model of logistic regression model for forecasting the risk of low profitability level of the studied agro-industrial enterprises

Factorial feature		Model coefficient value, *b±m*	The level of significance of the difference from 0, *p*	HS Indicator (95% CI)
Company	Astarta	Reference		
	KERNEL	5,20±1,34	0,001	181 (13 – 2500)
	NIBULON	1,95±1,02	0,055	7,1 (0,96 – 52)
Strategy 4		–1,51±0,42	< 0,001	0,22 (0,10 – 0,50)
Strategy 5		–1,16±0,41	0,005	0,31 (0,14 – 0,71)
Year		0,32±0,13	0,010	1,38 (1,08 – 1,77)

Source: calculated by authors.

It should be noted that the developed model of logistic regression is expressed by the following formula:

$$In\left(\frac{Y}{1-Y}\right) = -407.8 + X1 - 1.51 \cdot X2 - 1.16 \cdot X3 + 0.32 \cdot X4 \quad (4)$$

$$\text{Rent} = 3742{,}6 + 3{,}86 \cdot X1,$$

where Y is the risk oflow profitability level of the development strategy of a diversified enterprise,

$X1$ = 5,2 for the «KERNEL» Group of Companies,

$X1$ = 1,95 for the «NIBULON» Group of Companies, $X1$ = 0 for other companies;

$X2$ — value of the indicator of implementation level of the system of GPS-surveillance and monitoring of fuel use (in points);

$X3$ — value of the indicator of implementation level of software and facilities;

$X4$ — year of forecasting.

The model of the operational characteristics curve of the four-factor model of logistic regression for forecasting the probable level of risk of low profitability of the studied diversified enterprises is shown in *Fig. 9.*

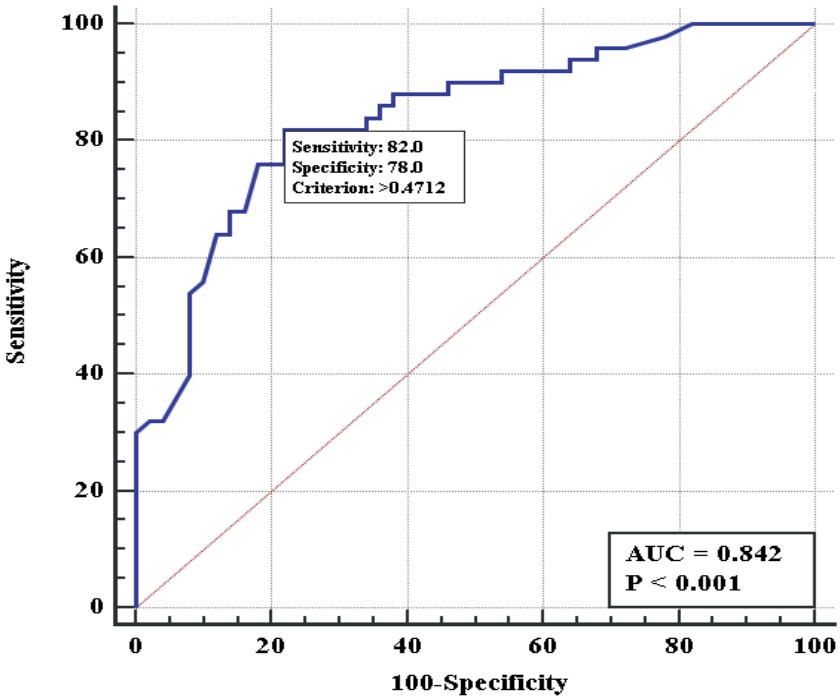


Fig. 9. **The ROC-curve of the four-factor model of logistic regression for forecasting the probability of low profitability risk of diversified agro-industrial enterprises (The values of sensitivity and specificity of the model when choosing the optimal critical threshold are indicated)**

Source: developed by authors.

According to the results of the study, it was determined that with effective implementation of innovative diversification strategies the probability of low profitability risk decreases ($p < 0.001$), CC = 0.22 (95% CI 0.10 – 0.50) for each point (with standardization by others risk factors). Area under the curve of operational characteristics of the model AUC = 0.84 (95% CI 0.76 – 0.91), which indicates a strong relationship between the indicators of the studied diversified enterprises with innovative strategies for strategic development of diversified enterprises, a certain period of time and level of risk implementation of innovative strategies for the development of agro-industrial enterprises.

