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CONSTRUCTION INDUSTRY ENTERPRISES BANKRUPTCY IN MODELING CREDIT RATING

ABSTRACT

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GENERAL CHARACTERISTICS OF THE WORK

The construction industry is one of the basic sectors of the national economy, a source of satisfaction of domestic demand for residential and industrial buildings and is presented in the economies of all countries of the world without exception. Unfortunately, in Ukraine in recent years this industry does not show stable development and often periods of economic growth are replaced by regression periods. The effectiveness of construction companies depends on the availability of financial resources. Moreover, the success of construction companies is driven by a steady volume of significant funding.

During the direct construction, the risks accumulate at different stages of this process. Accumulated risk in a case of its realization need to be covered by financial resources. According to the current state of the Ukrainian financial market, it is quite often the only entity that can legally finance risk coverage of this size and with the necessary promptness, are commercial banks. Which in their turn, during the making a financing decision in the form of a loan, are guided by the credit rating of a particular enterprise, which is determined on the basis of the assessment of bankruptcy probability. Therefore, an objective assessment of the probability of bankruptcy of an enterprise adversely affects the decision to finance the enterprise and, as a result, the inability to cover the risks with financial resources leads to suspension of construction and even bankruptcy.

Both foreign and domestic scientists, including John B. Caouette, Edward I. Altman, Paul Narayann, George W. Fenn and Rebel A. Cole, have devoted their research to outlining the problem and finding ways to solve it. Directly on the study of the accuracy of predicting the probability of bankruptcy assessment using different models have concentrated in their scientific works Barth, ME, Beaver, WH, Hand, Kennelly, J., Voss, W., Shurpenkova R. K., Fuchezhi V.I., Didenko, I.S.

However, despite the large number of studies aimed at assessing the probability of bankruptcy, incorporating results into credit rating, and the accuracy of estimates, the accuracy of bankruptcy probability prediction models of Ukrainian construction industry enterprises remains poorly researched.

Summarizing the above, it should be noted that the relevance of the study lies in the connection between the use of bankruptcy probability prediction models based on credit rating and the correctness of the decision to finance the construction industry of Ukraine commercial banks.

The problem of the study is the negative impact of the use of models of estimation of bankruptcy, which are not adapted to the peculiarities of the Ukrainian construction business, in determining the debtor's credit class and, accordingly, the inability of the construction industry of Ukraine to cover the realized risks.

The hypothesis of the study is that the use of bankruptcy probability estimation models not adapted to the peculiarities of the Ukrainian construction business leads to incorrect determination of the borrower's credit rating and accordingly negatively influences the decision on its financing.

The purpose is to develop theoretical, methodological and practical aspects of bankruptcy probability assessment of Ukrainian construction industry enterprises during the process of determining their credit rating. Achieving this goal requires the following tasks:

– outline the theoretical foundations and prerequisites for modeling the credit rating of enterprises;

– to generalize methodological approaches to modeling of credit rating of enterprises and peculiarities of its application in practical implementation of credit relations;

– to deepen theoretical and methodological approaches to bankruptcy probability estimation of construction industry enterprises in Ukraine and substantiate the specifics of their consideration in modeling the credit rating of enterprises;

– to argue the grouping of financial indicators to assess the likelihood of bankruptcy and to model the credit rating of Ukrainian construction industry enterprises;

– assess the likelihood of bankruptcy in modeling the credit rating of Ukrainian construction industry enterprises and establish their accuracy;

– to substantiate directions of application of results of research of role of bankruptcy probability in modeling of credit rating of the enterprises of the construction industry.

The object of the study is the process of assessing the probability of bankruptcy of Ukrainian construction industry enterprises as a component of the borrower's credit rating model.

The subject of the study is a set of theoretical, methodological and practical aspects of assessing the probability of bankruptcy of enterprises as a component of modeling the credit rating of enterprises.

The information base of the research is scientific works and methodological improvements of foreign and domestic scientists, financial statements of enterprises of the construction industry of Ukraine, normative legal acts and court decisions on opening of the bankruptcy case of the enterprise.

In research was applied the methods of analysis and synthesis (in the study of theoretical bases of bankruptcy probability estimation and determination of credit rating), financial and economic analysis (during calculation of bankruptcy probability and interpretation of the obtained results), abstract-logical generalization (systematization of the results and formulation of the results of the conducted analysis).

The novelty of the conducted research is to determine the place and role of bankruptcy probability estimation of the enterprises of construction industry of Ukraine in modeling their credit rating and is expressed in the following provisions:

– deepened theoretical and methodological approaches to bankruptcy probability estimation of construction industry enterprises in Ukraine, taking into account the specifics of their consideration in modeling the credit rating of the borrowing companies during the decision of the lender on financing;

– the establishment of accuracy of estimation of bankruptcy probability of construction industry enterprises has been improved depending on step-by-step stages of approaching to the moment of recognition of the enterprise bankrupt;

– justification of factors influencing the accuracy of bankruptcy probability estimation of the enterprises of the construction industry of Ukraine has been further developed.

The structure of the master's work corresponds to the stated purpose and defined tasks and consists of introduction, literature review, research methodology, calculation part, research results and recommendations, conclusions, list of used sources and literature and applications. The list of sources contains 50 sources and is given on 6 pages, the total volume of work is 102 pages of computer text, 42 tables and 2 pictures.

MAIN CONTENT OF THE RESEARCH

The introduction substantiates the relevance of the chosen topic, defines the object, subject, purpose, main tasks, reveals the scientific novelty and practical significance of the research and the structure of the research. A graphical representation of the problem formation highlighted in the master's work is shown in Fig. 1.

