ANALYSIS AND PREDICTION OF THE BANKRUPTCY RISK IN ROMANIAN BUILDING SECTOR COMPANIES

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Abstract. *In this study, the bankruptcy risk of the companies acting in the Romanian building sector was evaluated. The main purpose of this paper is to present, using the scoring method, the classification of enterprises according to their financial performance into both successful and bankrupt companies, To achieve this goal, we used two well-known models: Conan & Holder, and Altman. Based on financial data for the period 2008–2012, we performed a comparative analysis of bankruptcy risk and noted that the same company could be classified differently by these two models. The results may constitute a landmark for Romanian companies in substantiating decisions and in order to analyze the financial failure from at least two perspectives.*

Key words: *scoring method, failure risk, bankruptcy prediction, financial ratios, discriminant analysis*

Introduction

In the recent years, due to the inherent dynamism of economic and financial activities of companies, it has become necessary to know more precise information on the bankruptcy risk in future. Since the last months of 2008, the risk of bankruptcy issue has become very important for all building sector enterprises, because this sector was significantly affected by incidents of payment.

Because these issues aren't new and have preoccupied the economists for a long time, they had developed a method for predicting the bankruptcy risk, called the scoring method, which has seen a significant development with the use of statistical methods for analyzing the financial situation. The scoring method is an internal and external diagnosis method, which aims to measure the risk of investors, creditors and the economic agent himself in his future work. This method occupies an important position in financial analysis and is based on the discriminant analysis (Bordeianu et al., 2011).

Following the application of the discriminant analysis, the scoring is a linear function of a set of ratios or of significant financial variables. Depending on the way in which the ratios are customised, more scoring models are known. Altman achieved a multivariate

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analysis of bankruptcy, which means that a multiple discriminant analysis had been developed. The main idea of the multivariate analysis is combining the information of several financial rates in a single function as a weighted index (Stroe, Bărbuță-Mişu, 2010).

A multivariate discriminant analysis is more often used to create insolvency predictive models that could effectively predict any future failure of a company. In this type of analysis, financial ratios obtained from corporate balance sheets are used as independent variables, while a failed / non-failed company is the dependent variable. The results indicate that financial ratios of failed enterprises differ significantly from those of non-failed enterprises. Failed companies are less profitable and less liquid, and have higher leverage ratios and lower quality assets (Chung et al., 2008).

The current period is marked by economic instability which determines changes of the correlations of the score function that limit the temporary use of these models. Also, it requires the score function to be updated at regular periods. In this study, we have selected two models, the Conan & Holder model and the Altman model with 5 variables. The main purpose is to predict the risk of bankruptcy of five enterprises acting in the building sector, given the fact that the amount of building works has decreased.

The paper is structured of four sections: section 2 presents a theoretical and empirical review of the bankruptcy risk models; section 3 highlights the data and methodology of the study; section 4 presents a specific analysis of assessing the risk of bankruptcy using the Altman and the Conan & Holder models, and the paper is ended with the conclusions drawn from a comparative analysis of the two models.

Literature review

Science-based models for bankruptcy prediction have been developed for the first time in the U.S. in the ’60s by W.H. Beaver (1966) and E.I. Altman (1968). Taking into account that different treatment of forecast errors may potentially ignore ordinal properties of the data, Beaver (1979) analyzed and found a positive association between unsystematic security returns and the magnitude of annual earnings forecast errors. The essential message of his study is that ignoring the magnitude of the forecast error “throws away” some of the information content of earnings (Beaver et al., 1979). Thus, there may be the case that a company is in an imminent bankruptcy situation and shows a minimal risk due to appropriately untreated annual earnings forecast errors, and vice versa.

The work begun by Beaver was continued by Altman who introduced the multivariate discriminant technique for predicting firms’ failure (Borlea, Achim, 2013). He used a sample of 33 companies which had failed during the period 1946–1965. He started with 22 financial indicators and selected five of them which made a good distinction between failed companies and non-failed ones using information dating to 5 years back before failure.

Beaver (1966) and Altman (1968) had numerous successors who developed different models for predicting the risk of bankruptcy in different countries. Also, they improved many times their first models. In the bankruptcy prediction, two schools appeared (Anghel, 2002): the Anglo-Saxon school represented by the Beaver model, models developed by Altman, the Edmister model (1972), the Diamond model (1976), the probabilistic model of Deakin (1977), the Springate model the (1978), Koh & Killough model (1980), Ohlson's model (1982), Zavgren's study (1983), the Fulmer model (1984), the Koh model (1992), the K & P model (Clark et al.,1997), the Shirata model (1999), and the *mainland school* represented by Yves Collongues (1976), the Conan & Holder model (1979), the Central Bank of France model, the model of French Commercial Credit (CCF), the model of Accountants Approved (CA Score, 1987), the score function AFDCC 2 (1999).

