

CONSISTENCY OF THREE SELECTED BANKRUPTCY PREDICTION MODELS

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Abstract

Purpose: This paper aims to analyze the bankruptcy models developed by several authors, elaborating the consistency of the models in predicting the performance of the representative transportation companies. By analyzing the stated issue, suggestions are the focus of what should be noticeable if one is to conduct a similar research on bankruptcy prediction, improving the quality of the research.

Methodology: The paper chose to use three models with nearly similar set of indicators to create a basic analysis of them on how they predict the bankruptcy rate in transportation sector. Using samples of 30 transportation companies as database for the models, the paper summarized 11 indicators used among the three models and construct the database then proceed to apply the collected data into the models. Then the paper conducted simple comparison and analysis with the aggregate score compiled into tables. The secondary data collected from the firms has proven to be valuable for future research.

Findings: Altman Z-score utilizes more indicators and the prediction scores tends to follow a very broad sense, whereas the the Springate model and Zemijewski model presented a form of collective score largely based on the firms' selective financial results. Other authors or readers should pay attention to each model in their predicting capability in order to avoid confusion when considering a research in the similar field. As the statistical method is the single conduct with simple key indicators, more complex or hybrid methods should be in consideration for future research in order to better utilize the source of data available for research.

Originality/value: the paper was in conduct with the most recent data sample utilizing the range of data used for the comparison with the latest 5-year period. The paper in a sense illustrates the most basic concept on the development of bankruptcy prediction.

Keywords: bankruptcy prediction models, transportation companies, Altman Z-score model, Springate model, Zemijewski model, sample, review

Introduction

The World Economic Crisis in 2008 has affected several key industrial sectors in developing the business, heavily affected the transportation at a substantial level, halting the speed of production in major fields. Specifically, the stated Economic Crisis began with the financial sector, following by international trade, production, directly influencing the structure of transportation industry clearly seen in countries with high foreign trade volume (Rothengatter, 2011). Ending in the 2010s, the recovery of the world's economy is showing some expectations despite several obvious obstacles remaining; in transport sector, more specifically in maritime industry, trade and transport volume has not been stable and has several low-points worth noting, such as volumes of transportation passengers and gross weight of goods handled in port staying near the minimum level (Collet, 2013). Therefore, the need for financial failure prediction is becoming more obvious as the results of business bankruptcy likely lead to heavy losses, with its effects directing at the national economy and the employment level (Sulub, 2014)

Regarding the definition of bankruptcy, several trustful sources mentioned different ways to define the phenomenon over the last few decades. Sun et al. (2014) summarized from their findings on classical materials that bankruptcy happens when a firm is overwhelmed with debts or existing dividends, leading to deposit overdraft, serious liquidity for creditors' interests and therefore filing bankruptcy proceedings. In a related research, Camichael (1972) concluded that bankruptcy was the result of a firm' inability in maintaining the balance between its liquidity, equity, debt and capital.

Forecasted by economists and accountants for several years, bankruptcy is considered to be one of the extremely important factors that decide the future of the world's economy. Bankruptcy forecasting therefore has become a trend for several research topics since 1968, with the effective use of predicting models. The first bankruptcy prediction model ever publicized created by Professor Edward Altman was considered to be a monument for the prosperity of the research branch. After Altman's pioneering establishment, several other attempts appeared over the decades, using the methods that are very similar to that of Altman's. The few notable prediction models among those brave attempts were of Grigaravičius (2003) followed by Stoškus et al. (2007), whose research conducted in Lithuania, with a subsequent work concluded that the above-mentioned bankruptcy prediction models were equal in term of accuracy comparing to the international models, such as the Altman Z-score model (Šlefendorfas, 2016). Even more recent ones in measuring with the Altman z-score model were the Bex Index⁴ and Baltic Dry Index⁵, which can evaluate the performance excellence of an industry or a company (Jurun et al., 2015). Each of these models has been tested and applied in various contemporary situations, including the performance of shipping and transportation companies. Each of those models also requires a different set of indicators, with the similarity happened in one or a few indicators of the sets. The models, therefore, have their own advantages and drawbacks, which this paper will not provide the details of them due to its main focus. The information elaborating above is for the purpose of introducing the history of the bankruptcy predicting models that has become very important in analyzing companies' performance, however rare they might be comparing to other research topics within the finance major.

