Assessing the functionality of models for predicting bankruptcy of pharmaceutical companies

Оценка функциональности моделей прогнозирования банкротства фармацевтических компаний

Written by:
Danil Alekseevich Zyukin[113]
https://orcid.org/0000-0001-8118-2907
SPIN: 1980-8503
Alexey Anatolyevich Golovin[114]
https://orcid.org/0000-0003-4962-2022
SPIN: 5759-0678
Olga Viktorovna Pshenichnikova[115]
SPIN: 5850-5686
Marina Nikolaevna Nadzhafova[116]
SPIN: 8636-1115

Abstract

The article considers the problem of the functionality of existing bankruptcy forecasting models for the pharmaceutical industry, the significance of which is due to the strategic role of this industry in ensuring drug safety in Russia. In conditions of import dependence, it is possible to increase the competitiveness of domestic enterprises by investing in it, which actualizes the task of increasing their investment attractiveness, one of the main elements of which is long-term and predictable financial stability. The study shows that today the assessment of financial stability and the likelihood of bankruptcy is possible only on the basis of generalized models of domestic and foreign authors, which in general give ineffective results. This is due to the fact that standard models do not take into account the industry specifics of the enterprises in question, and therefore are not able to reliably determine the presence or absence of a threat of insolvency. An important direction in the development of the pharmaceutical industry of the Russian Federation in the current environment is the search for effective tools for economic analysis and the development of the

Аннотация

В статье рассматривается проблема функциональности существующих моделей прогнозирования банкротства для предприятий фармацевтической промышленности, значимость которой обусловлена стратегической ролью данной отрасли для обеспечения лекарственной безопасности России. В условиях импортозависимости, повышение конкурентоспособности отечественных предприятий возможно достичь путем осуществления инвестиций в нее, что, в свою очередь, актуализирует задачу по повышению их инвестиционной привлекательности, одним из основных элементов которой является долгосрочная и прогнозируемая финансовая устойчивость. В исследовании показано, что сегодня оценка финансовой устойчивости и вероятности наступления банкротства возможна только на основе обобщенных моделей отечественных и зарубежных авторов, которые в общем случае дают малоэффективные результаты. Это связано с тем фактом, что стандартные модели не учитывают отраслевой специфики рассматриваемых предприятий, а потому не способны достоверно определить наличие или

[113] Candidate of Economic sciences, Senior Researcher, Kursk State Agricultural Academy named after I.I. Ivanova, Russia.
[114] Doctor of Economic sciences, Associate Professor, Head of the Department of Economic Theory, Regional Studies and Legal Regulation of Economics, Kursk Academy of State and Municipal Service, Russia.
[115] Candidate of Economic sciences, Associate Professor, Chair of Department of Economics and Accounting, Kursk State University, Russia.
[116] Senior Lecturer, Department of Economics and Management, Kursk State Medical University, Russia.

correct adapted methodology for predicting the probability of bankruptcy.

Key Words: industry, pharmaceutical industry, sanctions, economic crisis, recession, liquidity, solvency, financial stability, bankruptcy, bankruptcy forecasting models.

отсутствие угрозы неплатежеспособности. Важным направлением развития фармацевтической отрасли РФ в текущих условиях является поиск инструментов эффективных инструментов экономического анализа и разработка корректной адаптированной методологии прогнозирования вероятности банкротства.

Ключевые слова: промышленность, фармацевтическая отрасль, санкции, экономический кризис, рецессия, ликвидность, платежеспособность, финансовая устойчивость, банкротство, модели прогнозирования банкротства.