All these models demonstrate an intense concern for bankruptcy prediction. Thus, Jouzbarkand et al. (2013) compiled two models for the prediction of bankruptcy, related to the Iranian economic situation. They studied the Ohlson and Shirata models, using the logistic regression method, examining and comparing the possibilities of these models. For classifying and ranking the companies, they used their business law to determine the bankrupt companies and a simple Q-Tobin to specify the solvent companies. Their results show that the created models are able to predict the bankruptcy.

Alkhatib and Bzour (2011) performed a study in order to report the effect of financial ratios in bankruptcy prediction in Jordanian companies by using the Altman and Kida models. They included in the sample non-financial service and industrial companies for the years 1990–2006. The results of the two models were then compared to recognize which one was most favourable to give an early warning about the possibility of bankruptcy for each of those years. Of the two models, Altman's model has an advantage in company bankruptcy prediction, with a 93.8% average predictive ability of the five years prior to the liquidation incident, while the average for Kida's model is only of 69%.

Xu and Zhang (2009) have investigated whether the bankruptcy of certain Japanese companies can be predicted using data from 1992 to 2005 and the traditional measures, such as Altman's Z-score, Ohlson's O-score, and the option pricing theory-based distance-to-default, previously developed for the U.S. market, in order to find if these models are useful for the Japanese market. They have found that the predictive power is substantially enhanced when these measures are combined.

Brédart (2014) developed an econometric forecasting model, and he found that this model using three simple and a few correlated and easily available financial ratios as explanatory variables shows a prediction accuracy of more than 80%. Dakovic et al. (2010) developed statistical models for bankruptcy prediction of Norwegian firms in the limited liability sector, using the annual balance sheet information. Based on information on the industry sector, they modelled the unobserved heterogeneity among different sectors

through an industry-specific random factor in the generalized linear mixed model. The models developed are shown to outperform the model with Altman's variables.

Kahl (2002) elaborates a research based on a group of companies which are close to the corporate default threshold. He concludes that only a third of these companies manage to survive independently, while the other companies either are taken over or disappear. Consequently, Saretto creates a model of corporate risk of bankruptcy assessment in a continuous way using financial ratios which reflect both the book value and the market value (Triandafil, Brezeanu, 2008).

Aziz, Dar (2006) reviewed 89 studies on the prediction of bankruptcy risk in 1968–2003. They carried out a critical analysis of the methodologies and empirical findings of the application of these models across 10 different countries and found that the multivariable models (Z-Score) and logit were most popular in the 89 papers studied.

Chung et al. (2008) examined the insolvency predictive ability of different financial ratios for ten failed finance companies during 2006–2007 in New Zealand and found that four of the five Altman (1968) ratios, one year prior to failure, were superior to other financial ratios for predicting corporate insolvency.

Lifschutz, Jacobi (2010) conducted an empirical investigation of whether it is possible to rely on two versions of the Altman model (1968) to predict the financial failure of publicly trading companies in Israel between 2000 and 2007. They found that, given the sample and the study term, the preferable model for predicting financial failure of Israeli companies was the Ingbar version of the Altman model with a critical value of 1 and with the addition of the grey area.

Romanians also expressed an interest in obtaining a synthetic tool to forecast the risk of bankruptcy both for banks and companies. In this regard, we should mention the B Score Function (1998) developed by D. Băileşteanu from University of Timişoara, Model I (1998) built by Ivoniciu (a similar development of the B Score Function), Model A (2002) Ion Anghel's outcome on the Romanian economy, an aggregate index of financial performance for the building sector enterprises designed by Bărbuță-Mişu (2009), the model of the Conan & Holder model adjusted to the specificity of Romanian enterprises (Bărbuță-Mişu, Stroe, 2010), etc. Also, we observed that many Romanian studies used the Conan & Holder model to evaluate the financial performance of the companies.

Currently, there is no model for assessing the risk of bankruptcy, which can be applied nationally or internationally and to enterprises acting in all sectors; scoring models cannot be generalized in the territory (Vintilă, Toroapă, 2012). Thus, the main disadvantage is that these models can be applied only in the economies where a statistical study has been performed or in an analysed sector, but even so these models cannot be successfully applied in different time periods.

Data and methodology description

Considering the international relevance of the Conan & Holder model and the Altman model, this paper proposes a common approach to them. The analysis was carried out on a sample of 5 companies acting in the Romanian building sector, using their financial statements for the period 2008–2012. In order to develop a correct analysis, financial data were collected from the Annual Financial Statement of the selected enterprises, available on the Bucharest Stock Exchange. The companies were selected from different cities with a distinct market share so as to allow their hierarchization in terms of performance and insolvency risk.