The purpose of the paper, as previously stated in abstract, will be a focus of a few notable bankruptcy prediction models, namely the Altman Z-score, and the Springate and Zmijewski models, and their effectiveness when applying to the current situation of the shipping market. By evaluating them with their financial indicators, the paper seeks to provide a comprehensive comparison of accuracy in bankruptcy prediction techniques. Furthermore, this paper will provide the updated financial data with high accuracy and the detailed values of major international stock-listed shipping companies reported primarily in Data Stream, namely NYSE and NASDAQ, for future research's reference.

The organization of this paper's structure is as follow. After the introduction, the second part will present a background of history of bankruptcy prediction models and their structures, as well as basic methodology that previous authors used to apply them under their research purposes. Third section will delve into the case study incorporating the modes into a selective database of companies in the industry of general transportation. This analysis process will be nonetheless comprehensive using the database of chosen companies within the time range 2011-2016. The final section will be a dedication for conclusion and possible future research avenues for all stakeholders.

A review of research on bankruptcy prediction models

Researchers constructed the prediction models by applying statistical methods. Based on their close similarity in the choice of indicators, the paper selected three following models for comparison:

Altman Z-score

In 1968, E. Altman, by analyzing multiple audits among 22 ratios, selected 5 financial ratios he considered as the best predictor of bankruptcy. During the following decades, he made multiples attempts to revise and improve the accuracy of his own model. The newest Z-score model's structure is as follow:

¹ The Business Excellence Model, otherwise known as the Bex index, represents models based on balance indicators developed for the capital market including (1) Earnings before Interest and Taxes/Total Assets, (2) Net Profit /Equity Capital x capital price. (3) Net Working Capital /Total Assets, (4) 5 x (Net Profit +Depreciation + Amortization) /Total Debt. The model enables a fast and simple evaluation of a company's solvency.

⁵ The Baltic Dry Index refers to the economic indicator issued daily and London-based Baltic Exchange, which contains route assessments based only on time-charter hire rates "USD hire paid per day", formulated by $((\text{CapesizeTCavg} + \text{PanamaxTCavg} + \text{SupramaxTCavg} + \text{HandysizeTCavg}) / 4) * 0.110345333$ TCavg = Time charter average. The index measures the demand for shipping capacity versus the supply of dry bulk carriers.

$Z = 1.2x_1 + 1.4x_2 + 3.3x_3 + 0.6x_4 + 1.1x_5$
 $X_1 = \text{Working capital/ total assets}$
 $X_2 = \text{Retained earnings/total assets}$
 $X_3 = \text{Earnings before interest and taxes / total assets}$
 $X_4 = \text{market value of equity / value of debt}$
 $X_5 = \text{Sales / Total Assets}$

This model considered the value $Z < 1.8$ for bankrupt company,
 $1.8 < Z < 2.675$ for likely-bankrupt company
 $Z > 2.675$ for "safe" or non-bankrupt company

Springate Model

In 1978, Gordon Springate developed his bankruptcy predicting model by selecting out four common ratios to test the likelihood that a firm's health is in distress. The model utilized discriminant analysis to conduct scores for each company in sample. Majority of data is collected from the balance sheet, the income statement and cash flow statement.

$Z = 1.03A + 3.07B + 0.66C + 0.4D$
 $A = \text{Working capital / total assets}$
 $B = \text{Net profit before interest and taxes / total assets}$
 $C = \text{Net profit before tax / current liabilities}$
 $D = \text{Sales / Total Assets}$

In this model: if $z < 0.862$, the possibility of bankruptcy is dangerously high and the company's health is considered to be in distressed signal. Springate's test with a sample of 40 companies on this model resulted in an accuracy of 92.5%.

Zemijewski model

The Zemijewski model, invented by Zemijewski in 1984, used analysis based on probability to predict a firm's bankruptcy within two years.