Introduction

The current problem of import dependence in Russia on the provision of medicines to the population has not only economic, but also social and political reasons. The pharmaceutical industry is a strategically important part of the national economy, since not only the health of the population, but also the ability to ensure drug safety of the country depends on the level of its development and functioning efficiency (Komarsky, 2017; Najafova, 2019). The current economic situation in the country is complex, which has intensified the existing systemic problems that have affected, in the first place, industry as the most vulnerable sector of the economy. As a result, the emerging economic crisis adversely affected domestic pharmaceutical enterprises. On the one hand, as part of the implementation of the import substitution strategy, the deterioration of the foreign policy situation should be a powerful impetus to the development of the domestic potential of the pharmaceutical industry of the Russian Federation. On the other hand, a general deterioration in the domestic economic situation may jeopardize the financial stability of pharmaceutical enterprises and the possibility of their normal functioning, as well as long-term development in view of the worsening investment climate and tightening monetary policy (Sukhorukova, 2016; Danilina, Malikova & Gorelov, 2019).

Changes in the foreign policy environment are increasingly actualizing the task of developing the domestic pharmaceutical industry and increasing its domestic potential, which is of great importance as part of the implementation of the import substitution strategy for this type of product. The current situation is complicated by the fact that today the domestic pharmaceutical market has an extremely high import

dependence, since more than 70% of the drugs traded on the market are imported (Reprintseva & Nadzhafova, 2019; Krylov, 2018). In such conditions, domestic pharmaceutical production has serious competition from foreign pharmaceutical companies, while showing relatively low competitiveness in comparison with them (Bezuglova & Krupnova, 2017). Given the industry specifics, it is possible to increase the competitiveness of the domestic pharmaceutical industry only by making a large amount of investment in it (Ferus, 2014). However, taking into account the risky nature of investing in this sector of the economy (Nezhnikova & Maksimchuk, 2019), in order to increase the investment attractiveness of pharmaceutical enterprises, it is important not only to have data on the financial situation and level of production efficiency, but also to know the pairing and interrelation between these indicators.

Methodology

In the course of the study, eight large operating domestic pharmaceutical enterprises were selected that have their own production in various regions of Russia and have a different level of efficiency of their activities and are not in dire financial condition. Based on various bankruptcy forecasting models for these enterprises, the probability of their loss of financial stability was determined. In the study, two foreign and two domestic methods were used, which are the most popular in the scientific and practical environment, namely: two-factor model of E. Altman, which is distinguished by its simplicity and informativeness, and its indicators are balance ones; the four-factor model of R. Lis, which includes factors reflecting the level of liquidity, profitability and financial

independence of the enterprise under study (Najafova, 2018 a, b). The main advantages of domestic methods of V.V. Kovalev and Moscow State University of Printing Arts (MSUPA) is their adaptability to Russian conditions, which will provide the most reliable forecasting results. Also, the method of V.V. Kovalev differs in that the indicators included in its composition cover not only the data of financial statements, but also internal information (García, Marqués, Sánchez & Ochoa-Domínguez, 2019). The MSUPA model, which includes two factors, has as its main advantages simplicity of calculation and emphasis on liquidity and financial stability indicators (Najafova, 2017).

Further, the obtained results of bankruptcy forecasting for each of the four models were compared with the performance and business activity of enterprises, namely, profitability of sales and the duration of the operating cycle. The rationale for the choice of these indicators as key is related to their information content regarding the results of the development of domestic enterprises in a crisis and subsequent stagnation in the economy. The identification of patterns between the indicators was carried out using the correlation analysis.

The study period is determined in 2014-2018, while conditionally divided into 2 parts: 2014-2016 and 2017-2018. The results of 2014 are characterized by the state of affairs at the time the crisis began; 2015-2016 reflect the most unfavorable period of the structural crisis in the Russian economy; 2017-2018 characterize the changing situation and the state of recession in the country's economy.