The method of classification used in this paper is based on the regression function. Our aim is to compare companies acting in the building sector: some with financial difficulties as shown by financial data and the analysed and the calculated ratio: *Concivia Brăila* (**ConBr**), *Concefa Sibiu* (**ConS**), *Concas Buzău* (**ConB**), and those prospering: *Transilvania Construcții* (**TraC**), *Construcții Sibiu* (**ConsS**). For each of them we calculated a set of financial rates and then applied simultaneously two forms of the linear function:

$$Z = a_1x_1 + a_2x_2 + \cdots + a_ix_i + \cdots + a_nx_n + \beta,$$

where:

a_i – the regression coefficient experimentally established;

x_i– various financial rates involved in the analysis;

β – the error term; the variable that capture all other factors which influence the dependent variable, other than the repressors mentioned above.

The American professor Altman (1968) developed one of the first scoring functions the (Altman model with 5 variables). Using the discriminant analysis of rates, Altman managed to predict properly about 95% in a sample of 66 companies, identifying those in trouble before becoming bankrupt. Calculating the Z score is based on the following equation:

$$Z = 3.3 \times \frac{\text{Earnings before interest and taxes}}{\text{Total assets}} + 1 \times \frac{\text{Sales}}{\text{Total assets}} + 0.6 \times \frac{\text{Market value of equity}}{\text{Total liabilities}} + 1.4 \times \frac{\text{Retained earnings}}{\text{Total assets}} + 1.2 \times \frac{\text{Current assets}}{\text{Total assets}}.$$

The interpretation of the Z score is presented in Table 1.

The Conan & Holder model (1979) applies to industrial companies with a number of employees between 10 and 500. It is based on a sample of 95 small and medium enterprises, half of which went bankrupt during the period 1970–1975. The analysed companies were grouped statistically in order to determine a score function applicable

TABLE 1. **Z score interpretation of the Altman model**

Value of Z function	Company's situation and the risk of bankruptcy
Z < 1.8	the bankruptcy situation is imminent;
1.8 < Z < 3	the financial situation of the company is difficult, with performances clearly diminished and very close to the bankruptcy state;
Z > 3	the financial situation of the company is good and the creditors can trust the respective company; it is solvent.

Source: Altman, E. I. (1968). Financial ratios, Discriminant Analysis and the prediction of Corporate Bankruptcy, Journal of Finance, Vol. 23, September, p. 589–609.

for industrial companies, construction companies, wholesale and transport companies. The model is based on the following function (Conan, Holder, 1979):

$$Z = 0.24 \times \frac{Gross\ operating\ surplus}{Total\ debs} + 0.22 \times \frac{Equity}{Total\ liabilities} + 0.16 \times \frac{Current\ assets - Inventories}{Total\ liabilities} -$$
$$- 0.87 \times \frac{Financial\ expenses}{Sales} - 0.1 \times \frac{Personal\ costs}{Value\ added}$$

The Z score interpretation in the Conan & Holder model is presented in Table 2.

TABLE 2. **Z score interpretation**

Value of Z function	Company's situation and the risk of bankruptcy
Z < -0.05	Failed, probability of bankruptcy risk is higher than 90% Risk, probability of bankruptcy risk is between 65% and 90%
0.04 < Z < 0.10	Alert, probability of bankruptcy risk is between 30% and 65%
0.10 < Z < 0.16	Good, probability of bankruptcy risk is between 10% and 30%
Z > 0.16	Very good, probability of bankruptcy risk is lower than 10%

Source: Conan, D. & Holder, M. (1979). Variables explicatives de performances et controle de gestion dans les P.M.I., These d'Etat, CERG, Universite Paris Dauphine.

Using these two models, we calculated the Z score for five companies selected for this study, acting in the building sector, for the period 2008–2012, and then we interpreted the results by comparing them with the initial ranking of the companies. The analysis is completed with critical appreciation and also by economic circumstances.

A specific analysis of assessing the risk of bankruptcy

In order to classify firms into bankrupt / non-bankrupt companies, we determined the variables / ratios included into each of the two presented models. We compiled the necessary tables for a case study of five companies and for determining the Z score (see Appendices 1 and 2). One essential condition taken into account when establishing the sample was that

the companies acting in this sector show a continuous activity during the chosen time interval (2008–2012). The analyzed companies were grouped into those of a low and a high risk of bankruptcy as follows: the first two enterprises (*TraC*, *ConsS*) with a low risk and the last three enterprises (*ConBr*, *ConS*, *ConB*) with a high risk of bankruptcy.

The results were compared with the predetermined intervals of value and found a different framing. According to the Altman model, the values presented in Table 3 were obtained.

