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Determining of the Bankrupt Contingency as the Level Estimation Method of Western Ukraine Gas Distribution Enterprises' Competence Capacity

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Abstract: The functioning of Ukrainian national gas sector is directly dependent on the processes of fuel and energy resources consumption and trends in domestic and foreign markets. Nowadays, the majority of approaches and methods are formed with the obligatory use of expert assessment methods, which, in its turn, predetermines relatively subjective judgments and results. In the process of conducting a comprehensive analysis of financial and economic indicators and those reflecting the results of economic activity of gas distribution network operators functioning in the western region of Ukraine, the following approaches have been used in our study with the involvement of: Altman's two-factor model; Altman's five-factor model; Lis's bankruptcy prediction model; Richard Taffler's model; Beaver's coefficient; Tereshchenko's model and Matviychuk's model; however, the existing models for diagnosing bankruptcy of enterprises are characterized by ambiguity; as for example, if Lis's model indicates a low bankruptcy level, then other models prove the opposite situation; domestic diagnostic models need to be improved, as they were developed in the early 2000s and disregard current trends in functioning of enterprises. Since the existing models for diagnosing the bankruptcy of enterprises are characterized by ambiguity, the authors proposed and approbate their own approach to determining the level of competitiveness of gas distribution network operators. A feature of the proposed methodology is taking into account modern trends in the functioning of enterprises, taking into account the peculiarities of the activities of gas distribution network operators, and the market stage. A tangible advantage of this approach is the ability to identify the presence or likelihood of critical events at an early stage.

Keywords: assessment of the level of competitiveness; bankruptcy; competitiveness; gas distribution network operators (GDNO); natural gas market



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1. Introduction

The functioning of Ukrainian national gas sector is directly dependent on the processes of fuel and energy resources consumption and trends in domestic and foreign markets. The implementation of innovation policy, in its turn, is constantly intensified by the exigency to improve the fixed assets level of gas distribution network operators (GDNO), to eradicate such phenomena as the imbalance of tariff supply relative to purchasing power of consumer demand, by the necessity of alternative energy sources use and the priority of local stimulation methods of regional competitiveness. Effective and desirable implementation of economic reforms in the gas distribution companies' activities in western region of

Ukraine is supposed to increase their competitiveness level through the introduction of innovative measures [1–6]. However, the indicators of the level of innovative measures implementation that would help increase the competitiveness of GDNO have been scarcely researched until now. Moreover, the fundamental foundations have not been developed so far: stimulating the competitiveness of GDNO; adaptation of all participants of the natural gas distribution market to the improvement of economic conditions of these operators functioning [7]. Thus, all above mentioned factors outline the high anticipation of meaningful analysis of values, ways, methods, structure, nature, and implementation of innovation policy in order to achieve the highest competitiveness level of GDNO performance in western Ukraine, as well as identification of areas for further stimulation of their activities, given the specific social-economic characteristics of each regional group.

Nowadays, the majority of approaches and methods are formed with the obligatory use of expert assessment methods, which, in its turn, predetermines relatively subjective judgments and results. Moreover, modern methods for assessing the level of competitiveness of an enterprise are mainly focused on assessing the efficiency of using capital in the short term and, to a lesser extent, on the task of ensuring the safe use of capital, which makes it possible to increase the validity of long-term strategic decisions. They do not take into account the risks of a potential decrease in profit generation, complete or partial loss of capital, forecasting the level of bankruptcy of an enterprise. A significant relationship between the levels of competitiveness and the values of the bankruptcy forecast is shown by the studies of this aspect [8,9]. The results of our research have proven the significantly increased exigency for measures to prevent possible bankruptcy of gas distribution network operators functioning in the western region of Ukraine with the practical application of both foreign and domestic approaches.

The purpose of this work is to deepen the methodological provisions and develop practical recommendations with the purpose of increasing the competitiveness level of gas distribution network operators.

To achieve this goal, it is necessary to systematize and test the main existing models for diagnosing bankruptcy, namely (1) E. Altman's two-factor model; (2) E. Altman's five-factor model; (3) R. Fox's bankruptcy forecasting model; (4) Richard Taffler's model; (5) W. Beaver coefficient; (6) model O. Tereshchenko; (7) Matviychuk's model. This comparison is necessary due to the fact that basically these models were developed quite a long time ago as for rapidly changing business conditions; models were developed in specific conditions of a particular country and environment; may not take into account the peculiarities of managing companies in the energy industry, and so on.

