“Financial distress prediction of listed companies – empirical evidence on the Vietnamese stock market”

AUTHORS	Tran Quoc Thinh https://orcid.org/0000-0003-1504-8122 Dang Anh Tuan https://orcid.org/0000-0001-8754-2811 Nguyen Thanh Huy Tran Ngoc Anh Thu

ARTICLE INFO	Tran Quoc Thinh, Dang Anh Tuan, Nguyen Thanh Huy and Tran Ngoc Anh Thu (2020). Financial distress prediction of listed companies – empirical evidence on the Vietnamese stock market. *Investment Management and Financial Innovations*, *17*(2), 377-388. doi:10.21511/imfi.17(2).2020.29
DOI	http://dx.doi.org/10.21511/imfi.17(2).2020.29
RELEASED ON	Monday, 06 July 2020
RECEIVED ON	Sunday, 31 May 2020
ACCEPTED ON	Monday, 29 June 2020

JOURNAL	"Investment Management and Financial Innovations"
ISSN PRINT	1810-4967
ISSN ONLINE	1812-9358
PUBLISHER	LLC “Consulting Publishing Company “Business Perspectives”
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
17	1	6

BUSINESS PERSPECTIVES

LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine

www.businessperspectives.org

Tran Quoc Thinh (Vietnam), **Dang Anh Tuan** (Vietnam),
Nguyen Thanh Huy (Vietnam), **Tran Ngoc Anh Thu** (Vietnam)

FINANCIAL DISTRESS PREDICTION OF LISTED COMPANIES – EMPIRICAL EVIDENCE ON THE VIETNAMESE STOCK MARKET

Abstract

Financial distress is a matter of concern in the recent period as Vietnam gradually enters global markets. This paper aims to examine the factors of Altman Z-score to detect the financial distress of Vietnamese listed companies. The authors use a sample of 30 delisted companies due to financial problems and 30 listed companies on the Vietnamese stock market from 2015 to 2018. They employ Independence Samples T-test to test the research model. It is found that there are significant differences in the factors of Altman Z-score between the group of listed companies and the group of delisted companies. Further analyses using subsamples of delisted companies show that the factors of Altman Z-score are also statistically different between companies with a low level of financial distress and those with a high level of financial distress. Based on the results, there are some suggestions to assist practitioners and the State Securities Commission in detecting, preventing, and strictly controlling financially distressed businesses. These results also enable users of financial statements to make more rational economic decisions accordingly.

Keywords bankruptcy risk, corporate failure, financial distress, financial forecasting, prediction model, Z-score

JEL Classification G33, C53

Received on: 31st of May, 2020
Accepted on: 29th of June, 2020
Published on: 6th of July, 2020

Tran Quoc Thinh, Ph.D., Associate Professor, Faculty of Accounting and Auditing, Department of Economic, Banking University of Ho Chi Minh City, Vietnam.

Dang Anh Tuan, Ph.D., Faculty of Economics, Ho Chi Minh City Open University, Vietnam.

Nguyen Thanh Huy, Bachelor of Accountancy, Ernst & Young Vietnam Limited, Vietnam.

Tran Ngoc Anh Thu, Bachelor of Accountancy, PwC (Vietnam) Limited, Vietnam. (Corresponding author)

Conflict of interest statement:
Author(s) reported no conflict of interest

INTRODUCTION

Along with the modern trend in international economic integration, studies on corporate financial distress are of great importance for assisting the economies, governments, and investors in detecting financially distressed companies. In the context of developing capital markets, the prediction of listed companies' financial health plays a very important role because of high financial risks in these markets. In this paper, the authors examine the financial distress of listed companies in Vietnam, a developing country.

While there have been many previous studies on prediction of financial distress, the most popular study is the Altman Z-score models with three variants, including Z-score (Altman, 1968) for manufacturing companies, Z-score (Altman, 2000) for private companies, and Z-score (Altman, 2000) for non-manufacturing companies and emerging economies. Various studies have applied the Altman Z-score model (e.g., Malik, Awais, Timsal, & Hayat, 2016; Babatunde, Akeju, & Malomo, 2017; AlAli, 2018; Saini, 2018).