TABLE 3. **Determining the Z score function proposed by Altman**

Year / Company	*TraC*	*ConsS*	*ConBr*	*ConS*	*ConB*
2008	9.3610	4.3053	3.0171	1.6883	3.5716
2009	5.5125	3.8663	5.9816	1.4624	18.2045
2010	4.4648	6.1659	3.2385	1.7950	28.7520
2011	2.3024	7.6423	9.9547	0.8778	84.1348
2012	2.3874	8.9668	10.8063	-0.8367	34.3579

Source: calculated by the authors using financial data of analysed companies (Appendix 1).

From the analysis of the obtained Z scores it follows that during the period 2008–2012 fluctuating values were registered. Thus, for the *TraC* company the values were favourable in the first three years of the analysis, even if they follow a declining trend: decreased by 41.11% in 2009, 19.01% in 2010, and 48.43% in 2011. The last two years have values less than 3, the year 2012 assuming an increase over the previous year with 3.69%.

The values of has Z function registered by the *ConsS* company are superior toward the threshold of 3. We can observe a fluctuating evolution of the Z function: it decreased in 2009 by 10.20% and then was increasing year by year during 2010–2012 with 59.48%, 23.94% and respectively with 17.33% in 2012.

The values of the Z score for the *ConBr* company were higher than 3 every year and registered a fluctuating evolution: increased in 2009 by 98.26% and decreased by 45.86% in 2010. In the last two years of analysis, the Z score registered an increase 3.07 times in 2011 versus 2010, and by 8.55% in 2012 versus 2011.

The lowest values of the Z score were achieved by the *ConS* company. The only increase of its Z score was registered in 2010 versus 2009 (22.74%). In the period 2011–2012, the Z score values were decreasing each year as follows: by 51.10% in 2011 towards 2010 and became negative in 2012.

For the *ConB* company, the Z score values were higher than 3, with an increasing trend in the period 2008–2011: 5.10 times in 2009 versus 2008, 57.94% in 2010 versus 2009, and 2.93 times in 2011 versus 2010. The value of the Z score decreased in 2012 versus 2011 by 59.16%. The annual ranking of the companies is shown in Fig. 1.

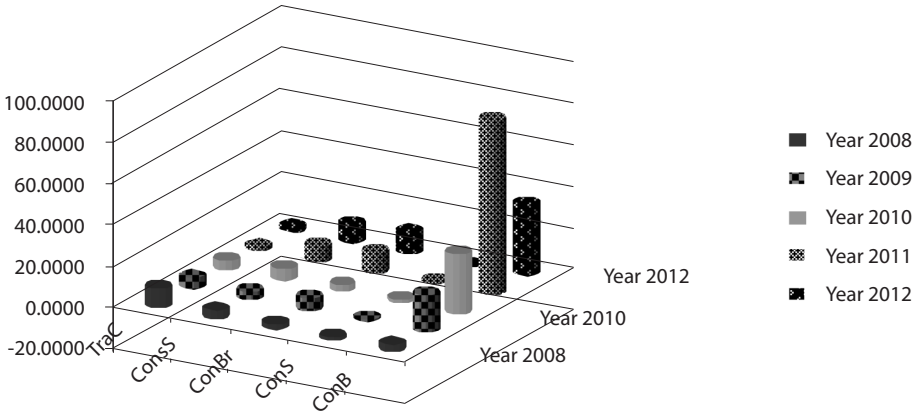

FIG. 1. **Annual ranking of the companies using the Altman model**

Source: compiled by the authors.

The hierarchy for 2008 shows that the *TraC* company was placed at the highest ranking level. In the period 2009–2010, the company was placed on the third place and on fourth place in 2011–2012. This situation presents an increased trend of bankruptcy risk. The company *ConsS* was placed on the second place in 2008, and then it was on the fourth place in 2009 and in last two years of analysis was placed on the third level, coming down from the second place occupied in 2010.

The company *ConBr* was set on the fourth place in 2008, ascended to the second place in 2009, and afterwards it returned to the place occupied at the beginning. The company advanced to the second place and remained on the same level during 2011–2012. Concerning the last two analyzed companies it can be observed that there is a relative constant situation. The company *ConS* occupied the fifth place each year, being the most predisposed company to become bankrupt. The firm *ConB* occupied the first place in all analyzed years, except 2008.

The ranking marks show a significant difference between the financial performances established at the beginning and the predisposition to bankruptcy risk reflected by the Altman model (Table 4). If the companies *TraC* and *ConsS* were considered initially at the lowest risk of bankruptcy, now the Altman model shows that the companies *ConB*, *ConsS*, and *ConBr* (the last 2 companies with the same ranking) have the lowest risk of bankruptcy. All these companies had the Z score values higher than 3; this means that the companies are solvent.

The values of the Z score for each company evolve differently, but companies' classification does not differ significantly from one year to another (see Table 5).