Thus, the object of the study is the process of identifying, evaluating, and predicting the bankruptcy of enterprises.

The basis of research are gas distribution enterprises of western Ukraine.

2. Literature Review

Some of the most famous studies on corporate bankruptcy are [8,10–14]. Earlier research [14–16] focused on the probability of bankruptcy and comparing empirical predictions and theoretical models. Some scientific papers focus on probability and risk [10,14,16–19]. There are also various research and review studies. These models and pieces of research vary from various perspectives.

First, each model is developed in the specific condition of the individual country and environment.

Second, the basic data set usually consists of companies from various economic categories.

Third, some of them look at the maker environment and some focus on Corporate Governance and Sustainability [12,20–23] or information disclosure [10–12,24,25]. Fourth, the main difference is the methodology used for model construction.

Another stream of the bankruptcy prediction literature focuses on market-based information. Large firms have a smaller probability of bankruptcy and that a part of

this explanation is related to corporate diversification [26]. Among others, a BSM-Prob bankruptcy prediction model that is based on the Black–Scholes–Merton option pricing model has been developed [27].

On the other hand, recent-year-popular methods include artificial intelligence [13], fuzzy rules-based classification models [28], neural networks [29], expert systems and decision trees [30], survival analysis [31], rough set analysis [32–34], genetic algorithms [35,36], logistic regression [37], and self-organizing maps (SOM) [38]. Moreover, even if one model is superior to another, this does not imply that the inferior model should be neglected altogether and it might be possible to combine the models to form an even better one [15,39,40].

There is a current need to form appropriate economic and organizational and administrative support to solve the tasks of determining the current state of competitiveness of the eight largest GDNO functioning in western Ukraine, as well as feasible methodological and practical aspects of determining the level of their competitiveness [3,32,33,41]. Several scientists from “scientific world” have been engaged in determining the essence and theoretical approaches, meanings, and vectors of implementation of enterprises’ competition policy [42–44]. Meanwhile, a significant contribution to consideration of the regional features affecting the enterprises’ competitiveness was reflected in the works of: [45–47].

Thus, the need for scientific and practical development of the identified obstacles to the maximum competitiveness level, given the peculiarities of the regional conditions of the GDNO, testifies to timeliness and substantiality of the chosen research topic. Meanwhile, the implementation of further theoretical research and solving topical issues, failure to clarify controversial issues of methodological and applied nature to determine the level of competitiveness of GDNO helped to outline further goals, objectives, and logical structure strategies of this study. We have already mentioned the high degree of relevance of the issue concerning the formation and subsequent implementation of a systemic policy to increase the competitiveness of the GDNO of western region of Ukraine [48,49]. A wide range of approaches is known to determine the level of competitiveness not only of an individual entity, but also of a particular regional market in which it operates—within the national or regional scale of implementation. In fact, S.V. Grubyak noted in her research that it is the prices for consumed natural gas that reflect the efficiency of GDNO activities, as they are this factor’s “first” indicator [50].

Associate professor S.V. Grubyak has additionally used a practical approach of “the current producers’ interests-based methodology for tariffs determining” [50]. Provided that this “solution” is implemented, we believe that the level of dissatisfaction from the consumer sector’s side will only increase, as the tariffs for natural gas distribution are inevitably likely to soar in the future at the last stage of the natural gas market which is consumption. At the same time, L.A. Tarasenko strongly supports the position of the feasibility and practical possibility of process effectiveness determination of the so-called “conditional division” of the enterprise into components: “assessment of the dynamics of indicators available; analytical delineation of the situation at a particular timeslot [51].

With the direct activities of the GDNO in mind, we should pay attention to the results of the O.Y. Savko’s study maintaining that it is the market entity’s financial condition which is indicative of the most objective values of its performance. Ultimately, finances are an integral value. In its turn, the notion of finances category presupposes an insightful analytical study of the components of financial stability and solvency. All this provides a certain information basis for determining the level of current and strategic management of financial and material resources of GDNO and indicators of this operator’s competitiveness level [52].