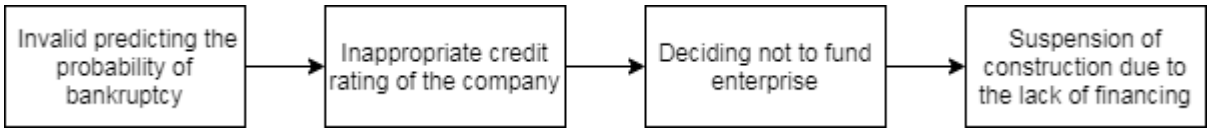

Fig 1. Influence of Bankruptcy probability on enterprise financing

The literature review examines credit risk from the position of unrealized risk and states that this category is rooted in the existence of organized lending. The development of the concept of credit risk in the historical framework is outlined, the period when most loans were issued based on a comparative analysis of the size of the loan and the financial capabilities of the borrower, ie subjective judgments, is clearly defined. The mid-eighties and the backbone of the junk bond crisis, which was characterized by high levels of loan defaults and bond repayments, led to the fact that managers at the time began to use default risk assessment methods, but despite the common use of new models, they were not created. Only in 1994 on the wave of economic growth risk, along with the emergence of new methods of risk hedging, was the use of rating models of enterprise valuation based on the estimation of the probability of bankruptcy of the enterprise becoming widespread.

Although the peak of the popularity of this approach came at the end of the twentieth century, but at the beginning of the same century began the formation of this direction of scientific research. Prior to the advent and development of the era of quantitative analysis of enterprise indicators, agencies, including future rating agencies, focused on qualitative indicators and enterprise information, such as expert assessments of the creditworthiness of a particular enterprise (For example, the well-

known Dun & Bradstreet was founded in 1949 in Cincinnati of Ohio to provide an independent assessment of the creditworthiness of the enterprise). Formally, large-scale studies related to the precursors of bankruptcy have been encountered since the 1930s, but the real boom in this area of economic science came much later.

One of the classic scientist of quantitative indicators that can indicate the probability of bankruptcy and the classification of bankruptcy is considered Beaver. Moreover, one can assume that his analysis of the forerunners of bankruptcy in 1967 was the beginning of an era of research by him and other authors on the topic of analyzing and identifying quantitative indicators of bankruptcy. Analyzing the financial performance of a sample of firms that went bankrupt and successfully continued their operations, Beaver found that a number of indicators were decisive for the bankruptcy of an enterprise over the next five years.

Most current research has adapted a multifactorial approach to predict the probability of bankruptcy of an enterprise, combining analysis of financial statements and other information about the enterprise in a number of statistical formulas. One of the first such models is one of the most famous - the Altman model. This scientist has developed an equation that optimally combines the five ratios, which in turn reflect the analysis of the financial statements and market performance of the enterprise. The discriminant function known to the general public as the Z model envisaged 24 of the 25 bankruptcy firms using data a year before the actual bankruptcy. And in a sample of 66 firms that failed bankruptcy, only 14 out of 66 cases were mistaken.

And in 1977, Altman published the results of a new study that resulted in a five-factor model. According to this model, it became possible to correctly predict the bankruptcy of 91% of random sampled enterprises, analyzing their activity one year before bankruptcy, and 77% for five years, respectively. The largest share of the new model was held by retained earnings ratios for assets (25% of model weight) and income stability (20% of model weight).

In 1972, Roman Lis developed his own methodology for predicting the bankruptcy probability of an enterprise, which was based on an analysis of such indicators as the ratio of working capital to assets, ie liquidity, profitability calculated

as the ratio of profit to tax and the amount of operating assets, retained earnings calculated and compared operating assets, and a financial lever which in turn is nothing but the amount of equity to debt. And this technique is still considered one of the simplest, in its time it became known, but since the basis of this model is an analysis of the effectiveness of managing the assets of the enterprise (unlike the Altman model which determines the market value of the shares crucial for the fulfillment of obligations) it is difficult to call it the most suitable for use in Ukrainian realities, because of the use of total assets, not taking into account their distribution by degree of liquidity, which in turn does not give a real understanding of the threat of insolvency and business, but only reflects its level of autonomy.

In the model developed by Tuffler, if the figure Z, is positive, it can be considered that the company is relatively solvent and has a low probability of bankruptcy within the next year. And if the result was a negative aggregate, then the firm is in the risk zone and the financial profile of the firm is similar to the profiles of those firms that have already become bankrupt.

In the course of promoting the research and forecasting the probability of bankruptcy of the enterprise, some scientists conducted research into the relevance of the already developed methods. Thus, Zmiyevsky made a comparative analysis of 13 bankruptcy probability models of an enterprise, checking them on a sample of companies whose shares were traded on such exchanges as AMEX and NYSE. The sample included 72 companies that went bankrupt and 3573 successfully continued their operations. This study has shown that the most useful for certain bankrupt companies is performance based on securities returns.

Despite the effectiveness of the above models, the most useful for the development of appraisal of loans to businesses was the Chesser model. The basis of this model, which was created specifically for banks in order to verify the borrower's creditworthiness, is the study of banks' data on 37 outstanding loans and 37 completed ones. Moreover, under outstanding loans means not only not directly repaid, but also any other deviations that make the loan less profitable than originally envisaged. As for the duration of the experiment, the calculation involved the

financial performance of the companies a year before they were given loans to these companies. According to the forecast, Chesser's model was able to predict the failure of three out of every four contracts, that is, out of 37 not executed contracts, only 9 were not previously declared unreliable for the loan. The model is based on 6 indicators that in turn constitute a variable that will determine the value of "Z" and accordingly whether the enterprise will be assigned to the group of those who do not fulfill the terms of the contract or not.

In the second section, Research Methodology, it was noted that most banks heed the Basel Committee's requirements, which in most cases are in line with the bank's capital to its risks and ability to identify and manage those risks. The internal risk approach involves the calculation of the expected loan losses by formula 1:

$$ECL = PD \times LGD \times EAD \quad (1)$$

ECL – expectation of loss from non-repayment of the loan;

PD* – bankruptcy probability;

LGD* – the amount of money that will be lost if enterprise become bankrupt;

EAD – the amount of money at risk.

In order to meet the requirements set out in Basel 2, the NBU approved in 2012 the provision "On the procedure for the formation and use of reserves by banks of Ukraine to compensate for possible losses on active banking transactions". To determine the main factors that influence the level of credit risk to a legal entity by a national bank, a rating system was introduced. According to the rating, the risk of defaulting on a loan depends on the state of debt service, qualitative and quantitative criteria of creditworthiness, which are set by the intra-bank provisions and the class of the debtor. Moreover, the class of debtor is most often decisive whether the loan will be repaid or not.