TABLE 4. **Ranking marks of the companies after Altman model**

Year/ Company	*TraC*	*ConsS*	*ConBr*	*ConS*	*ConB*
2008	1	2	4	5	3
2009	3	4	2	5	1
2010	3	2	4	5	1
2011	4	3	2	5	1
2012	4	3	2	5	1
Ranking	**3.0**	**2.8**	**2.8**	**5**	**1.4**

Source: compiled by the authors.

TABLE 5. **Centralization and interpretation of results – the Altman model**

***Z* score**	**2008**	**2009**	**2010**	**2011**	**2012**
Z_{TraC}	Solvent / good financial standing	Solvent / good financial standing	Solvent / good financial standing	Difficult financial situations	Difficult financial situations
Z_{ConsS}	Solvent / good financial standing	Solvent / good financial standing	Solvent / good financial standing	Solvent / good financial standing	Solvent / good financial standing
Z_{ConBr}	Solvent / good financial standing	Solvent / good financial standing	Solvent / good financial standing	Solvent / good financial standing	Solvent / good financial standing
Z_{ConS}	Bankruptcy is imminent	Bankruptcy is imminent	Bankruptcy is imminent	Bankruptcy is imminent	Bankruptcy is imminent
Z_{ConB}	Solvent / good financial standing	Solvent / good financial standing	Solvent / good financial standing	Solvent / good financial standing	Solvent / good financial standing

Source: compiled by the authors.

Centralized data show a favourable situation of the *ConsS*, *ConBr* and *ConB* companies in the analyzed period. In all the years these companies were solvent, i.e. had a good financial standing. The Z score values recorded by the *ConS* company were significantly lower during 2008–2012 as compared with those recorded by other companies. The situation occurred as a result of significant losses that didn't lead to positive earnings against taxes.

One can see that in this situation a company initially established as a company with financial difficulties is classified as a performant company exceeding the threshold of 3 (which is the case of the *ConB* and *ConBr* companies) and a company with a low initial risk of bankruptcy, whereas the Altman model classified it as with a high risk of bankruptcy (the case of the *TraC* company). Only the *ConsS* and the *ConS* companies preserved their classification: the *ConsS* with a low risk and the *ConS* with a high risk of bankruptcy.

In the next part of the paper, we also test the Conan & Holder model for the selected companies. The Z score is presented in Table 6.

TABLE 6. **Determining the Z score function as proposed by the Conan & Holder model**

Year/ Company	*TraC*	*ConsS*	*ConBr*	*ConS*	*ConB*
2008	0.2076	-0.0963	0.0526	0.0309	-2.5285
2009	0.1303	1.8799	0.0505	-0.1559	-2.8366
2010	0.1234	-0.3020	0.0109	0.0246	-1.7138
2011	0.1062	-0.3555	-0.2680	0.1285	-1.5594
2012	0.0770	-0.2587	-0.1355	-0.1669	-1.9094

Source: calculated by the authors using financial data of analysed companies (Appendix 2).

The calculated indicators, based on the profit and loss, show that the recorded negative values lead to lower values of the Z function ratios. The companies with financial difficulties have obtained a negative gross operating surplus and a negative value added, and the weight of personal costs in the value added was significant.

The Z score determined for the *TraC* company is decreasing year by year in the period 2008–2012 with 37.24%, 5.30%, 13.94% and 27.50%, indicating an increased bankruptcy risk. The evolution of the Z score in the *ConsS* company is fluctuating: in all analyzed years the values are negative except 2009 when the value is higher than the threshold of 0.16. The determined Z score for the *ConBr* company had a decreasing trend in the first three years of analysis with 3.99% in 2009 versus 2008 and 78.42% in 2010 versus 2009. In the last two years, the values are negative – lower than –0.05, indicating an unfavourable situation.

The same classification is valid for the *ConS* company. Its Z score registered during the analyzed years was not higher than 0.04, except 2011 when this value exceeded the limit of 0.10. The *ConB* company registered in each year negative values of the Z score. The values are below the lowest limit proposed by the model, i.e. –0.05. The annual ranking of the companies is shown in Fig. 2.

The ranking of the companies is based on the annual value of the Z function and is different for each company (Table 7). Thus, the *TraC* company is on the first place in all years, except 2009 and 2011 when it occupied the second place. The *ConBr* company was on the second place in 2008, it occupied the third place in 2009–2011, and afterwards in 2012 it returned to the second place occupied at the beginning.