3. Materials and Methods

With planning and intersectoral instability prevailing on contemporary market, real, effective, and feasible results of GDNO are particularly problematic to yield, and economic mobility plays a significant role in the formation and implementation of innovative competitiveness enhancement policies. These factors necessitate available and relevant information

on the effectiveness of GDNO, as well as their financial and economic position in regional markets for natural gas distribution. However, today the vast majority of approaches and methods are formed with the obligatory use of expert assessment methods, which conversely entails relatively subjective judgments and results. Today, due to significantly escalated economic tensions, the likelihood of crisis in the state gas sector and the simultaneous formation of national and other important regional distribution markets among natural gas consumers, the question of determining the bankrupt contingency among regional gas distribution companies has acutely risen.

To pre-determine the level of probability and threat of bankruptcy of organizations, leading scientists have already developed a number of model approaches, the results of which will reflect the financial and economic situation, solvency of GDNO, and their bankrupt contingency. At the same time, our research has proven the increased necessity to implement measures to prevent possible bankruptcy of GDNO functioning in western region of Ukraine with application of both foreign and domestic approaches [53–56].

Altman's Two-Factor Model. The most well-known foreign model for diagnosing the bankrupt contingency is E. Altman's two-factor model as one of the easiest to forecast the probability of bankruptcy of an enterprise, the calculating process of which takes into account the impact of as many as 2 indicators:

$$Z = -0.3877 - 1.0736 * X_1 + 0.0579 * X_2, \quad (1)$$

where X_1 is the current liquidity ratio; X_2 —the coefficient of financial dependence (the amount of borrowed funds relative to the total liabilities of the balance sheet). If the value of $Z > 0$, the situation in the analyzed company is critical, the contingency of bankruptcy being high.

Altman's Five-Factor Model. This model is more common and reasonable. It involves taking into account the five values of indicators to some extent reflecting the full range of the organization's financial position. At the same time, a tangible advantage of this approach is the ability to detect the presence or likelihood of critical phenomena at early stages.

We believe this approach to have undisputable strengths over its foreign counterparts to include the following:

- The ability to predict the likelihood of bankruptcy, as well as potential risk areas for the company itself;
- Simplicity of calculations; logical sequence of research;
- A small number of indicators accurately and qualitatively providing the results of the study;
- Availability of source data of financial statements.

Moreover, equally important is the fact that after calculating the required indicator with the help of this model it is possible to determine the potential or locate existing risk area of the specific studied company. The formula for calculating E. Altman's five-factor model is formed as follows:

$$Z = 1.2 * X_1 + 1.4 * X_2 + 3.3 * X_3 + 0.6 * X_4 + 0.999 * X_5, \quad (2)$$

where X_1 —the ratio of working capital to total assets; X_2 —the ratio of retained earnings to total assets; X_3 —the ratio of profit relative to interest payment to the total asset; X_4 —the ratio of equity to liabilities; X_5 —the ratio of net income to total assets.

Lis's Bankruptcy Prediction Model. This model was created for British companies in 1972. This is one of the first European models to be created after the model of the American E. Altman (1968). The Lis's model is given below:

$$Z = 0.063 * X_1 + 0.092 * X_2 + 0.057 * X_3 + 0.0014 * X_4, \quad (3)$$

where X_1 —working capital/amount of assets; X_2 —gross profit/amount of assets; X_3 —retained earnings/amount of assets; X_4 —equity/debt capital. If $Z < 0.037$, the company is potentially bankrupt; $Z > 0.037$ shows a stable financial position.

Taffler's Model. In addition to Lis's model for British companies, Richard Taffler's Model was built, as given below:

$$Z = 0.53 K_1 + 0.13 * K_2 + 0.18 * K_3 + 0.16 * K_4, \quad (4)$$

where K_1 = gross profit/current liabilities; K_2 = current assets/liabilities; K_3 = current liabilities/assets; K_4 = turnout/assets. Therefore, in accordance with the regulatory value, provided that the value of Z-count is greater than 0.3, it indicates the company to have fairly normal long-term prospects. If the value of the Taffler index is less than 0.2, the company will go bankrupt in the long run. The advantage of this methodological approach is the simplicity of calculation and the possibility of use to exercise external diagnostics. However, the method disregards the assessment of business according to market criteria (i.e., quotations of shares, provided, of course, that they are listed on the stock exchange), which may turn out to be a sort of disadvantage [57].