The process of determining the debtor's credit class in accordance with the rating system is called calibration and is based on determining the probability of bankruptcy of the debtor himself and comparing the obtained value with the intervals

of bankruptcy probability. The intervals themselves are formed based on the statistics of bad loans generated by the bank itself, or based on a statistical estimate. Based on UBS bank, Credit Suisse bank, Moody's Investor services, Standard & Poor's credit ratings, which discussed in the research, was compared their rating scales in table 1.

Table 1

Comparison credit rating scales of different banks and agencies

Risk level	Rating scale of UBS bank	Rating scale Credit Suisse	Rating scale of Moody's Investor services	Rating scale of Standard & Poor's
Investing level	0 та 1	CR 01 – CR 04	Aaa	AAA
	2		Aa1 до Aa3	AA+ до AA-
	3	CR 05 – CR 06	A1 до A3	A+ до A-
	4		Baa1 до Baa2	BBB+ до BBB
	5	CR 07 – CR 10	Baa3	BBB-
Sub-investing level (speculative)	6		Ba1	BB+
	7	CR 11 – CR 13	Ba2	BB
	8		Ba2	BB
	9		Ba3	BB-
	10	CR 14 – CR 16	B1	B+
	11		B2	B
	12		B3	B-
	13	CR 17 – CR 18	Caa до C	CCC до C
Defolt	14		D	D

For calculating the probability of bankruptcy of the selected companies, were chosen next indicators of financial statements: net profit, accumulated depreciation, long-term liabilities, short-term liabilities, assets, equity, non-current assets, current assets, profit. All of these indicators are used in calculating coefficients based on which integral indicator of each model calculates. In part of this work, where models values are calculated empirically, all of these indicators are represented in a form of tables for every enterprise, which participates in bankruptcy probability estimation. Also, in that part of master's work are represented small conclusions about financial states of enterprises based on mentioned before financial statement indicator.

Further based on this sample for every enterprise, which participates in research, was taken correspondent indicators and grouped, so that to compare same indicators of different enterprises as it is shown at Fig 2.

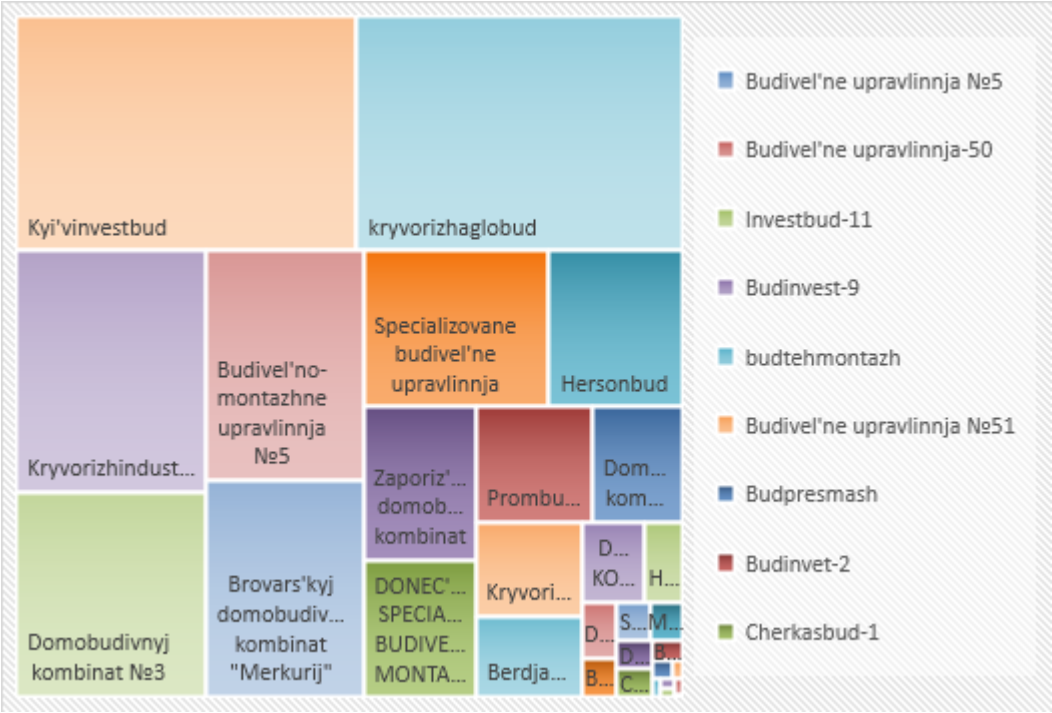

Fig.2. Assets amount comparison of enterprises, 5 years before bankruptcy

The methodology that was used in the calculations, namely the components of the bankruptcy probability estimation models of the enterprise, and specifying the normative values of these models were considered in detail. The following models were considered and subsequently used in the calculations: Lis, Beaver including the calculation of the accompanying indicators of the crisis state of the enterprise, Chesser, the two-factor Altman model, the five-factor Altman model and the Altman model for emerging markets.

The first among the bankruptcy probabilities used in this work was the Beaver Ratio, which reflects nothing but the ratio of net income to the total amount of liabilities of an enterprise. In addition to the direct Beaver ratio, the methodology also includes the calculation of the return on assets, financial leverage, the ratio of coverage of assets with own working capital (working capital), the ratio of general liquidity on the basis of which the decision on the probability of bankruptcy, the indicators do not boil down to a common denominator, and so the decision on the probability of bankruptcy is still left to the expert, ie the model is a semi-expert model, which is not surprising given the historical framework of its origin.