At the beginning of the analyzed period, the *ConS* company occupied the third place in the ranking. Afterwards, it showed a gradual progress and reached the first place in 2011. This company was the third in the hierarchy in 2012, followed by the *ConsS* company. In all years except 2009, the latter company occupied the fourth place. Only in 2009 the enterprise was on the first place. The *ConB* company is placed at the end of the

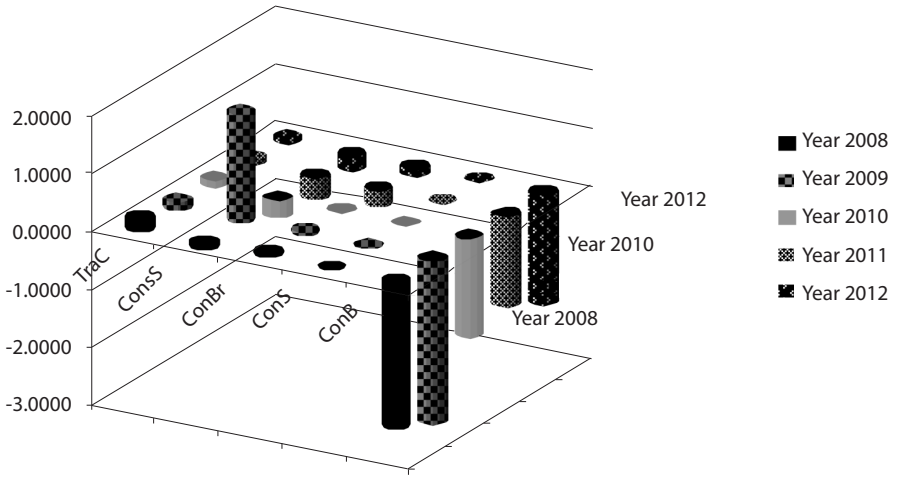

FIG. 2. **Annual ranking of the companies using the Conan & Holder model**
Source: compiled by the authors.

TABLE 7. **Ranking marks of the companies after the Conan & Holder model**

Year/ Company	*TraC*	*ConsS*	*ConBr*	*ConS*	*ConB*
2008	1	4	2	3	5
2009	2	1	3	4	5
2010	1	4	3	2	5
2011	2	4	3	1	5
2012	1	4	2	3	5
Ranking	**1.4**	**3.4**	**2.6**	**2.6**	**5**

Source: compiled by the authors.

ranking over the review period. One can see that this company is the closest to becoming bankrupt as compared with the other companies.

The ranking identifies a difficult situation for the *ConB*, *ConS* and *ConsS* companies. The model shows that the *TraC* company is prospering from the beginning of the study period. An opposition between this classification and the ranking determined by the Altman model can be observed. The *ConB* company was the first enterprise in the ranking proposed by Altman model but it was placed at the end of the classification determined by the Conan & Holder model. However, for the *ConBr* and *ConS* companies the framing coincides in both models, placing them second according to the average points of ranking (Tables 4 and 7). The global analysis shows a lack of added value from the operating activity, which determines the classification shown in Table 8.

The analysis of the obtained scores shows that the Z score function for the majority of the companies was lower than the threshold of 0.04, emphasising an unfavourable financial situation and a significant bankruptcy risk. The lowest risk of bankruptcy was

TABLE 8. **Centralization and interpretation of results according to the Conan & Holder model**

Score function	2008	2009	2010	2011	2012
Z_{TraC}	Very good, probability of bankruptcy risk is lower than 10%	Good, probability of bankruptcy risk is between 10% and 30%	Good, probability of bankruptcy risk is between 10% and 30%	Good, probability of bankruptcy risk is between 10% and 30%	Alert, probability of bankruptcy risk is between 30% and 65%
Z_{ConsS}	Failed, probability of bankruptcy risk is higher than 90%	Very good, probability of bankruptcy risk is lower than 10%	Risk, probability of bankruptcy risk is between 65% and 90%	Risk, probability of bankruptcy risk is between 65% and 90%	Risk, probability of bankruptcy risk is between 65% and 90%
Z_{ConBr}	Alert, probability of bankruptcy risk is between 30% and 65%	Alert, probability of bankruptcy risk is between 30% and 65%	Risk, probability of bankruptcy risk is between 65% and 90%	Failed, probability of bankruptcy risk is higher than 90%	Failed, probability of bankruptcy risk is higher than 90%
Z_{ConS}	Risk, probability of bankruptcy risk is between 65% and 90%	Failed, probability of bankruptcy risk is higher than 90%	Risk, probability of bankruptcy risk is between 65% and 90%	Good, probability of bankruptcy risk is between 10% and 30%	Failed, probability of bankruptcy risk is higher than 90%
Z_{ConB}	Failed, probability of bankruptcy risk is higher than 90%	Failed, probability of bankruptcy risk is higher than 90%	Failed, probability of bankruptcy risk is higher than 90%	Failed, probability of bankruptcy risk is higher than 90%	Failed, probability of bankruptcy risk is higher than 90%

Source: compiled by the authors.

registered for the *TraC* company which had an alert situation in 2012 as compared with some financial difficulties described by the Altman model. We must note that both models reflect a decreasing performance of this company.