Beaver's Coefficient. To timely detect a possible tendency of profitable fully functioning GDNO forming an unsatisfactory balance sheet structure, as well as to implement actions aimed at foreseeing and preventing bankruptcy, a periodic rapid analysis of the economic, financial, and economic organizational position of GDNO should be implemented using W. Beaver's coefficient. This ratio is calculated as the ratio of the difference between accrued depreciation to the sum of long-term and current liabilities and net income. If the W. Beaver coefficient does not exceed the value of 0.2 for 1.5–2 years, the balance sheet structure is unsatisfactory, an undesirable process of reducing profits (their share) intended to improve the production process can be observed. This trend consequently leads to a rather unsatisfactory balance sheet structure, while the GDNO begins to work in debt, its ratio of own funds decreases—0.1.

Tereshchenko's Model. This model is considered to be the most common domestic model of enterprise's bankruptcy analysis in Ukraine [56]. In its turn, the discriminant O. Tereshchenko's model is characterized by significant advantages unlike the widespread traditional methods, namely due to: solving the problem of critical values of indicators, through different variations of the basic model applied to variously functioning companies; convenience and simplicity in the implementation process; involvement of domestic data of statistical indicators with modern international practice taken into account; respecting the (industry) enterprise's specifics, and is therefore depicted as:

$$Z = 1.5 * X_1 + 0.08 * X_2 + 10 * X_3 + 5 * X_4 + 0.3 * X_5 + 0.1 * X_6, \quad (5)$$

where X_1 is the ratio of cash receipts to liabilities; X_2 —the ratio of balance sheet currency to liabilities; X_3 —the ratio of net income to the average annual amount of assets; X_4 —the ratio of profit to revenue; X_5 —the ratio of inventories to revenue; X_6 —the ratio of revenue to fixed capital.

Matviychuk's Model. This model is also worth mentioning [55]. Depending on the value of Z, the following bankrupt contingency is predicted: if the value of $Z > 2$ is obtained during the assessment of financial economic and industrial indicators of the enterprise's state, it indicates a satisfactory financial condition and low probability of bankruptcy. With the increase of Z value, the financial economic and industrial stability of the GDNO's condition increases. Under the value of $Z < 1$, there is a threat of financial crisis. Accordingly, with the decrease in Z, the threat of the analyzed enterprise's bankruptcy increases.

$$Z = 0.033 * X_1 + 0.268 * X_2 + 0.045 * X_3 - 0.018 * X_4 - 0.004 * X_5 - 0.15 * X_6 + 0.702 * X_7, \quad (6)$$

Table 1 explicates the variables according to the above-mentioned model, [55]

Table 1. Matviychuk’s model.

Index	Coefficient/Ratio	Calculation
X_1	Asset mobility	Current assets/Noncurrent assets
X_2	Turnover of accounts payable	Net sales revenue/Current liabilities
X_3	Turnover of equity	Net sales revenue/Equity
X_4	Return on assets	Balance/Net sales revenue
X_5	Provision of own working capital	(Current assets-Current liabilities)/Current assets
X_6	Concentration of borrowed capital	(Long-term liabilities + Current liabilities)/Balance sheet
X_7	Debt coverage with equity	Equity/(Ensuring subsequent costs and payments + Long-term liabilities + Current liabilities)

Source: compiled by the authors using the source: [55].

4. Research Results

In order to substantiate the submission of proposals for improving the models for detecting bankruptcy, it is necessary to test the main models in practice and analyze the obtained results: how similar are their results, are there any unacceptable discrepancies. Approval of models will be carried out on the basis of data from the economic activities of 8 major western Ukraine gas distribution enterprises («Volyngas» JSC, «Zakarpatsgas» JSC, «Ivano-Frankivskgas» JSC, «Lvivgas» JSC, «Rivnegas» JSC, «Ternopilgas» LLC, «Khmelnyskgas» JSC, «Chernivtsigas» JSC).

According to the indicators of Altman’s two-factor model (Table 2), all investigated enterprises are characterized by a less than 50% level of bankrupt contingency.