The third section of the study is devoted to calculations based on the financial statements of real enterprises in the construction industry of Ukraine. In order to determine the adequacy and fairness of the decisions based on the results obtained with modern models of enterprise bankruptcy assessment, and accordingly the impact of these models on the decision-making on lending to the construction industry, the financial statements and bankruptcy probability models of Lis, Beaver, and Beer were analyzed. Altman. Altogether, twenty-five to thirty construction companies were involved in the calculation, five to two years before the bankruptcy. It is mainly the financial statements for 2013, 2016 and 2017. Based on the financial statements for the five years prior to the bankruptcy, thirty enterprises were analyzed, twenty-five enterprises in the two years and twenty-six enterprises in the initial sample, one year before the bankruptcy. In the sample of financial statements of enterprises, five years before bankruptcy, nearly half, namely fourteen, became bankrupt. A sample of enterprises two years prior to bankruptcy is represented by nine bankruptcies and sixteen enterprises that did not become bankrupt as of January 2020. And among the businesses that were reported for the year before the alleged bankruptcy, as many as ten became bankrupt, and sixteen continue to operate.

Altman's two-factor model is calculated using three constant coefficients and two variable coefficients, which in turn are calculated using the financial statements of the selected entity. Details of model calculating are presented in formula 2.

$$Z = -0{,}3877 - 1{,}0736 \times \mathrm{X1} + 0{,}0579 \times \mathrm{X2} \quad (2)$$

Z – integral indicator

$$X1 = \frac{\text{current assets}}{\text{short} - \text{term liabilities}}$$

$$X2 = \frac{(\text{long} - \text{term} + \text{short} - \text{term liabilities})}{\text{equity}}$$

The next model used in the study is the five-factor Altman model, which was first published in the academic journal Financial Ratios, Discriminant Analysis and Corporate Bankruptcy Forecasting in 1968. This method, as opposed to the previous one, is more complex and takes into account a number of factors, and consequently the result of bankruptcy forecasting is more accurate.

$$Z = 1{,}2 \times \mathrm{X1} + 1{,}4 \times \mathrm{X2} + 3{,}3 \times \mathrm{X3} + 0{,}6 \times \mathrm{X4} + \mathrm{X5} \quad (3)$$

Z – integral indicator

$$X1 = \frac{\text{current assets}}{\text{assets}}$$

$$X2 = \frac{\text{net profit}}{\text{assets}}$$

$$X3 = \frac{\text{operating income}}{\text{assets}}$$

$$X4 = \frac{\text{current assets}}{\text{long} - \text{term} + \text{short} - \text{term liabilities}}$$

$$X5 = \frac{\text{net profit}}{\text{assets}}$$

Also, when calculating the probability of bankruptcy of the enterprise, the Altman model was applied to the emerging markets (formula 4).

$$\mathrm{EMZ} = 6{,}56 \times \mathrm{X1} + 3{,}26 \times \mathrm{X2} + 6{,}72 \times \mathrm{X3} + 1{,}05 \times \mathrm{X4} + 3{,}25 \quad (4)$$

EMZ – integral indicator

$$X1 = \frac{\text{current assets}}{\text{assets}}$$

$$X2 = \frac{\text{net profit}}{\text{assets}}$$

$$X3 = \frac{\text{operating income}}{\text{assets}}$$

$$X4 = \frac{\text{equity}}{\text{long} - \text{term} + \text{short} - \text{term liabilities}}$$

The more balanced model used in this study is the Lis Model. In addition to the usual bankruptcy comparison of debt with a number of other indicators, this model also focuses on the level of profitability, return on assets of the enterprise and sources of formation of these same assets.

$$Z = 0{,}717\text{X1} + 0{,}847\text{X2} + 3{,}107\text{X3} + 0{,}42\text{X4} + 0{,}995\text{X5} \quad (6)$$

Z – integral indicator

$$X1 = \frac{\text{own working capital}}{\text{assets}}$$

$$X2 = \frac{\text{net profit}}{\text{assets}}$$

$$X3 = \frac{\text{EBIDTA}}{\text{assets}}$$

$$X4 = \frac{\text{equity}}{\text{long} - \text{term} + \text{short} - \text{term liabilities}}$$

$$X5 = \frac{\text{net profit}}{\text{assets}}$$

In the fourth section, in order to determine the adequacy and fairness of decisions based on the results obtained using modern models of enterprise bankruptcy assessment, and accordingly the impact of these models on the decision to lend to the construction industry, the financial statements and bankruptcy probability models were analyzed. Chesser and Altman. Altogether, twenty-five to thirty construction

companies were involved in the calculation, five to two years before the bankruptcy. It is mainly the financial statements for 2013, 2016 and 2017. Based on the financial statements for the five years prior to the bankruptcy, thirty enterprises were analyzed, twenty-five enterprises in the two years and twenty-six enterprises in the initial sample, one year before the bankruptcy. In the sample of financial statements of enterprises, five years before bankruptcy, nearly half, namely fourteen, became bankrupt. A sample of enterprises two years prior to bankruptcy is represented by nine bankruptcies and sixteen enterprises that did not become bankrupt as of January 2020. And among the businesses that were reported for the year before the alleged bankruptcy, as many as ten became bankrupt, and sixteen continue to operate.

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From three periods, one, two and five years before forecasted bankruptcy, five years before bankruptcy period gave the most accurate results. Other periods gave relatively similar results, if we compare different models, but almost each model separately gave less accurate forecasts. The first model chosen was the bankruptcy probability prediction model of Forest, which is based on the calculation of four coefficients that, as a result, form the value of the general indicator or, in other words, the value of the model itself. Results of model calculation are presented in Table 2.