$Z = -4.336 - 4.513X_1 + 5.679X_2 - 0.004X_3$
 $X_1 = \text{Net income/ total assets}$
 $X_2 = \text{Total liabilities / total assets}$
 $X_3 = \text{Current assets / current liabilities}$

In this model, when $Z < 0.5$, the company's bankrupt probability is highly alerted.

Results of research

As the research's aim is to evaluate the consistency of the three chosen models in predicting the rate of bankruptcy, the structure of the results followed will have a design that helps reflect the comparison clearly. Evaluation for samples is a conduct with analysis and comparison in order to check for inconsistency within the same type of value.

First, we conduct the set of indicators for using in the models. The process began with selecting a sample of 30 firms' data in transportation industry, with a total of 11 indicators. After selection is a review of data and filtering to choose the most completed set of indicators for presenting and subsequent application into models, as shown in the table 1.

With the available data input, the next step was to promptly apply them into each model for outputting results. The process required selecting the appropriate data and applying them into the respective model. The methods used were simple classification and analysis to determine values. After compiling the results into one single table, the comparison is as in the table 2.

	WC	TA	RE	Core EBIT	MC	TL	Sales	EBT	NI	CA	CL
SFL											

2011	1861 5000	28961 28000	2546 8300 0	1627 0500 0	13180 77701	20390 37000	29511 4000	1311 7500 0	1311 7500 0	19276 3000	17414 8000
2012	4511 4000	29730 89000	2885 1000 0	2076 2000 0	12394 74901	19783 21000	31969 2000	1858 3600 0	1858 3600 0	24263 2000	19751 8000
2013	- 1402 3600 0	30459 83000	2686 0200 0	1173 6600 0	15294 37887	18540 50000	27086 0000	8920 6000	8920 6000	29220 4000	43244 0000
2014	1264 7000 0	30415 54000	2392 7500 0	1451 4600 0	16309 97297	18880 62000	32748 7000	1228 1500 0	1228 1500 0	34022 5000	21375 5000
2015	1369 5200 0	30648 25000	2775 1300 0	1660 4600 0	14953 80512	18230 15000	40674 0000	2008 3200 0	2008 3200 0	37591 7000	23896 5000
2016	3945 7000	29373 77000	2556 3000 0	1680 8900 0	14558 86209	18032 82000	41295 1000	1464 0600 0	1464 0600 0	27842 7000	23897 0000
TK											
2011	8182 6000	11131 39600 0	7926 8200 0	9811 2000	20646 26735	77995 95000	19537 82000	- 3824 3100 0	- 3867 2100 0	12127 56000	11309 30000
2012	3252 4000	11002 02500 0	6482 2400 0	- 1503 9300 0	21178 36285	77817 36000	19562 35000	- 3255 2200 0	- 3111 1600 0	15554 25000	15229 01000
2013	- 2709 2400 0	11555 70100 0	4352 1700 0	6274 6000	27565 71525	83360 87000	18300 85000	3835 2000	3548 0000	16745 90000	19455 14000
2014	- 3072 4000	11864 21200 0	3558 6700 0	4271 5900 0	40838 03927	84627 37000	19939 20000	1341 7500 0	1240 0200 0	13352 52000	13659 76000

2015	- 5671 4400 0	13061 24800 0	1588 9800 0	6251 3200 0	27897 09900	91045 03000	24503 82000	3886 9300 0	4054 6000 0	13196 44000	18867 88000
2016	- 3650 2600 0	12814 75200 0	2289 3000	3842 9000 0	68051 3039.6	84763 57000	23285 69000	1111 3200 0	8666 4000	12814 34000	16464 60000