Table 2. Altman’s two-factor model approbation.

Regional Gas Distribution Enterprise	2017	2018	2019	2020	2021	Normative Value
«Volyngas» JSC	-1.036	-1.055	-1.231	-1.082	-0.758	If the value of $Z < 0$ –then the bankrupt contingency is less than 50%; $Z = 0$ –is 50%; $Z > 0$ –more than 50%.
«Zakarpatsgas» JSC	-0.979	-0.761	-0.720	-0.612	-0.508	
«Ivano-Frankivskgas» JSC	-1.050	-1.234	-1.303	-1.010	-0.569	
«Lvivgas» JSC	-1.397	-1.353	-1.324	-1.164	-0.826	
«Rivnegas» JSC	-1.134	-1.273	-1.302	-1.266	-0.949	
«Ternopilgas» LLC	-1.091	-0.915	-0.947	-0.930	-0.614	
«Khmelnyskgas» JSC	-1.122	-1.432	-1.376	-1.308	-0.783	
«Chernivtsigas» JSC	-0.737	-0.872	-1.074	-0.570	-0.452	

Source: methodology—[10–12]; data for analysis—open sources [58–62].

Analyzing the data in Table 2 discloses the bankrupt contingency to be less than 50%, which is a very good result. This model’s strength of involving assessing the possibility of bankruptcy of enterprises is in its easy calculation. The disadvantage, however, is the small number of values and indicators taken into account. This approach to calculation was defined for companies operating in the United States, the standards of which cannot be projected onto domestic enterprises [51].

Next, depending on the obtained results, it is necessary to determine the value of the bankrupt contingency of the company using the following scale (Table 3).

Table 3. Altman’s model approbation-based scale for determining (bankrupt contingency) an enterprise’s state.

Index (Criterion)	Bankrupt Contingency Level
1.8	Rather high
1.81–2.6	High
2.61–2.9	Low
2.91–3.0	Rather low

Source: [53,54].

Thus, the value received with the use of the scale presented above is compared (Table 3) and summarized concerning bankrupt contingency of the company the activity of which is investigated. In order to outline the level of financial position and potential, we propose to use the following matrix (Table 4) [53,54].

Table 4. Altman’s model approbation-based matrix for determining the level of financial potential of GDNO.

Bankrupt Contingency Level	Financial Stability	Financial Potential
Rather high High	The enterprise characterized by financial instability. Without financial stability	Low
Low	The company’s results are quite profitable whereas its financial condition largely depends on possible changes, internal and external environment	Middle
Very low	Stable financial situation. Profitable company’s activity	High

Source: author’s development.

The lower the bankrupt contingency, the higher is the level of financial, economic, and industrial potential of the regional gas distribution enterprise (Novosad, 2020).

The calculations performed according to this method as shown in Table 5 indicate an up to more than 80% increase in bankrupt contingency for almost all western regional gas distribution enterprises during 2020–2021. Exceptions are “Rivnegas” JSC and “Chernivtsigas” JSC in 2018, as their bankrupt contingency is high (from 40% to 50%) [51].

Table 5. Altman’s five-factor model approbation.

Regional Gas Distribution Enterprise	2017	2018	2019	2020	2021	Normative Value
«Volyngas» JSC	0.619	0.442	1.814	1.259	0.343	If the value of $Z < 1.8$ –then the bankrupt contingency is very high (over 80%); $1.81 < Z < 2.7$ –high (from 40% to 50%); $2.71 < Z < 2.99$ –possible (from 15% to 20%); $Z > 3$ very low
«Zakarpogas» JSC	2.033	1.534	1.639	0.928	−0.077	
«Ivano-Frankivskgas» JSC	1.960	1.781	2.534	1.251	−0.862	
«Lvivgas» JSC	2.573	2.167	2.383	1.730	0.517	
«Rivnegas» JSC	1.980	1.483	2.134	2.068	1.419	
«Ternopilgas» LLC	2.467	2.521	1.469	0.747	−1.654	
«Khmelnyskigas» JSC	2.531	2.290	2.225	1.137	0.209	
«Chernivtsigas» JSC	0.573	0.864	1.956	2.320	0.019	

Source: methodology—[10–12]; data for analysis—open sources [58–62].