Table 2

Bankruptcy probability calculation results according to the Lis model, 5 years before the forecasted bankruptcy

Company	Result	Regulatory value	Model forecast	In fact
Hersonbud	0,050	≥0,037	Not bankrupt	Bankrupt
kryvorizhaglobud	0,071	≥0,037	Not bankrupt	Bankrupt
Domobudivnyj kombinat №3	0,381	≥0,037	Not bankrupt	Bankrupt
Budivel'ne upravlinnja №1	0,058	≥0,037	Not bankrupt	Bankrupt
Specializovane bud.upravlinnja	0,029	≥0,037	Bankrupt	Bankrupt
Kryvorizhzhytlobud	0,050	≥0,037	Not bankrupt	Bankrupt
Zaporiz'kyj dom.kombinat	0,081	≥0,037	Not bankrupt	Bankrupt
Budivel'no-mon. upravlinnja №5	0,031	≥0,037	Bankrupt	Bankrupt
Dom.komb. "Merkurij"	0,064	≥0,037	Not bankrupt	Bankrupt
Domobud. kombinat "vidradnyj"	-0,071	≥0,037	Bankrupt	Bankrupt
Donec'ke bud.mont. upr №1	0,130	≥0,037	Not bankrupt	Bankrupt
Dniprobud	0,061	≥0,037	Not bankrupt	Bankrupt
Kyi'vinvestbud	0,043	≥0,037	Not bankrupt	Bankrupt
Budivel'ne upravlinnja №5	-0,561	≥0,037	Bankrupt	Bankrupt
Dniprovs'kprombud	0,046	≥0,037	Not bankrupt	Not bankrupt
Kryvorizhindustrbud	0,295	≥0,037	Not bankrupt	Not bankrupt
Berdjans'kbud	0,030	≥0,037	Bankrupt	Not bankrupt
Melitopol'bud	0,094	≥0,037	Not bankrupt	Not bankrupt
Svitlovods'ke bud. upr. №1	0,058	≥0,037	Not bankrupt	Not bankrupt
Cherkasbud-1	0,073	≥0,037	Not bankrupt	Not bankrupt
Hmel'nyc'kbud	0,060	≥0,037	Not bankrupt	Not bankrupt
Domobudivnyj kombinat	0,070	≥0,037	Not bankrupt	Not bankrupt
Prombud-2	0,031	≥0,037	Bankrupt	Not bankrupt
Budivel'ne upravlinnja №51	0,278	≥0,037	Not bankrupt	Not bankrupt
Budivel'ne upravlinnja-50	0,610	≥0,037	Not bankrupt	Not bankrupt
budtehmontazh	7,628	≥0,037	Not bankrupt	Not bankrupt
Budpresmash	-0,056	≥0,037	Bankrupt	Not bankrupt
Investbud-11	-0,172	≥0,037	Bankrupt	Not bankrupt
Budinvet-2	0,113	≥0,037	Not bankrupt	Not bankrupt
Budinvest-9	0,351	≥0,037	Not bankrupt	Not bankrupt

The model of the Lis demonstrated rather modest results in bankruptcy forecasting, and with the dynamics to reduce the accuracy of bankruptcy forecasts with the decrease of the period before the projected bankruptcy. This inaccuracy is largely related to the third factor of the model, namely the ratio of retained earnings to assets, this ratio can artificially lower the value of the overall coefficient and how the value of the coefficient will not exceed the normative value and as a consequence the low probability of bankruptcy will be predicted.

Table 3

Bankruptcy probability results based on the Chesser model five years before bankruptcy prediction

Company	Result	Regulatory value	Model forecast	In fact
Hersonbud	0,200	0,5	Not bankrupt	Bankrupt
kryvorizhaglobud	0,004	0,5	Not bankrupt	Bankrupt
Domobudivnyj kombinat №3	0,000	0,5	Not bankrupt	Bankrupt
Budivel'ne upravlinnja №1	-	0,5	Bankrupt	Bankrupt
Specializovane bud.upravlinnja	0,200	0,5	Not bankrupt	Bankrupt
Kryvorizhzhytlobud	0,000	0,5	Not bankrupt	Bankrupt
Zaporiz'kyj dom.kombinat	1,000	0,5	Bankrupt	Bankrupt
Budivel'no-mon. upravlinnja №5	0,500	0,5	Not bankrupt	Bankrupt
Dom.komb. "Merkurij"	0,100	0,5	Not bankrupt	Bankrupt
Domobud. kombinat "vidradnyj"	1,000	0,5	Bankrupt	Bankrupt
Donec'ke bud.mont. upr №1	0,022	0,5	Not bankrupt	Bankrupt
Dniprobud	1,000	0,5	Bankrupt	Bankrupt
Kyi'vinvestbud	0,000	0,5	Not bankrupt	Bankrupt
Budivel'ne upravlinnja №5	1,000	0,5	Bankrupt	Bankrupt
Dniprovs'kprombud	0,048	0,5	Not bankrupt	Not bankrupt
Kryvorizhindustrbud	0,000	0,5	Not bankrupt	Not bankrupt
Berdjans'kbud	0,067	0,5	Not bankrupt	Not bankrupt
Melitopol'bud	0,050	0,5	Not bankrupt	Not bankrupt
Svitlovods'ke bud. upr. №1	-	0,5	Bankrupt	Not bankrupt
Cherkasbud-1	0,250	0,5	Not bankrupt	Not bankrupt
Hmel'nyc'kbud	0,143	0,5	Not bankrupt	Not bankrupt
Domobudivnyj kombinat	1,000	0,5	Bankrupt	Not bankrupt
Prombud-2	0,167	0,5	Not bankrupt	Not bankrupt
Budivel'ne upravlinnja №51	-	0,5	Bankrupt	Not bankrupt
Budivel'ne upravlinnja-50	1,000	0,5	Bankrupt	Not bankrupt
budtehmontazh	0,000	0,5	Not bankrupt	Not bankrupt
Budpresmash	1,000	0,5	Bankrupt	Not bankrupt
Investbud-11	1,000	0,5	Bankrupt	Not bankrupt
Budinvet-2	0,004	0,5	Not bankrupt	Not bankrupt
Budinvest-9	1,000	0,5	Bankrupt	Not bankrupt

Chesser model is probably the best in predicting bankruptcy probability, as it has the highest percentage of bankruptcies correctly predicted, but even so, the accuracy of the forecast wants to remain better. The main reason for the most inaccurate forecast is the first factor, namely the ratio of cash and highly liquid securities to assets, because, given the specific nature of the business, even the most successful companies simply cannot afford to hold a significant share of assets in

cash and securities, because the construction business needs continuous financing of building.