Results

An assessment of the correlation between the main financial and economic indicators of enterprises and the likelihood of their bankruptcy in accordance with various forecasting models showed heterogeneous final results according to 2014 data. According to the methods of Altman and Lis, the enterprises under study have a high degree of financial stability, and there is no threat of insolvency. However, despite this, the correlation of these indicators with profitability of sales and the duration of the operating cycle is significantly differentiated. So, the indicator calculated by the Altman method has a weak direct relationship with the level of profitability, while the correlation with the duration of the operating cycle is direct and very close. An assessment of the relationship of these criteria with the results of the Lis model showed the opposite result: the relationship with the profitability of sales is close, and the inverse and weak with the duration of the operating cycle. Analysis of the results of assessing the probability of bankruptcy by domestic methods showed that not all of the pharmaceutical companies under consideration had financial stability in 2014. According to the Kovalev methodology, only two of the eight subjects analyzed were financially stable and only half of the subjects were financially stable in accordance with the MSUPA methodology. At the same time, the Kovalev technique showed low functionality, since the tightness of the established correlation with sales profitability and the duration of the operating cycle is direct moderate and weak, respectively. The relationship between the considered indicators and the probability of bankruptcy according to the MSUPA methodology is more consistent, which is confirmed by the correlation coefficients (table 1).

Table 1.

Analysis of the correlation between the main indicators of the activities of pharmaceutical enterprises and the values of complex indicators for assessing the probability of bankruptcy in accordance with different calculation methods in 2014

Company name	Performance Indicators and Business Activity		Bankruptcy Forecasting			
	Return on sales,%	Operating cycle, days	Altman's Technique	Lis technique	Methodology of V.V. Kovalev	Methodology MSUPA
	Y_1	Y_2	X_1	X_2	X_3	X_4
JSC "Irbit Chemical Farm"	28,2	169,6	-2,21	0,107	78	1,46
JSC "Kraspharma"	5,1	316,3	-2,13	0,043	77	1,45
JSC "Marbiopharm"	31,5	182,2	-2,13	0,075	81	1,15
JSC "Nizhpharm"	46,9	306,3	-2,87	0,091	116	1,30
JSC "Novosibkhimpharm"	5,6	216,7	-1,69	0,055	56	1,07
JSC "Otisifarm"	24,7	299,0	-2,12	0,080	174	1,67
JSC "Tyumen Chemical Farm"	6,2	144,4	-2,48	0,080	97	1,66
JSC "Pharmstandard"	48,5	682,9	-0,97	0,070	99	0,86
The correlation coefficient Y_1Xi			0,13	0,51	0,33	-0,45
The correlation coefficient Y_2Xi			0,70	-0,24	0,19	-0,59

In 2015, a change in the current situation is noted, which is due to the deterioration of the economic situation and the beginning of a structural crisis in the Russian economy. In accordance with foreign bankruptcy forecasting techniques, the studied enterprises are financially stable. At the same time, there is an increase in the correlation indicators of efficiency and business activity of enterprises with values according to the Altman model, as a result of which there is a direct close and very close relationship, respectively, which indicates that this model is functional for predicting the likelihood of bankruptcy in a given period. In 2015, the degree of correlation between indicators and the Lis model has not changed and remains at the level of the previous year.

The results of calculations of the probability of loss of financial stability by the studied enterprises in 2015, in accordance with domestic methods, showed that not all pharmaceutical industries have a good financial position, and there is a threat of bankruptcy. The correlation between the main economic indicators of enterprises and the complex indicator according to the Kovalev model is weak and tends to weaken. A study of the functionality of the MSUPA methodology showed a decrease in the correlation between the indicator and the level of sales profitability, although the relationship is still moderate, and with the duration of the operating cycle, the tightness of the correlation remained the same (table 2).

Table 2.

Analysis of the correlation between the main indicators of the activities of pharmaceutical enterprises and the values of complex indicators for assessing the probability of bankruptcy in accordance with different calculation methods in 2015