Table 1. Summary of data collection

Year	Companies Models	SFL	TK	CMRE	DAC	DHT	DCIX
2011	Altman Z-score	0.816	0.490	0.741	0.374	4.881	1166.250
	Springate score	0.262	0.072	0.331	0.172	-0.182	1.013
	Zemijewski score	-4.545	-4.184	-4.538	-4.353	-3.982	-4.470
2012	Altman Z-score	0.879	0.400	0.759	0.237	-0.772	70.106
	Springate score	0.335	0.005	0.325	0.084	-0.685	0.283
	Zemijewski score	-4.623	-4.212	-4.499	-4.224	-3.296	-4.440
2013	Altman Z-score	0.788	0.415	0.669	0.350	0.441	36.849
	Springate score	0.138	0.059	0.228	0.209	0.392	-0.630
	Zemijewski score	-4.471	-4.353	-4.511	-4.379	-4.395	-3.543
2014	Altman Z-score	0.954	0.632	0.894	0.356	0.663	47.405
	Springate score	0.275	0.186	0.304	0.150	0.225	0.307
	Zemijewski score	-4.525	-4.387	-4.529	-4.333	-4.391	-4.409
2015	Altman Z-score	0.997	0.513	0.885	0.470	1.220	23.692
	Springate score	0.338	0.205	0.335	0.208	0.616	-0.051
	Zemijewski score	-4.638	-4.479	-4.584	-4.480	-4.686	-4.160
2016	Altman Z-score	0.966	0.315	0.701	-1.001	0.650	0.310
	Springate score	0.299	0.144	0.281	-1.037	0.275	-2.560
	Zemijewski score	-4.566	-4.370	-4.483	-3.808	-4.375	-1.814

Table 2. Summary of the results

Note: Green shaded cells implied that the company is highly likely to become bankruptcy forecasted by the prediction models, while the blue shaded cells implied that the company is not likely to become bankruptcy in the near future.

Based on the results, we can see that all three models' consistency is significant when comparing them in scores prediction. As the selected constant numbers and indicators set in each model varies, results also differ by each model. In order to know if a firm's health is in distress or not, as stated previously, their scores will be lower than 1.8 (Altman Z-score), lower than 0.862 (Springate model) or lower than 0.5 (Zemijewski model). There are overall consistency in all three models; however, as Springate used earnings before taxes (EBT) as an indicator, whereas a number of firms do not have tax responsibilities (due to the laws of the countries or regions they operate in), a slight inconsistency occurred at which the score went down below zero, in contrast to Altman Z-score that has the value much higher than zero at that point. Another reason for this is due to Altman score requires more complete data, which also include the market capitalization (a volatile indicator that depends on a firm's daily stock price) and this is likely to

fluctuate strongly for the results, whereas the other two models favor internal data of a firm, thus resulting in a different perspective of a firm's financial health which clearly shown in predicting the odds of bankruptcy for Diana Containerships Inc. between 2011~2015. Note that the data with a negligible inconsistency is normal as the predictors' accuracy varies for each firm with different operating methods. Generally speaking, three selected models have an established status in bankruptcy prediction.

Conclusions

This paper aimed to assess the consistency of similar bankruptcy prediction models, specifically in three popular models called Altman Z-score, Springate and Zemijewski with a sample of six among thirty shipping firms reported in the Data Stream database around the world. Results indicate that more indicators will produce more conclusive results, notably the Altman Z-score; however, selecting indicators with internal perspectives and using more complex constant yield more consistent results, which Springate and Zemijewski models illustrated.

The paper recognizes its limitation on the availability of the data and literature sources that the researchers can access. Due to the limitation of database, the paper was not able to apply the predicting models on already bankrupted large shipping firms such as Hanjin Shipping Corp (Korea), Daiichi Chuo Kisen (Japan), Copenship (Danish), or China's Winland Ocean Shipping Corp. This might have the chance resulting to biased results at some minor points. The use of only three most popular bankruptcy prediction models as without reviewing the other bankruptcy prediction models with more complex structures that might be helpful in increasing prediction accuracy.

The paper suggests that future research could include the following areas. First, expanding the size of the useful database can allow researchers to employ a wider, more complex method to compare the predicting models, reinforcing the transparency of the results. Depending on the amount of data available, researchers can use cross-sectional and panel data to construct and specify the new bankruptcy prediction models. Future research avenues can include the improving the accuracy of bankruptcy prediction by incorporating statistic and intelligent methods, improving the quality of predicting the bankruptcy scores, improving both the accuracy and efficiency of forecasting financial distress companies in the other service industry around the world.

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