Table 4

Bankruptcy Probability Results According To Altman's Two-Factor Model, Five Years Before Bankruptcy Forecast

Company	Result	Regulatory value	Model forecast	In fact
Hersonbud	-1,523	0	Not bankrupt	Bankrupt
kryvorizhaglobud	1,589	0	Bankrupt	Bankrupt
Domobudivnyj kombinat №3	-1,078	0	Not bankrupt	Bankrupt
Budivel'ne upravlinnja №1	-8,104	0	Not bankrupt	Bankrupt
Specializovane bud.upravlinnja	-1,053	0	Not bankrupt	Bankrupt
Kryvorizhzhytlobud	-1,250	0	Not bankrupt	Bankrupt
Zaporiz'kyj dom.kombinat	-0,597	0	Not bankrupt	Bankrupt
Budivel'no-mon. upravlinnja №5	-0,623	0	Not bankrupt	Bankrupt
Dom.komb. "Merkurij"	-2,146	0	Not bankrupt	Bankrupt
Domobud. kombinat "vidradnyj"	-0,696	0	Not bankrupt	Bankrupt
Donec'ke bud.mont. upr №1	-1,063	0	Not bankrupt	Bankrupt
Dniprobud	-2,046	0	Not bankrupt	Bankrupt
Kyi'vinvestbud	-4,939	0	Not bankrupt	Bankrupt
Budivel'ne upravlinnja №5	-0,891	0	Not bankrupt	Bankrupt
Dniprovs'kprombud	-1,695	0	Not bankrupt	Not bankrupt
Kryvorizhindustrbud	-1,343	0	Not bankrupt	Not bankrupt
Berdjans'kbud	-2,222	0	Not bankrupt	Not bankrupt
Melitopol'bud	-1,918	0	Not bankrupt	Not bankrupt
Svitlovods'ke bud. upr. №1	-8,104	0	Not bankrupt	Not bankrupt
Cherkasbud-1	-0,769	0	Not bankrupt	Not bankrupt
Hmel'nyc'kbud	-1,526	0	Not bankrupt	Not bankrupt
Domobudivnyj kombinat	-2,627	0	Not bankrupt	Not bankrupt
Prombud-2	-0,866	0	Not bankrupt	Not bankrupt
Budivel'ne upravlinnja №51	-0,518	0	Not bankrupt	Not bankrupt
Budivel'ne upravlinnja-50	-0,746	0	Not bankrupt	Not bankrupt
budtehmontazh	5,911	0	Bankrupt	Not bankrupt
Budpresmash	-1,215	0	Not bankrupt	Not bankrupt
Investbud-11	-0,568	0	Not bankrupt	Not bankrupt
Budinvet-2	-16,234	0	Not bankrupt	Not bankrupt
Budinvest-9	9,034	0	Bankrupt	Not bankrupt

Altman's two-factor model, because of its simplicity, as a result of the calculation, showed the least accurate results in the bankruptcy of the enterprise itself. The distortion is due to the fact that the first factor, which by the way has the largest share, estimates the working capital ratio to short-term liabilities is possibly the most unsuccessful for estimating the probability of bankruptcy of construction

industry enterprises, since the specificity of the industry implies that most of the debt will be long-term because of high level of planning in this branch.

Table 5

Bankruptcy probability calculation results according to the Altman five-factor model, two years before the predicted Bankruptcy

Company	Result	Regulatory value	Model forecast	In fact
Hersonbud	2,199	1,23	Not bankrupt	Bankrupt
kryvorizhaglobud	10,193	1,23	Not bankrupt	Bankrupt
Domobudivnyj kombinat №3	1320,416	1,23	Not bankrupt	Bankrupt
Budivel'ne upravlinnja №1	3,209	1,23	Not bankrupt	Bankrupt
Specializovane bud.upravlinnja	-8,299	1,23	Bankrupt	Bankrupt
Kryvorizhzhytlobud	2,349	1,23	Not bankrupt	Bankrupt
Zaporiz'kyj dom.kombinat	-332,950	1,23	-	Bankrupt
Budivel'no-mon. upravlinnja №5	6,550	1,23	Not bankrupt	Bankrupt
Dom.komb. "Merkurij"	0,698	1,23	Bankrupt	Bankrupt
Domobud. kombinat "vidradnyj"	4,220	1,23	Not bankrupt	Not bankrupt
Donec'ke bud.mont. upr №1	13,692	1,23	Not bankrupt	Not bankrupt
Dniprobud	17,192	1,23	Not bankrupt	Not bankrupt
Kyi'vinvestbud	9,992	1,23	Not bankrupt	Not bankrupt
Budivel'ne upravlinnja №5	3,988	1,23	-	Not bankrupt
Dniprovs'kprombud	0,202	1,23	Bankrupt	Not bankrupt
Kryvorizhindustrbud	8,380	1,23	Not bankrupt	Not bankrupt
Berdjans'kbud	2,025	1,23	Not bankrupt	Not bankrupt
Melitopol'bud	28,594	1,23	Not bankrupt	Not bankrupt
Svitlovods'ke bud. upr. №1	69,677	1,23	Not bankrupt	Not bankrupt
Cherkasbud-1	19,962	1,23	Not bankrupt	Not bankrupt
Hmel'nyc'kbud	149,590	1,23	-	Not bankrupt
Domobudivnyj kombinat	100,030	1,23	-	Not bankrupt
Prombud-2	1,515	1,23	Not bankrupt	Not bankrupt
Budivel'ne upravlinnja №51	26,316	1,23	-	Not bankrupt
Budivel'ne upravlinnja-50	14,280	1,23	Not bankrupt	Not bankrupt

The five-factor Altman model, which can easily rank third in bankruptcy forecasting accuracy, but just like the previous models does not take into account the specifics of the construction business, so it significantly exceeds the percentage of enterprises that were assessed as bankrupt. The reason for this is the correlation of retained earnings to assets and income from operating activities to assets, which, through a significant operating cycle, may reduce the values of these ratios in separate periods.