Conclusion. Thus, the results of constructing a linear regression multifactor model of strategic the level of profitability forecast of the studied diversified enterprises, as well as a multifactor model of logistic regression of strategic forecast of the low profitability risks probability, allowed to formulate the following conclusions:

1. When conducting a one-factor analysis, an increase ($p = 0.006$) in the level of the development strategy profitability of diversified agro-industrial enterprises with an increase in the level of implementation of a digital platform for automatic planning of production processes; an increase ($p = 0.042$) in the level of profitability of the defined development strategy with an increase in the assessment of the computer software implementation level has been established; facilities, databases and information.

2. Within the multifactor analysis of the logistic regression model, the following factors are identified: the specifics of the company, year of evaluation, the level of implementation of GPS-monitoring and monitoring of fuel use and the level of implementation of computer software, facilities, databases and information, — which are strongly (AUC = 0.84 (95% CI 0.76 – 0.91)) associated with the risk of low profitability of the diversified agro-industrial enterprises development strategy.

3. When standardizing by other factors, the increase in the assessment of the implementation level of the GPS-surveillance system and monitoring of fuel use of the company is associated with a decrease ($p < 0{,}001$) in the risk of low profitability, CC = 0,22 (95% CI 0,10 – 0,50) on each mark; the increase in the assessment of the level of implementation of computer software, support facilities (Facilities), databases and information is associated with a decrease ($p = 0.005$) in the risk of low profitability, HS = 0.31 (95% CI 0.14 – 0, 71) on each mark.

Thus, analyzing the effectiveness of innovative strategies for the development of diversified agro-industrial enterprises, we can draw a general conclusion about the need to develop a system of strategic innovative solutions in terms of improving the efficiency of management in today's information society. At the same time, we should not ignore the results of diagnostics of all elements of micro- and macrosystem of innovation infrastructure of the enterprise, which directly or indirectly affects the effectiveness of optimal decisions on choosing the best options for innovative development of diversified agro-industrial enterprises in the long run.

Література

1. Агрохолдинги України. *zerno.org.ua*. 2018. URL : http://www.zerno.org.ua/links/20-агрохолдинги-україни?start=20.
2. Anderson N., Potocnik K., Zhou J. Innovation and Creativity in Organizations. A State-of-the-Science Review, Prospective Commentary, and Guiding Framework. *Journal of Management.* 2014. Vol. 40 (5). P. 1297—1333.
3. Capaldo A., Lavie D., Petruzzelli A. M. Knowledge Maturity and Scientific Value of Innovations. The Roles of Knowledge Distance and Adoption. *Journal of Management.* 2014. Vol. 43 (2). P. 503—533.
4. Chandler D., Hwang H. Learning From Learning Theory. A Model of Organizational Adoption Strategies at the Micro foundations of Institutional Theory. *Journal of Management.* 2015. Vol. 41 (5). P. 1446—1476.
5. Foss N. J., Saebi T. Fifteen Years of Research on Business Model Innovation. How Far Have We Come, and Where Should We Go? *Journal of Management.* 2016. Vol. 43 (1). P. 200—227.
6. Gaur A. S., Pattnaik C., Singh D., Lee J. Y. Internalization advantage and subsidiary performance: The role of business group affiliation and host country characteristics. *Journal of International Business Studies.* 2019. Vol. 50 (8). P. 1253—1282.
7. González-Pernía J. L., Peña-Legazkue I., Vendrell-Herrero F. Innovation, entrepreneurial activity and competitiveness at a sub-national level. *Small Business Economics.* 2012. Vol. 39 (3). P. 561—574.
8. Hoskisson R. E., Hitt M. A. Antecedents and Performance Outcomes of Diversification: a Review and Critique of Theoretical Perspectives. *Journal of Management.*1990. Vol. 16 (2). P. 461—509.
9. Jha A. K., Bose I. Innovation in IT firms: An investigation of intramural and extramural R&D activities and their impact. *Information & Management.* 2016. Vol. 53 (4). P. 409—421.