Company name	Performance Indicators and Business Activity		Bankruptcy Forecasting			
	Return on sales,%	Operating cycle, days	Altman's Technique	Lis technique	Methodology of V.V. Kovalev	Methodology MSUPA
	Y_1	Y_2	X_1	X_2	X_3	X_4
JSC "Irbit Chemical Farm"	60,5	151,1	-2,24	0,139	94	1,48
JSC "Kraspharma"	12,3	218,2	-1,75	0,054	82	1,35
JSC "Marbiopharm"	19,5	235,4	-1,64	0,055	77	1,01
JSC "Nizhpharm"	26,5	355,4	-2,09	0,071	83	1,15
JSC "Novosibkhimpharm"	20,8	195,9	-2,61	0,075	80	1,36
JSC "Otisifarm"	38,1	235,6	-2,49	0,090	180	1,78
JSC "Tyumen Chemical Farm"	10,4	151,2	-2,74	0,090	108	2,14
JSC "Pharmstandard"	69,8	663,0	-1,11	0,074	96	0,98
The correlation coefficient Y_1Xi			0,44	0,53	0,18	-0,32
The correlation coefficient Y_2Xi			0,76	-0,28	-0,07	0,59

In the crisis year 2016, a structural change in the functionality of the models under consideration was noted: domestic methods are beginning to more closely correlate with the performance and business activity of pharmaceutical enterprises compared to previous years. As a result, indicators obtained by the MSUPA methodology, according to which not all enterprises are financially stable, have a close correlation relationship with the level of profitability and the duration of the operating cycle, the nature of which is direct and inverse, respectively, which is justified from the standpoint of the logic of economic analysis: with growth the level of profitability of sales, there is a decrease in the probability of bankruptcy, and the duration of the operating

cycle due to increased efficiency also decreases. According to the Kovalev methodology, similar results were obtained, however, the correlation of the revealed correlation is different: it is very close with sales profitability and moderate with the duration of the operating cycle.

Considering the results of calculations in the context of using the results of foreign methods, we can note the low functionality of the Lis model, since the correlation is weak. The degree of correlation between the indicator according to the Altman model and sales profitability increased by 2016, becoming very close, and with the duration of the operating cycle decreased and became moderate (table 3).

Table 3.

Analysis of the correlation between the main indicators of the activities of pharmaceutical enterprises and the values of complex indicators for assessing the probability of bankruptcy in accordance with different calculation methods in 2016

Company name	Performance Indicators and Business Activity		Bankruptcy Forecasting			
	Return on sales,%	Operating cycle, days	Altman's Technique	Lis technique	Methodology of V.V. Kovalev	Methodology MSUPA
	Y_1	Y_2	X_1	X_2	X_3	X_4
JSC "Irbit Chemical Farm"	33,6	172,4	-3,48	0,136	131	1,91
JSC "Kraspharma"	20,3	207,2	-3,02	0,063	114	1,67
JSC "Marbiopharm"	16,1	184,4	-2,08	0,051	84	1,21
JSC "Nizhpharm"	32,6	334,4	-1,42	0,076	84	1,19
JSC "Novosibkhimpharm"	33,6	194,1	-3,37	0,093	100	1,66
JSC "Otisifarm"	47,4	226,2	-6,52	0,100	251	2,73
JSC "Tyumen Chemical Farm"	39,5	125,2	-4,22	0,140	173	2,50
JSC "Pharmstandard"	37,0	473,8	-1,27	0,079	85	1,02
The correlation coefficient $Y_1 X_i$			0,74	0,23	0,79	0,61
The correlation coefficient $Y_2 X_i$			0,53	-0,25	-0,42	-0,61

An assessment of the data for 2017, which is characterized by the beginning of a recession in the country's economy, showed mixed results. As before, in accordance with the results of forecasting the likelihood of bankruptcy by foreign methods, all pharmaceutical companies under consideration are financially stable. Domestic methods allow to conclude that some of the studied pharmaceutical enterprises have an unfavorable financial situation; moreover, the coincidence of enterprises at risk of insolvency, in accordance with the methodology of Kovalev and MSUPA, indicates the objectivity of these results. At the same time, there is a tendency to reduce the correlation between the results of bankruptcy forecasting according to foreign methods and the indicators of enterprise efficiency and business activity. Among domestic bankruptcy forecasting models, the results by the Kovalev methodology show an inverse moderate correlation with the level of sales profitability, which contradicts the logic of economic analysis, since the growth in profitability should not be accompanied by a decrease in the probability of bankruptcy, the positive dynamics of which is determined by its higher value. The results of bankruptcy forecasting according to the MSUPA methodology show an inverse close correlation with the duration of the operating cycle of enterprises, which corresponds to the logic of economic and production analysis and confirms the possible functionality of this model (table 4).