Table 6

Bankruptcy Probability Results, Altman's Model for Emerging Markets Five Years Before Bankruptcy Forecast

Company	Result	Regulatory value	Model forecast	In fact
Hersonbud	7,980	1,1	Not bankrupt	Bankrupt
kryvorizhaglobud	9,886	1,1	Not bankrupt	Bankrupt
Domobudivnyj kombinat №3	32,335	1,1	Not bankrupt	Bankrupt
Budivel'ne upravlinnja №1	17,015	1,1	-	Bankrupt
Specializovane bud.upravlinnja	6,804	1,1	Not bankrupt	Bankrupt
Kryvorizhzhytlobud	8,200	1,1	Not bankrupt	Bankrupt
Zaporiz'kyj dom.kombinat	10,275	1,1	Not bankrupt	Bankrupt
Budivel'no-mon. upravlinnja №5	6,492	1,1	Not bankrupt	Bankrupt
Dom.komb. "Merkurij"	10,163	1,1	Not bankrupt	Bankrupt
Domobud. kombinat "vidradnyj"	0,089	1,1	Bankrupt	Bankrupt
Donec'ke bud.mont. upr №1	14,222	1,1	Not bankrupt	Bankrupt
Dniprobud	10,354	1,1	Not bankrupt	Bankrupt
Kyi'vinvestbud	7,647	1,1	Not bankrupt	Bankrupt
Budivel'ne upravlinnja №5	-26,556	1,1	Bankrupt	Bankrupt
Dniprovs'kprombud	10,157	1,1	Not bankrupt	Not bankrupt
Kryvorizhindustrbud	26,245	1,1	Not bankrupt	Not bankrupt
Berdjans'kbud	27,088	1,1	Not bankrupt	Not bankrupt
Melitopol'bud	20,361	1,1	Not bankrupt	Not bankrupt
Svitlovods'ke bud. upr. №1	17,015	1,1	-	Not bankrupt
Cherkasbud-1	9,964	1,1	Not bankrupt	Not bankrupt
Hmel'nyc'kbud	9,410	1,1	Not bankrupt	Not bankrupt
Domobudivnyj kombinat	10,003	1,1	Not bankrupt	Not bankrupt
Prombud-2	34,264	1,1	Not bankrupt	Not bankrupt
Budivel'ne upravlinnja №51	143,123	1,1	-	Not bankrupt
Budivel'ne upravlinnja-50	50,039	1,1	Not bankrupt	Not bankrupt
Hersonbud	762,247	1,1	Not bankrupt	Not bankrupt
kryvorizhaglobud	0,583	1,1	Bankrupt	Not bankrupt
Domobudivnyj kombinat №3	-6,368	1,1	Bankrupt	Not bankrupt
Budivel'ne upravlinnja №1	30,876	1,1	Not bankrupt	Not bankrupt
Specializovane bud.upravlinnja	29,844	1,1	Not bankrupt	Not bankrupt

Due to the specifics of the construction industry, bankruptcy of enterprises and the Altman model for emerging markets failed to correctly predict, since the ratio of current assets to total assets in the construction business will always be significant, but this does not mean that the company can simply dispose of them to pay off short-term debt, whether it indicates the successful operation of the enterprise.

The conclusions in Table 7, which compares the accuracy of the models, with data of predicting bankruptcy of the enterprise, considering the different periods of time before the actual bankruptcy or non-bankruptcy of the enterprises, analyzed the feasibility and fairness of using the same models in the development of the rating model and its subsequent use in the decision to lend to enterprises. construction industry.

Table 7

The accuracy results of the selected models

Model	5 years before forecasted bankruptcy		2 years before forecasted bankruptcy		1 year before forecasted bankruptcy	
	% of correctly forecasted bankrupts	% of non-correctly forecasted bankrupts	% of correctly forecasted bankrupts	% of non-correctly forecasted bankrupts	% of correctly forecasted bankrupts	% of non-correctly forecasted bankrupts
Lis	28%	75%	22%	75%	20%	81%
Chesser	36%	56%	33%	56%	50%	62,50%
Two factor Altman model	7%	88%	0%	100%	0%	100%
Five factor Altman model	23%	93%	25%	91%	20%	100%
Altman model for developing markets	15%	100%	13%	100%	10%	100%
Beaver	42%	50%	11%	56%	20%	50%

The analysis of the table shows that the accuracy of most models is significantly different from that shown on the basis of the financial statements of foreign companies. The most accurate result for businesses that went bankrupt, however, is the Chesser and Beaver models, while the other models most often cannot predict bankruptcy even with a 30% probability. This indicates that most models of bankruptcy probability assessment of an enterprise in the features of the Ukrainian economy and financial statements, respectively, can not objectively assess the probability of bankruptcy of such an enterprise, because of which may adversely affect the objectivity of the decision to issue a loan and the amount of credit security that appears to the debtor assigned to the wrong class.

Thus, by analyzing, it can be clearly concluded that none of the selected models in practice does not give a sufficiently high percentage of accuracy in

predicting the probability of bankruptcy of the construction business and thus confirms the theory that using these models when deciding on a loan to a construction company, the bank can misclassifying a debtor and in the event of a refusal to finance it can really create a situation that causes the company to go bankrupt or freeze construction for a long time. The main reason why these models are not reliable enough to determine the probability of bankruptcy and the subsequent use of the probability to classify debtors in rating systems is that these models do not take into account the specifics of the selected business, namely the long operating cycle, the possibility of no profit until completion of construction, large volumes of current assets and constant allocation of funds for the implementation of operating activities.

CONCLUSIONS

The obtained results of the diploma research make it possible to make practical and theoretical conclusions regarding the influence of the bankruptcy probability estimation accuracy of the construction industry enterprise in Ukraine on the reliability of the enterprise credit rating modeling:

1. Research of existing scientific studies has shown that the emergence of a credit rating is a completely natural process of developing the concept of credit risk. The very emergence of a credit rating is closely linked to the crisis-driven need to clearly classify businesses and conduct their credit policies with banks so as to minimize the risk of default.

Consideration of the historical prerequisites for the creation of bankruptcy likelihood models of enterprises has shown that their appearance is due to the need to objectively determine the status of the borrower, that is, to reduce the impact of human factors and subjectivity of judgment and minimize the risk of default.