ISSN 2306-4994 (print); ISSN 2310-8770 (online)

10. Kogan L., Papanikolaou D., Seru A., Stoffman N. Technological Innovation, Resource Allocation, and Growth. *The Quarterly Journal of Economics*. 2017. Vol. 132 (2). P. 665—712.
11. Lee J., Kim M. Market Driven Technological Innovation Through Acquisitions. The Moderating Effect of Firm Size. *Journal of Management.* 2014. Vol. 42 (7). P. 1934—1963.
12. Li X. R., Kami R. Diversification and the Internal Capital Market Building Motive in China. *Journal of Transnational Management*. 2010. Vol. 15. P. 103—116.
13. Liebenberg A. P., Sommer D. W. Effects of Corporate Diversification: Evidence from the Property-Liability Insurance Industry. *Journal of Risk & Insurance*. 2008. Vol. 75 (4). P. 893—919.
14. Liou R.-S., Chao M. C.-H., Yang M. Emerging economies and institutional quality: Assessing the differential effects of institutional distances on ownership strategy. *Journal of World Business.* 2016. Vol. 51 (4). P. 600—611.
15. Lohwasser T. S., Wagner D., Van Essen M., Lander M. W., Marano V. Do Institutions Matter for the Relationship between Diversification and Performance? A Meta-Analysis. *Academy of Management Proceedings.* 2019. August 1.
16. Montgomery C. A. Corporate Diversification. *Journal of Economic Perspectives.* 1994. Vol. 8. P. 163—178.
17. Компанія «Агропросперіс» : офіційний сайт. URL : https://www.agroprosperis.com/about-us.html (дата звернення: 22.02.2020).
18. Компанія «Нібулон» : офіційний сайт. URL : https://www.nibulon.com (дата звернення: 15.02.2020).
19. Компанія «Укрлендфармінг» : офіційний сайт. URL : https://www.agroprosperis.com/about-us.html (дата звернення: 12.03.2020).
20. Компанія «Астарта» : офіційний сайт. URL : https://tripoli.land/companies/astarta-kiev (дата звернення: 13.02.2020).
21. Компанія «Кернел» : офіційний сайт. URL : https://www.kernel.ua/ua/ (дата звернення: 03.03.2020).
22. Агроіндустріальний холдінг «МНР» : офіційний сайт. URL : https://www.mhp.com.ua/ru/home (дата звернення: 15.02.2020).
23. Компанія «Прометей» : офіційний сайт. URL : https://prometey.org.ua (дата звернення: 02.03.2020).
24. Компанія «Тріполі» : офіційний сайт. URL : https://tripoli.land/ukragrocom (дата звернення: 10.03.2020).
25. Компанія «Укрпроминвест-Агро» : офіційний сайт. URL : http://www.upi-agro.com.ua/ru (дата звернення: 11.03.2020).
26. Parola F., Satta G., Panayides P. M. Corporate strategies and profitability of maritime logistics firms. *Maritime Economics and Logistics.* 2015. Vol. 17 (1). P. 52—78.
27. Sakhartov A. V. Economies of Scope, Resource Relatedness, and the Dynamics of Corporate Diversification. *Strategic Management Journal*. 2017. Vol. 38 (11). P. 2168—2188.
28. Державна служба статистики України. Наукові кадри та кількість організацій. URL : http://ukrstat.org/uk/operativ/operativ2005/ni/ind_rik/ind_u/2002.html.
29. Terjesen S., Patel P. P. In Search of Process Innovations: The Role of Search Depth, Search Breadth, and the Industry Environment. *Journal of Management*. 2015. Vol. 43 (5). P. 1421—1446.
30. The Global Innovation Index. Explore the interactive database of the GII 2017 indicators. *Analysis.* 2016. URL : https://www.globalinnovationindex.org/analysis-indicator.
31. Аграрний сектор України. Статистична інформація. 2018. URL : http://agroua.net/statistics.
32. Wan W. P., Hoskisson R. E. Home Country Environments, Corporate Diversification Strategies, and Firm Performance. *Academy of Management Journal.* 2003. Vol. 46 (1). P. 27—45.
33. Wan W. P., Hoskisson R. E., Short J. P., Yiu D. W. Resource-based Theory and Corporate Diversification: Accomplishments and Opportunities. *Journal of Management*. 2011. Vol. 37 (5). P. 1335—1368.