A significant risk (higher than 90%) was recorded by the *ConB* company in all studied years, contrary to the Altman model which considers this company solvent. The variations of framing can be observed for the *ConsS* company, the minimum risk of its bankruptcy being 10% in 2009. The Altman model considers the *ConS* company as having a high risk of bankruptcy, while the Conan & Holder model shows it as having a risk of bankruptcy between 65% and 90% or higher than 90% during 2008–2012, except the year 2011 when the risk of its bankruptcy was between 10% and 30%.

Excepting the *TraC* company, these two models assign different companies after the risk of bankruptcy, considering that models were created using companies that apply different accounting systems – Anglo-Saxon or French. Our ranking, based on financial ratio analysis proposed at the beginning of the study, is more close to the framing offered by the Conan & Holder model, which shows that the ways of reporting financial statements are influenced by the performance of companies.

Conclusions

This study was carried out to evaluate and predict the risk of bankruptcy of the companies acting in the building sector, using the common approach of the Conan & Holder and Altman models. A reliable classification of all the five companies with a high or low risk of bankruptcy was made by a comparative analysis. The increase of the prediction power of the models was realized by inclusion of some non-financial variables which ensured a better prediction accuracy as shown by Keasey & Watson (1991) or Sohn & Kim (2007).

The relevance of this study depends on the actual global economic environment. The economic environment may increase the risk of failure of construction companies if they cannot perform because of a lower demand from the population most heavily affected by the economic and financial crisis. The volume of construction works decreased in the period 2008–2012 and determined a higher probability of bankruptcy, as results from the calculations proposed by Conan and Holder, but not from the ones of the Altman model.

Consequently, comparing the parameter values of the Z score, we can observe significant differences between these two models. The sample of companies (performant and non-performant) set in this study are relevant for the Conan & Holder model in which the bankruptcy risk is minimum for the solvent company *TraC*, medium for the *ConsS* company, and high for those with financial difficulties. In opposition to this classification is the ranking proposed by Altman, which considers the *ConB* company as the best performant company, but also the *ConsS* and *ConBr* companies are solvent.

Taking into account the ranking of companies according to the obtained results, we conclude that the Conan & Holder model is more relevant to determine the risk of bankruptcy. It retains the initial classification of the companies and identifies a higher predisposition to bankruptcy for the analyzed companies in 2008–2012. So, in our study, this model was more relevant than the Altman model, their importance being highlighted by an accurate reporting of evolution in the construction industry.

Since 2008, companies have been affected by the "freezing" of construction projects, the lack of demand for works, and restrictions in getting the financing. All these reasons have led to an increased risk of bankruptcy which the Altman model does not identify because companies were considered largely solvent.

The ratios of the Conan & Holder model have correctly placed the companies while the Altman model made a reverse classification and a permissive analysis. Thus, the predisposition to risk is much lower, which may increase the vulnerability of companies. They may adopt inadequate financial decisions and may be indebted considering that they can cover the liabilities. This means that a more restrictive model such as that of the Conan & Holder provides a greater safety margin against the risk of bankruptcy and gives the external analysts, especially banks, the possibility to establish properly the creditworthiness of their customers.

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APPENDIX 1. **Calculation of the Z score for studied companies using the Altman model**

Indicator		Firm	2008	2009	2010	2011	2012
X_1	Earnings before interest and taxes / Total assets	TraC	0.0416	0.0044	0.0044	0.0151	0.0155
		ConsS	0.0219	0.0143	0.0025	0.0167	0.0257
		ConBr	0.0820	0.0498	0.0313	0.0066	0.0121
		ConS	0.0220	0.0275	0.0205	-0.2229	-0.4108
		ConB	0.0542	0.0688	0.0472	0.0392	0.0410
X_2	Sales / Total assets	TraC	3.5790	0.1931	0.2414	0.2512	0.2103
		ConsS	2.3722	1.3558	1.0616	1.5536	1.4605
		ConBr	1.4020	1.0623	0.7293	0.6097	0.6873
		ConS	0.7199	0.3868	0.4407	0.3654	0.1756
		ConB	1.9784	2.1889	2.0130	1.6318	1.4735
X_3	Market value of equity / Total liabilities	TraC	4.3748	5.0643	5.2435	1.7359	2.0140
		ConsS	2.2377	3.2137	7.4007	8.7630	10.9308
		ConBr	1.2912	6.8297	2.8412	14.5509	15.7643
		ConS	0.7790	0.9170	1.4614	1.4341	-0.2400
		ConB	0.6478	24.5793	42.4502	135.3986	52.6776
X_4	Retained earnings / Total assets	TraC	0.0000	0.0000	0.0000	0.0000	0.0000
		ConsS	0.0000	0.0000	0.0000	0.0000	0.0000
		ConBr	0.0000	0.0000	0.0000	0.0000	0.0000
		ConS	0.0000	0.0000	0.0000	0.0000	0.0000
		ConB	0.0000	0.0000	0.0000	0.0000	0.0000