Table 4.

Analysis of the correlation between the main indicators of the activity of pharmaceutical enterprises and the values of complex indicators for assessing the probability of bankruptcy in accordance with different calculation methods in 2017

Company name	Performance Indicators and Business Activity		Bankruptcy Forecasting			
	Return on sales,%	Operating cycle, days	Altman's Technique	Lis technique	Methodology of V.V. Kovalev	Methodology MSUPA
	Y_1	Y_2	X_1	X_2	X_3	X_4
JSC "Irbit Chemical Farm"	40,3	206	-5,24	0,070	181	2,42
JSC "Kraspharma"	32,4	201	-4,18	0,117	142	2,02
JSC "Marbiopharm"	61,0	314	-5,19	0,103	213	1,12
JSC "Nizhpharm"	15,1	144	-1,64	0,077	75	1,26
JSC "Novosibkhimpharm"	27,1	282	-2,09	0,052	93	1,50
JSC "Otisifarm"	54,6	172	-2,33	0,134	100	2,43
JSC "Tyumen Chemical Farm"	26,1	159	-8,38	0,143	288	3,28
JSC "Pharmstandard"	20,3	452	-1,08	0,068	86	1,02
The correlation coefficient Y_1Xi			-0,25	-0,02	-0,45	0,10
The correlation coefficient Y_2Xi			0,38	-0,22	-0,06	-0,64

A study of indicators for predicting the probability of bankruptcy of pharmaceutical enterprises in 2018 revealed tendencies similar to previous years: foreign methods testify to the financial stability of absolutely all the enterprises under consideration, while domestic ones show that some of the selected enterprises still have a risk of loss of solvency. However, it is worth noting that the domestic forecasting methods among themselves indicate the presence of financial problems among different enterprises, which makes it possible to doubt the reliability of the forecast obtained (table 5).

Table 5.

Analysis of the correlation between the main indicators of the activities of pharmaceutical enterprises and the values of complex indicators for assessing the probability of bankruptcy in accordance with different calculation methods in 2018

Company name	Performance Indicators and Business Activity		Bankruptcy Forecasting			
	Return on sales,%	Operating cycle, days	Altman's Technique	Lis technique	Methodology of V.V. Kovalev	Methodology MSUPA
	Y_1	Y_2	X_1	X_2	X_3	X_4
JSC "Irbit Chemical Farm"	19,5	287	-5,53	0,090	150	2,48
JSC "Kraspharma"	45,6	167	-3,77	0,112	180	2,05
JSC "Marbiopharm"	57,9	416	-4,88	0,103	237	1,25
JSC "Nizhpharm"	14,7	141	-2,24	0,080	78	1,44
JSC "Novosibkhimpharm"	26,1	253	-1,42	0,054	105	1,87
JSC "Otisifarm"	45,9	220	-3,53	0,091	124	2,40
JSC "Tyumen Chemical Farm"	10,4	173	-2,55	0,119	98	1,64
JSC "Pharmstandard"	17,5	383	-1,41	0,070	161	0,85
The correlation coefficient Y_1Xi			-0,49	-0,25	0,73	0,16
The correlation coefficient Y_2Xi			-0,20	-0,45	0,72	-0,44

According to the data of 2018, the most functional is the Kovalev model, which has a very close correlation with both indicators. But, at the same time, the fact that a direct correlation is observed with the duration of the operating cycle indicates a contradiction in the results. Another domestic technique, the MSUPA model, shows weak and moderate correlation with sales profitability and the duration of the operating cycle; however, the nature of the existing relationship is consistent with the logic of economic analysis.