Analyzing Table 6 explicates that all regional gas distribution companies are characterized by a low level of bankrupt contingency. However, it should also be mentioned that the specific conditions of gas distribution companies functioning in the western region of Ukraine are disregarded in this model, which makes the calculated coefficients in Table 6 far from entirely objective.

Table 6. Lis's model approbation.

Regional Gas Distribution Enterprise	2017	2018	2019	2020	2021	Normative Value
«Volyngas» JSC	0.087	0.077	0.153	0.159	0.168	If the value of $Z < 0.037$ —high bankrupt contingency; $Z = 0.037$ —limit value; $Z > 0.037$ —low bankrupt contingency
«Zakarpatsgas» JSC	0.130	0.188	0.198	0.215	0.214	
«Ivano-Frankivskgas» JSC	0.156	0.159	0.195	0.093	0.077	
«Lvivgas» JSC	0.148	0.170	0.182	0.183	0.207	
«Rivnegas» JSC	0.139	0.144	0.168	0.172	0.226	
«Ternopilgas» LLC	0.184	0.178	0.093	0.086	0.051	
«Khmelnitskgas» JSC	0.123	0.144	0.162	0.077	0.061	
«Chernivtsigas» JSC	0.115	0.148	0.178	0.420	0.397	

Source: methodology—[57]; data for analysis—open sources [58–62].

In today's Ukraine real conditions, with the specific regional features of the distribution market among end users of natural gas in mind, this method can be used only as an extra (parallel) model, as the coefficient values are partially related to the industry.

Although the implications confirm that in financial terms the most stable is “Chernivtsigas” JSC. Conversely, provided that regulatory trends from the side of the National Commission for Regulation of Economic Competition remain currently stable or intensify, bankrupt contingency is high for «Volyngas» JSC, «Ivano-Frankivskgas» JSC, «Ternopilgas» LLC and «Khmelnitskygas» JSC (Table 7).

Table 7. Taffler's model approbation.

Regional Gas Distribution Enterprise	2017	2018	2019	2020	2021	Normative Value
«Volyngas» JSC	0.087	0.077	0.153	0.159	0.168	If the value of $Z < 0.2$ —the probability of bankruptcy is quite high; $0.2 < Z < 0.3$ —possible bankruptcy; $Z > 0.3$ —the probability of bankruptcy is low
«Zakarpatsgas» JSC	0.130	0.188	0.198	0.215	0.214	
«Ivano-Frankivskgas» JSC	0.156	0.159	0.195	0.093	0.077	
«Lvivgas» JSC	0.148	0.170	0.182	0.183	0.207	
«Rivnegas» JSC	0.139	0.144	0.168	0.172	0.226	
«Ternopilgas» LLC	0.184	0.178	0.093	0.086	0.051	
«Khmelnitskgas» JSC	0.123	0.144	0.162	0.077	0.061	
«Chernivtsigas» JSC	0.115	0.148	0.178	0.420	0.397	

Source: methodology—[53,54], data for analysis—open sources [58–62].

Table 8 shows that the balance structure remains unsatisfactory in the majority of the studied regional gas companies. Again, the best situation is at “Chernivtsigas” JSC as the value of W. Beaver's coefficient is more than 0.2) [53,54].

Table 8. Beaver's coefficient approbation.

Regional Gas Distribution Enterprise	2017	2018	2019	2020	2021	Normative Value
«Volyngas» JSC	−0.513	−0.434	−0.157	−0.270	−0.361	If the value of $EA > 0.4$ —the company is not threatened with bankruptcy, when $EA < 0.2$ for a long period meaning the formation of an unsatisfactory balance sheet structure
«Zakarpatsgas» JSC	−0.221	−0.202	−0.067	−0.175	−0.202	
«Ivano-Frankivskgas» JSC	−0.774	−0.415	−0.160	−0.612	−0.962	
«Lvivgas» JSC	−0.753	−0.450	−0.2	0.156	−0.285	
«Rivnegas» JSC	−0.556	−0.361	−0.144	−0.178	−0.423	
«Ternopilgas» LLC	−0.620	−0.828	−0.588	−0.502	−0.759	
«Khmelnitskgas» JSC	−0.822	−0.436	−0.154	−0.581	−0.716	
«Chernivtsigas» JSC	−0.599	−0.411	−0.166	−0.005	0.204	

Source: methodology—[26]; data for analysis—open sources [58–62].