Статтю рекомендовано до друку 07.07.2021

References

1. Agroholdings of Ukraine [Ahrokholdynhy Ukrainy]. (2018). *zerno.org.ua*. Retrieved from http://www.zerno.org.ua/links/20-агрохолдинги-україни?start=20 [in Ukrainian].
2. Anderson, N., Potocnik, K., & Zhou, J. (2014). Innovation and Creativity in Organizations. A State-of-the-Science Review, Prospective Commentary, and Guiding Framework. *Journal of Management, 40* (5), 1297—1333. https://doi.org/10.1177/0149206314527128.
3. Capaldo, A., Lavie, D., & Petruzzelli, A. M. (2014). Knowledge Maturity and Scientific Value of Innovations. The Roles of Knowledge Distance and Adoption. *Journal of Management, 43* (2), 503—533. https://doi.org/10.1177/0149206314535442.
4. Chandler, D., & Hwang, H. (2015). Learning From Learning Theory. A Model of Organizational Adoption Strategies at the Microfoundations of Institutional Theory. *Journal of Management, 41* (5), 1446—1476. https://doi.org/10.1177/0149206315572698.
5. Foss, N. J., & Saebi, T. (2016). Fifteen Years of Research on Business Model Innovation. How Far Have We Come, and Where Should We Go? *Journal of Management, 43* (1), 200—227. https://doi.org/10.1177/0149206316675927.
6. Gaur, A. S., Pattnaik, C., Singh, D., & Lee, J. Y. (2019). Internalization advantage and subsidiary performance: The role of business group affiliation and host country characteristics. *Journal of International Business Studies, 50*(8), 1253—1282. https://doi.org/10.1057/s41267-019-00236-6.
7. González-Pernía, J. L., Peña-Legazkue, I., & Vendrell-Herrero, F. (2012). Innovation, entrepreneurial activity and competitiveness at a sub-national level. *Small Business Economics, 39* (3), 561—574. https://doi.org/10.1007/s11187-011-9330-y.
8. Hoskisson, R. E., & Hitt, M. A. (1990). Antecedents and Performance Outcomes of Diversification: a Review and Critique of Theoretical Perspectives. *Journal of Management, 16* (2), 461—509. https://doi.org/10.1177/014920639001600210.
9. Jha, A. K., & Bose, I. (2016). Innovation in IT firms: An investigation of intramural and extramural R&D activities and their impact. *Information & Management, 53* (4), 409—421. https://doi.org/10.1016/j.im.2015.09.002.
10. Kogan, L., Papanikolaou, D., Seru, A., & Stoffman, N. (2017). Technological Innovation, Resource Allocation, and Growth. *The Quarterly Journal of Economics, 132* (2), 665—712. https://doi.org/10.1093/qje/qjw040.