In turn, the assessment of the correlation of the results of predicting the probability of bankruptcy by foreign methods with the main economic indicators in all cases showed the presence of an inverse relationship, the tightness of which varies from weak to moderate, which indicates the failure of these models.

Discussions

The research results of several authors emphasize the idea that the application of several standard techniques at the same time to predict the likelihood of bankruptcy of a particular enterprise often gives a heterogeneous result, which does not allow a high degree of certainty to assess its financial situation (Samarina & Litvinova, 2019). This fact is due to the set of indicators included in the complex indicator, the corresponding weight coefficients, and, in general, the calculation methodology in accordance with various authors' methods (Zubrenkova, Kozlov & Lomachenko, 2018).

According to researchers, it is almost impossible to obtain objective results based on the use of existing standard domestic or foreign methods, since the approaches used by their authors are generalized and do not take into account the specifics of a particular industry (Fadeeva & Nesterenko, 2020). Therefore, an objective assessment of the probability of bankruptcy of enterprises of a certain industry can be obtained only by using an approach adapted to specific conditions (Nusinov, 2016).

Among the "classical" approaches to the prediction of bankruptcy, domestic methods are more objective compared to foreign ones, which have a high degree of error and an uncertainty interval that reduce the reliability of the results

(Vlasova & Dokukin, 2016). However, the Russian methods, according to the author, give generalized results, since they take into account certain national characteristics, but do not take

into account the industry affiliation of the studied enterprise (Stelmakh, 2019).

According to foreign researchers, forecasting the probability of bankruptcy on the basis of logit-models (logistic regression apparatus) is more functional and flexible, since such models allow avoiding the "uncertainty" interval, and the inclusion of not only operating, but also crisis enterprises into the sample allows to establish the relationship between indicators of the economic situation of enterprises and the likelihood of bankruptcy, while the assessment based on discriminant analysis allows to simply distribute enterprises in certain groups according to the degree of bankruptcy (Taylor & Keming, 2016).

Conclusions

The study made it possible to establish that the considered bankruptcy forecasting techniques as applied to the Russian pharmaceutical industry are not effective enough in the prevailing financial and economic conditions of 2014-2018. So, considering the results of forecasting according to foreign methods (two-factor Altman model and Lis model), we can conclude that they correlated with the level of sales profitability during the crisis of 2014-2016, and the analysis over the past two years indicates the complete failure of these models for forecasting probabilities of bankruptcy of pharmaceutical companies. An assessment of the functionality of the Kovalev methodology made it possible to establish its insolvency for the conditions of the period 2014-2015 for pharmaceutical enterprises, and that it is more suitable for the conditions of the economic recession - since 2016, a trend has been observed for a stable correlation of the indicator with the dynamics of the level of sales profitability. The methodology of MSUPA in the period 2014-2016 showed sufficient functionality to predict the likelihood of bankruptcy of pharmaceutical enterprises, and the viability of this model was preserved only in terms of correlation with the duration of the operating cycle in 2017-2018.

Thus, a change in the functionality of these models has a certain relationship with the analyzed time periods of the crisis and recession in Russia, respectively. If during the crisis, foreign methods showed at least a moderate correlation with the main indicators of the effectiveness of enterprises, then during the recession, interdependence became minimal. This, in our opinion, is due to the fact that foreign methods were initially less adapted to Russian conditions, therefore, during the recession and

structural changes, they completely lost the ability to capture current trends. Domestic methods, however, show great effectiveness, but are not able to predict with a high degree of certainty the likelihood of bankruptcy, which is confirmed by the heterogeneity of the results.

Therefore, today there is still a need to search for tools of economic analysis, the significance of the functionality of which is the need to switch to a new innovation and investment model and attract "long money" to the pharmaceutical industry, the development of which under the conditions of sanction pressure and the implementation of the import substitution strategy is fundamental. The study showed that simple standard models are not sufficiently informative, therefore, the development of the correct methodology for predicting the likelihood of bankruptcy of pharmaceutical companies is an urgent task. As a result, the use of techniques adapted for the relevant industry can become a tool for the development of domestic industry by increasing the efficiency and financial stability of enterprises.