In this situation, Tereshchenko's model proves the significant risks of bankruptcy for gas distribution companies operating within the western market of Ukraine (Table 9). In our opinion, this is primarily due to exponentially growing annually negative financial results.

Table 9. Tereshchenko's model approbation.

Regional Gas Distribution Enterprise	2016	2017	2018	2019	2020	Normative Value
«Volyngas» JSC	−1.555	−4.556	−0.189	−2.082	−6.657	If $Z > 2$ —bankrupt threatening, $1 < Z < 2$ —financial stability violated, $Z < 1$ —a threat of bankruptcy observed
«Zakarpatsgas» JSC	8.759	4.174	2.770	−2.689	−15.723	
«Ivano-Frankivskgas» JSC	4.505	1.564	3.085	0.687	−5.390	
«Lvivgas» JSC	7.624	4.051	3.447	2.285	−4.159	
«Rivnegas» JSC	2.899	0.406	1.776	1.423	−1.773	
«Ternopilgas» LLC	3.049	1.032	−2.699	−2.902	−10.990	
«Khmelnitskgas» JSC	6.392	4.147	2.972	1.465	−1.252	
«Chernivtsigas» JSC	−1.419	−2.604	0.066	−1.890	−7.433	

Source: methodology—[26]; data for analysis—open sources [58–62].

Based on the calculations in Table 10, the value of Z can be seen for all enterprises during 2017–2021 to have decreased significantly, indicating an increase in the threat of bankruptcy. However, «Chernivtsigas» JSC and «Khmelnitskgas» JSC are slightly better positioned.

Table 10. Matviychuk's model approbation.

Regional Gas Distribution Enterprise	2017	2018	2019	2020	2021	Normative Value
«Volyngas» JSC	1.232	21.984	6.670	−0.083	0.074	If $Z > 2$ —not bankruptcy threatening, $1 < Z < 2$ —financial stability violated, $Z < 1$ —a threat of bankruptcy observed
«Zakarpatsgas» JSC	1.139	0.619	0.579	−0.302	−0.104	
«Ivano-Frankivskgas» JSC	1.434	1.148	1.737	0.656	0.003	
«Lvivgas» JSC	1.735	1.057	1.176	−0.598	0.059	
«Rivnegas» JSC	1.654	1.117	1.673	5.524	0.103	
«Ternopilgas» LLC	1.620	1.522	0.741	1.206	0.300	
«Khmelnitskgas» JSC	2.506	1.350	1.020	0.843	0.783	
«Chernivtsigas» JSC	1.117	−0.048	−0.190	0.473	0.415	

Source: methodology—[26]; data for analysis—open sources [58–62].

Approbation of the main different models and their modifications in practice has shown that they give conflicting results. Thus, as a result of our study, a detailed analysis of the bankrupt contingency (level of competitiveness) of the largest gas distribution enterprises operating in the western region of Ukraine exposed the efficiency of gas distribution network operators to be different, regardless of their being in almost the same operating conditions, in terms of tariffs, access to raw materials, financial and labor markets. A synthesized and generalized value indicator of bankrupt contingency, as one of the approaches to determining the competitiveness level of GDNO functioning in the western region of Ukraine on seven models for the period 2014–2018 is presented in Table 11.

Table 11. Generalized value indicator of bankrupt contingency of gas distribution companies in the western region of Ukraine.

Regional Gas Distribution Enterprise	Altman's Two-Factor Model	Altman's Five-Factor Model	Lis's Model	Taffler's Model	Beaver's Coefficient	Tereshchenko's Model	Matviychuk's Model
«Volyngas» JSC	−	+	−	+	±	+	+
«Zakarpatsgas» JSC	−	+	−	±	−	+	−
«Ivano-Frankivskgas» JSC	−	+	−	±	−	+	+
«Lvivgas» JSC	−	+	−	±	+	+	+
«Rivnegas» JSC	−	±	−	±	−	+	+
«Ternopilgas» LLC	−	±	−	+	−	+	+
«Khmelnitskgas» JSC	−	−	−	−	−	+	+
«Chernivtsigas» JSC	−	−	−	−	±	+	+

(a) The probability of bankruptcy: − low; ± average; + high. (b) The contingent tendency of bankruptcy to: ↑—increase; ↓—reduction. (c) The generalized value of the calculation indicators by color gradation: red—positive value; yellow—neutral value; green—negative value. Source: methodology—[26]; data for analysis—open sources [58–62].