2. The methodology of the study is based on the credit ratings formed in accordance with the requirements of the Brazilian Committee for the introduction of internal methods of rating the borrowers of the bank, which provides the ability to assess the amounts responsible for the risk of losses, namely the average annual probability of default, the average expected value of the loan, the term of the loan, the term risk.

3. Since banks attribute a particular debtor to a particular class based on the value of its bankruptcy probability (as a result of calibration), in practice, the bankruptcy probability of an enterprise bankruptcy is performed using the following models: a two-factor, five-factor Altman model, a model developed by the same scientist to study the economies that developing, the Logit model Altman-Sabato, models Tuffler-Tishou, Forest, Cheser, Beaver.

4. As a result of the analysis of bankruptcy probability estimation common models and modeling enterprises credit rating, financial indicators were grouped according to the following parameters: net profit, accumulated depreciation, long and short-term liabilities, assets, equity, current and current assets, non-current and non-

current assets , operating income, cash and cash equivalents, interest payable, highly liquid securities.

5. An empirical study was conducted based on the financial statements of twenty-five to thirty construction industry companies for five, two years prior to bankruptcy. It is mainly the financial statements for 2013, 2016 and 2017. Based on the financial statements for the five years prior to the bankruptcy, thirty enterprises were analyzed, twenty-five enterprises in the two years and twenty-six enterprises in the initial sample, one year before the bankruptcy. In the sample of financial statements of enterprises, five years before bankruptcy, nearly half, namely fourteen, became bankrupt. A sample of enterprises two years prior to bankruptcy is represented by nine bankruptcies and sixteen enterprises that did not become bankrupt as of January 2020. And among the businesses that were reported for the year before the alleged bankruptcy, as many as ten became bankrupt, and sixteen continue to operate. The calculations were made according to the bankruptcy probability assessment models of Altman, Forest, Chesser, and Beaver.

6. The results obtained are correlated with the normative values of the bankruptcy probability estimation models and it is revealed that five years before the bankruptcy, the Beaver, Chesser and Lis models were found to be the most accurate, two years before the actual bankruptcy the best are Chesser, Forest and five factor Altman model. The five-factor Altman, Chesser, Forest, Beaver models were the most accurate in the year before bankruptcy. Nevertheless, the actual results of the accuracy of the models are significantly different from those claimed by the authors of these models and by foreign scientists. The main factors of influence on model inaccuracy in forecasting were analyzed.

LIST PUBLISHED WORKS ON RESEARCH

Борейко М.С. Моделювання кредитного рейтингу підприємств: сутність, генезис, методичні підходи / М. С. Борейко // Студентські наукові студії. – Миколаїв : вид-во ЧНУ ім. Петра Могили, 2020.

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АНОТАЦІЯ

БОРЕЙКО М.С. ІМОВІРНІСТЬ БАНКРУТСТВА У МОДЕЛЮВАННІ КРЕДИТНОГО РЕЙТИНГУ ПІДПРИЄМСТВ БУДІВЕЛЬНОЇ ГАЛУЗІ. – Рукопис.

Магістерська робота на здобуття ступеня вищої освіти магістр галузі знань 07 «Управління та адміністрування» спеціальності 072 «Фінанси, банківська справа та страхування» за освітньо-професійною програмою «Фінанси і кредит з поглибленим вивченням іноземної мови». – Чорноморський національний університет імені Петра Могили, Миколаїв, 2020.

Досліджено проблеми фінансового забезпечення підприємств будівельної галузі, зумовлені недостатнім кредитуванням, причинами якого є недостовірна оцінка імовірності банкрутства, як складова моделювання кредитного рейтингу позичальників.

Встановлено, що більшість рейтингових моделей у своєму складі містять оцінку імовірності банкрутства підприємства-позичальника. Обґрунтовано доцільність використання для цих цілей таких моделей прогнозування імовірності банкрутства: Ліса, Бівера включно з розрахунком супровідних показників кризового стану підприємства, Чессера, двофакторна модель Альтмана, п’яти факторна модель Альтмана та модель Альтмана для ринків, що розвиваються.

На основі проведення розрахунків імовірності банкрутства підприємств будівельної галузі за допомогою обраних моделей за п’ять, два та рік до імовірного банкрутства було отримано відсоток точності кожної моделі. Аргументовано доцільність застосування моделі Чессера, що дає вищий показник точності прогнозу.

Ключові слова: кредитний ризик, кредитний рейтинг, оцінка імовірності Bankruptcтва, Bankruptство, моделі оцінки імовірності Bankruptства, двофакторна модель Альтмана, п’ятифакторна модель Альтмана, модель Альтмана для ринків, що розвиваються, модель Чессера, модель Ліса, модель Бівера.

SUMMARY

BOREIKO M., CONSTRUCTION INDUSTRY ENTERPRISES BANKRUPTCY IN MODELING CREDIT RATING – Manuscript.

Master's work in obtaining a higher education Master of Science in the field of 07 "Management and Administration" of specialty 072 "Finance, Banking and Insurance" by the educational-professional program "Finance and Credit with In-depth Study of a Foreign Language". – Black Sea National University of Petro Mohyla, Nikolaev, 2020.

The problems of financial security of the construction industry enterprises, caused by insufficient crediting, the reasons of which are incorrect estimation of bankruptcy probability, as a component of credit rating modeling of borrowers, are investigated.

It is established that most of the rating models in their composition contain an assessment of the probability of bankruptcy of the borrowing enterprise. The feasibility of using the following models of bankruptcy prediction for these purposes: Forest, Beaver including the calculation of the accompanying indicators of the crisis state of the enterprise, Cheser, two-factor Altman model, five-factor Altman model and Altman model for emerging markets.

Based on the calculation of the probability of bankruptcy of construction industry enterprises using the selected models five, two and a year before the probable bankruptcy, a percentage of the accuracy of each model was obtained. The expediency of using the Cheser model is given, which gives a higher index of the accuracy of the forecast.

Keywords: credit risk, credit rating, bankruptcy probability estimation, bankruptcy, bankruptcy probability assessment models, two-factor Altman model, five-factor Altman model, Altman model for emerging markets, Chesser model, Lis model, Beaver model.