Bibliographic references

Bezuglova, M. N. & Krupnova, E. M. (2017). Import substitution in the Russian pharmaceutical market. Vector of Economics, 11 (17), 78.

Danilina, E., Malikova, I. & Gorelov, D. (2019). Financing and support of employees of bankrupt companies in transport sector at municipal and state levels: national and international practice. Amazonia Investiga, 9 (25), 135-142.

Fadeeva, Y. Y. & Nesterenko, A. A. (2020). Estimation and analysis of the probability of bankruptcy. Scientific and practical research, 1-1 (24), 147-150.

Ferus, A. (2014). The application of data envelopment analysis method in managing companies' credit risk. Business and Economic Horizons, 10 (1), 60-69.

García, V., Marqués, A. I., Sánchez, J. S. & Ochoa-Domínguez, H. J. (2019). Dissimilarity-based linear models for corporate bankruptcy prediction. Computational Economics, 53 (3), 1019-1031.

Komarskih, A. N. (2017). Problems and Potential of Import Substitution in Russia. Student Bulletin, 5-2 (5), 34-37.

Krylov, S. (2018). Target financial forecasting as an instrument to improve company financial health. Cogent Business and Management, 5 (1), 1-42.

Najafova, M. N. (2017). Assessment of the impact of business activity indicators and financial stability on the effectiveness of a pharmaceutical company. Karelian Scientific Journal, 6 (4, 21), 251-254.

Najafova, M. N. (2018a). Application of a two-factor Altman model for predicting the probability of bankruptcy of pharmaceutical enterprises. Karelian Scientific Journal, 7 (1, 22), 141-143.

Najafova, M. N. (2018b). Application of the four-factor Lis model to predict the likelihood of bankruptcy of pharmaceutical enterprises. Karelian Scientific Journal, 7 (1, 22), 147-149.

Najafova, M. N. (2019). On the development of the pharmaceutical industry in the Russian Federation. Karelian Scientific Journal, 8 (1, 26), 86-89.

Nezhnikova, E. V. & Maksimchuk, M. V. (2019). The pharmaceutical industry in the Russian Federation: problems and development prospects. Bulletin of the Peoples' Friendship University of Russia, series: Economics, 27 (1), 102-112.

Nusinov, V. (2016). Elaboration of the method of assessment of the severity degree of companies 'crisis. Eureka: Social and Humanities, 6 (6), 33-34.

Reprintseva, E. V. & Nadzhafova, M. N. (2019). On the relationship of business activity and the level of solvency in the pharmaceutical industry. Regional Bulletin, 1 (16), 43-45.

Samarina, N. S. & Litvinova, E. S. (2019). Diagnostics of the financial condition of the enterprise. Azimuth of Scientific Research: Economics and Management, 8 (4, 29), 260-262.

Stelmakh, V. S. (2019). Methodological aspects of predicting the probability of bankruptcy on the example of pharmaceutical companies. Economic and Social Changes: Facts, Trends, Forecast, 12 (2), 115-127.

Sukhorukova, M. G. (2016). Analysis of the pharmaceutical industry: problems and development prospects. Guidebook of the businessman, 29, 254-262.

Taylor, J. W. & Keming, Yu. K. (2016). Using auto-regressive logit models to forecast the exceedance probability for financial risk management. Journal of the Royal Statistical Society: Series A (Statistics in Society), 179 (4), 1069-1092.

Vlasova, I. A. & Dokukin, A. A. (2016). Comparative analysis of models for predicting bankruptcy of enterprises in Russian conditions. Actual problems of modern science, 46, 168-175.

Zubrenkova, O. A., Kozlov, S. N. & Lomachenko, O. A. (2018). Theoretical and methodological foundations of the analysis of the insolvency of organizations. Azimuth of Scientific Research: Economics and Management, 7 (2, 23), 154-156.