5. Discussion and Conclusions

Conducting a comprehensive analysis of financial and economic indicators and those reflecting the results of economic activity to diagnose possible bankruptcy (competitiveness level) of GDNO functioning in the western region of Ukraine, we used the following approaches: (1) E. Altman's two-factor model; (2) E. Altman's five-factor model; (3) R. Lis's bankruptcy prediction model; (4) R. Taffler's model; (5) W. Beaver's coefficient; (6) O. Tereshchenko's model; (7) A. Matviychuk's model. In general, it can be concluded from Table 11 that the situation regarding the level bankrupt contingency of GDNO varies depending on the calculation model. At the same time, almost always there is a tendency of its occurrence probability toward increase, which is quite an alarming signal. Evidence of exigency to form and search for innovative ways to implement policies that are supposed to increase the gas distribution companies' competitiveness are: the need for the National Commission, which carries out State Regulation in the Spheres of Energy and Communal Services alleviating regulatory measures regarding the establishment of clearly fixed tariffs, the level of remuneration of workers of various ranks and specialties, as well as the maintenance of gas distribution networks in joint state or communal property—in other words, there is a need for the fastest practical implementation of gas distribution companies operating on the basis of free market relations, especially at the regional level.

In general, based on the above study of the bankrupt contingency as a method of assessing the GDNO's competitiveness, the following conclusions can be drawn:

- Existing models for diagnosing enterprises' bankruptcy are characterized by ambiguity, because, for instance, the implementation of foreign approaches to the study of bankruptcy disregards the specifics of the enterprise's domestic [10–13,22,25];
- The described models of bankruptcy diagnosis of enterprises also show somewhat contradictory results [10–12,26,55–57].

After all, for example, if Lis's model indicates a low level of bankruptcy, then other models prove the opposite situation; domestic diagnostic models need to be improved, as they were developed in the early 2000s. Correspondingly, in our opinion, it disregards the current trends in the enterprises' functioning and development, and therefore the objectivity of the results is difficult to talk about.

Thus, the conducted research contributes both to the theoretical and methodological aspects of the research subject and to practical use. The study showed that the existing models for determining bankruptcy only partially correspond to the modern, rapidly changing conditions of enterprise management. The war in Ukraine, the consequences of the COVID-19 pandemic significantly affect the well-being of enterprises, especially in the energy sector. The proposed synthesized and generalized value indicator of bankrupt contingency allows for levelling the limitations of the models indicated above and taking into account the modern trends in the functioning of enterprises, the characteristics of the activities of gas distribution network operators, and the market stage. A tangible advantage for practical use is the ability to detect the presence or likelihood of critical events at an early stage.

In summary, we note quite low level of competitiveness of GDNO in the western region of Ukraine. We consider this conclusion to be fairly impartial and objective, as almost all GDNO are unprofitable. As a result, the financial condition of the GDNO calculated in our study is characterized as unsatisfactory. Meanwhile, the main reason for the low level of competitiveness of GDNO in the western region of Ukraine should be noted as "over-regulatedness" of the natural gas distribution market by government agencies, especially by the National Commission for State Regulation of Energy and Utilities; lack of the necessary model for the implementation of reformation aimed at regional gas markets, which in its turn depends on the pricing policy in energy markets; dependence on the tariffs establishment for natural gas distribution services; low level of population's solvency as a social factor [63].

The main limitation of this study is approbation in a rather specific area of business, as well as the influence of a geographical factor, namely, gas distribution enterprises in western

Ukraine. At the same time, we were based on universal models for identifying, valuing, and predicting bankruptcy. Nevertheless, we believe that, when applying the methodology proposed by us, it is necessary to check its effect on other areas with possible further minor adjustments, which in fact will become the subject of our subsequent research.

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