11. Lee, J., & Kim, M. (2014). Market Driven Technological Innovation through Acquisitions. The Moderating Effect of Firm Size. *Journal of Management, 42* (7), 1934—1963. https://doi.org/10.1177/0149206314535439.
12. Li, X. R., & Kami, R. (2010). Diversification and the Internal Capital Market Building Motive in China. *Journal of Transnational Management, 15,* 103—116. https://doi.org/10.1080/15475778.2010.481245.
13. Liebenberg, A. P., & Sommer, D. W. (2008). Effects of Corporate Diversification: Evidence from the Property-Liability Insurance Industry. *Journal of Risk & Insurance, 75* (4), 893—919. https://doi.org/10.1111/j.1539-6975.2008.00290.x.
14. Liou, R.-S., Chao, M. C.-H., & Yang, M. (2016). Emerging economies and institutional quality: Assessing the differential effects of institutional distances on ownership strategy. *Journal of World Business, 51* (4), 600—611. https://doi.org/10.1016/J.JWB.2016.03.001.
15. Lohwasser, T. S., Wagner, D., Van Essen, M., Lander, M. W., & Marano, V. (2019). Do Institutions Matter for the Relationship between Diversification and Performance? A Meta-Analysis. *Academy of Management Proceedings.* https://doi.org/10.5465/ambpp.2019.82.
16. Montgomery, C. A. (1994). Corporate Diversification. *Journal of Economic Perspectives, 8,* 163—178. https://doi.org/10.1257/jep.8.3.163.
17. Kompaniia «Ahroprosperis». (2020). *Ofitsiinyi sait [Official site]*. Retrieved February 22, 2020, from https://www.agroprosperis.com/about-us.htm [in Ukrainian].
18. Kompaniia «Nibulon». (2020). *Ofitsiinyi sait [Official site]*. Retrieved February 15, 2020, from https://www.nibulon.com/ [in Ukrainian].
19. Kompaniia «Ukrlendfarminh». (2020). *Ofitsiinyi sait [Official site]*. Retrieved February 17, 2020, from https://www.ulf.com.ua/ua/ [in Ukrainian].
20. Kompaniia «Astarta». (2020). *Ofitsiinyi sait [Official site]*. Retrieved February 13, 2020, from https://tripoli.land/companies/astarta-kiev [in Ukrainian].
21. Kompaniia «Kernel». (2020). *Ofitsiinyi sait [Official site]*. Retrieved March 03, 2020, from https://www.kernel.ua/ua/ [in Ukrainian].
22. Ahroindustrialnyi kholdinh «MHP». (2020). *Ofitsiinyi sait [Official site]*. Retrieved February 15, 2020, from https://www.mhp.com.ua/ru/home [in Ukrainian].
23. Kompaniia «Prometei». (2020). *Ofitsiinyi sait [Official site]*. Retrieved March 02, 2020, from https://prometey.org.ua/ [in Ukrainian].
24. Kompaniia «Tripoli». (2020). *Ofitsiinyi sait [Official site]*. Retrieved March 10, 2020, from https://tripoli.land/ukragrocom [in Ukrainian].
25. Kompaniia «Ukrpromynvest-Ahro». (2020). *Ofitsiinyi sait [Official site]*. Retrieved March 11, 2020, from http://www.upi-agro.com.ua/ru [in Ukrainian].
26. Parola, F., Satta, G., & Panayides, P. M. (2015). Corporate strategies and profitability of maritime logistics firms. *Maritime Economics and Logistics, 17* (1), 52—78. https://doi.org/10.1057/mel.2014.18.
27. Sakhartov, A. V. (2017). Economies of Scope, Resource Relatedness, and the Dynamics of Corporate Diversification. *Strategic Management Journal, 38* (11), 2168—2188. https://doi.org/10.1002/smj.2654.
28. Derzhavna sluzhba statystyky Ukrainy. (2021). *Naukovi kadry ta kilkist orhanizatsii — Scientific staff and number of organizations*. Retrieved from http://ukrstat.org/uk/operativ/operativ2005/ni/ind_rik/ind_u/2002.html [in Ukrainian].
29. Terjesen, S., & Patel, P. P. (2015). In Search of Process Innovations: The Role of Search Depth, Search Breadth, and the Industry Environment. *Journal of Management, 43* (5), 1421—1446. https://doi.org/10.1177/0149206315575710.
30. The Global Innovation Index. (2016). Explore the interactive database of the GII 2017 indicators. *Analysis.* Retrieved from https://www.globalinnovationindex.org/analysis-indicator.
31. Ahrarnyisektor Ukrainy. (2021). *Statystychna informatsiia [Statistical information]*. Retrieved from http://agroua.net/statistics [in Ukrainian].
32. Wan, W. P., & Hoskisson, R. E. (2003). Home Country Environments, Corporate Diversification Strategies, and Firm Performance. *Academy of Management Journal, 46* (1), 27—45. https://doi.org/10.5465/30040674.
33. Wan, W. P., Hoskisson, R. E., Short, J. P., & Yiu, D. W. (2011). Resource-based Theory and Corporate Diversification: Accomplishments and Opportunities. *Journal of Management, 37* (5), 1335—1368. https://doi.org/10.1177/0149206310391804.

The article is recommended for printing 07.07.2021

ISSN 2306-4994 (print); ISSN 2310-8770 (online)