Indicator		Firm	2008	2009	2010	2011	2012
X_5	$\frac{\text{Current assets}}{\text{Total assets}}$	TraC	2.5166	1.8886	0.8858	0.7999	0.7647
		ConsS	0.4318	0.4457	0.5462	0.6464	0.7191
		ConBr	0.4749	0.5476	0.5842	0.4940	0.5172
		ConS	0.3571	0.3622	0.3415	0.3229	0.4062
		ConB	0.8547	0.8676	0.9275	0.9455	0.9520
$Z = 3.3 \times X_1 + 1 \times X_2 + 0.6 \times X_3 + + 1.4 \times X_4 + 1.2 \times X_5$		TraC	**9.3610**	**5.5125**	**4.4648**	**2.3024**	**2.3874**
		ConsS	**4.3053**	**3.8663**	**6.1659**	**7.6423**	**8.9668**
		ConBr	**3.0171**	**5.9816**	**3.2385**	**9.9547**	**10.8063**
		ConS	**1.6883**	**1.4624**	**1.7950**	**0.8778**	**-0.8367**
		ConB	**3.5716**	**18.2045**	**28.7520**	**84.1348**	**34.3579**

Source: calculated by the authors.

APPENDIX 2. **Calculation of the Z score for studied companies using the Conan & Holder model**

Indicator		Firm	2008	2009	2010	2011	2012
Y_1	$\frac{\text{Gross operating surplus}}{\text{Total debs}}$	TraC	0.4812	0.2137	0.2484	0.0953	0.1296
		ConsS	–1.2199	–0.5760	–0.3659	–0.3854	–0.3595
		ConBr	0.00010	0.00008	0.00007	0.00008	0.00009
		ConS	0.1188	–0.0376	0.1235	–0.1098	–0.1276
		ConB	–10.9245	–12.2713	–7.5933	–7.0307	–8.4189
Y_2	$\frac{\text{Equity}}{\text{Total liabilities}}$	TraC	0.7864	0.8226	0.6496	0.6281	0.6619
		ConsS	0.3305	0.4259	0.4206	0.3949	0.3564
		ConBr	0.3222	0.3090	0.3188	0.5114	0.5752
		ConS	0.3182	0.3136	0.4217	0.2621	-0.1502
		ConB	0.4784	0.5327	0.4225	0.4767	0.5896
Y_3	$\frac{\text{Curent assets – Inventories}}{\text{Total liabilities}}$	TraC	0.1114	0.0855	0.0400	0.0561	0.0394
		ConsS	0.3866	0.2762	0.2885	0.4500	0.3480
		ConBr	0.4565	0.4687	0.3292	0.2585	0.2780
		ConS	0.2748	0.2940	0.2306	0.2895	0.2292
		ConB	0.5964	0.6335	0.7277	0.7340	0.6264
Y_4	$\frac{\text{Financial expenses}}{\text{Sales}}$	TraC	0.0528	0.0669	0.0292	0.0105	0.0699
		ConsS	0.0212	0.0350	0.0399	0.0073	0.0039
		ConBr	0.0482	0.0420	0.0565	0.0073	0.0039
		ConS	0.0659	0.1098	0.1154	0.2249	0.1452
		ConB	0.0017	0.0032	0.0041	0.0114	0.0253
Y_5	$\frac{\text{Personal costs}}{\text{Value added}}$	TraC	0.5275	0.5727	0.6016	0.5471	0.4524
		ConsS	–0.8041	–19.1071	3.1818	4.1549	3.0307
		ConBr	0.4940	0.5597	0.6276	4.1549	3.0307
		ConS	0.5420	1.6738	0.3433	–2.4652	0.1353
		ConB	1.0585	1.0730	0.9722	0.8437	0.9683
$Z = 0.24 \times Y_1 + 0.22 \times Y_2 + 0.16 \times Y_3 - - 0.87 \times Y_4 - 0,1 \times Y_5$		TraC	**0.2076**	**0.1305**	**0.1234**	**0.1062**	**0.0770**
		ConsS	**–0.0963**	**1.8799**	**–0.3020**	**–0.3555**	**–0.2587**
		ConBr	**0.0526**	**0.0505**	**0.0109**	**–0.2680**	**–0.1355**
		ConS	**0.0309**	**–0.1559**	**0.0246**	**0.1285**	**–0.1669**
		ConB	**–2.5285**	**–2.8366**	**–1.7138**	**–1.5594**	**–1.9094**

Source: calculated by the authors.