In addition to Altman's models, several researchers have developed models themselves to predict financial distress of listed companies. According to Aziz and Dar (2006), there are sixteen techniques for developing a new bankruptcy prediction model based on Altman (1968) and Ohlson (1980). However, Ijaz, Hunjra, and Azam (2017) conclude

that multiple discriminant analysis (MDA) and binary regression (logistic analysis) are the two most reliable and efficient methods. For example, Shaher, Salem, and Khasawneh (2012) use a multiple discriminative analysis to develop a prediction model with 22 financial ratios. Meanwhile, Ahmed and Govind (2018) improve the corporate bankruptcy model's predictive power by adding another variable to the regression model based on five Z-score variables. In another approach, Januri, Sari, and Diyanti (2017) compared Altman Z-score models with Springate and Zmijewski methods to find the most effective model for detecting companies under financial distress. Also, Hu and Ansell (2006) considered among five credit scoring techniques, including Naïve Bayes, Logistic Regression, Recursive Partitioning, Artificial Neural Network, and Sequential Minimal Optimization (SMO) to find out the best performance models.

Given that there are different models to predict financial distress, in this paper, the authors employ the Altman Z-score for emerging economies, which is one of the most popular models to examine the financial distress of Vietnamese listed companies. Using a sample of 30 delisted companies due to financial problems and 30 listed companies on the Vietnamese stock markets from 2015 to 2018, the authors show significant differences in the factors of Altman Z-score between the group of listed companies and the group of delisted companies. Further analyses using subsamples of delisted companies show that the factors of Altman Z-score are also statistically different between companies with a low level of financial distress and those with a high level of financial distress.

Based on the findings, there are some recommendations for practitioners. First, it is proposed that the authorities should establish a standardized scale based on the Z-score model to detect financially distressed companies. For example, the stock market authorities shall impose delisting for companies that have negative values of working capital, retained earnings, pre-tax, and interest income for three consecutive years. Second, it is suggested that users of financial statements, e.g., investors, not only rely solely on the information in the capital market or the trend of the market but also pay attention to companies with the Z-score value smaller than 4.35 for consecutive years.

1. LITERATURE REVIEW

1.1. Concept of financial distress

Financial distress usually takes place in developing countries where the business environment is not well controlled. The existence of this condition poses detrimental consequences on the social and economic of such nations. According to Beaver (1966) and Altman (1983), financial distress is a state when the afore-planned monetary commitment of an enterprise cannot be met. In most studies, bankruptcy is the most common term used to define financial distress. However, as mentioned by Muller, Steyn-Bruwer, and Hamman (2012), financial distress is regarded as "a major structural change to the company such as mergers, absorptions, delisting or liquidations." Generally speaking, financial distress can be defined as a condition when a company cannot continue to exist in its normal business form.

1.2. Altman Z-score models

Altman's model was based on Beaver's prior study (1966), which was the first time the T-test method was applied to predict companies' bankruptcy. Beaver (1966) employed this method to assess each accounting indicator's importance based on univariate analysis. Then, Altman's improvements over the previous studies are applying statistical analysis, numerical analysis, and the implementation of a combination of different items simultaneously.

Altman employed an analysis technique based on data collected from 66 companies in the US, divided into two groups consisting of 33 each. Group 1 includes companies that went bankrupt during 1946–1965. Group 2 includes non-bankrupt companies that were still operating normally until 1966. From the statement of financial position and statement of profit or loss, 22 financial indicators were calculated and divided into five

http://dx.doi.org/10.21511/imfi.17(2).2020.29

groups: liquidity, profit, leverage, solvency, and performance index. In the list of 22 financial indicators calculated, five indicators were selected for the predictive model of bankruptcy based on four criteria:

1) observe the statistical significance of multiple equations turn;
2) evaluating the correlation between related variables;
3) observe the model's ability to predict accurately; and
4) analyst's prediction.

Accordingly, three Altman models are specified as follows:

- the original Z-score model (Altman, 1968);
- Z-score estimated for private companies (Altman, 2000);
- Z-score estimated for non-manufacturers and emerging markets (Altman, 2000).

For emerging economies, Altman added constants +3.25 to the Z-score model for standardization. Accordingly, this paper proposes using this standardization factor for the sample of listed companies in Vietnam. The formula of the Z-score model is as follows:

$$Z\text{-score} = 6.56 \cdot X_1 + 3.26 \cdot X_2 + \\ +6.72 \cdot X_3 + 1.05 \cdot X_4 (+3.25), \quad (1)$$

where X_1 – Working capital per total assets (WCTA), X_2 – Retained earnings per total assets (RETA), X_3 – Earnings before taxes and interests per total assets (EBITTA), X_4 – Market capitalization per total liabilities (MVETL), X_5 – Revenue per total assets (REVTA).

Based on the statistics of the Z-score, Altman classified companies into three groups as follows:

- If Z > 5.85: in safe zone, a company is healthy;
- If 4.35 < Z < 5.85: in gray zone, a company is at risk of bankruptcy;
- If Z < 4.35: in distress zone, a company is in a dangerous position with high risk of bankruptcy.

Altman (1968) concluded that the analysis of every single financial indicator is not an important analytical technique in the academic environment anymore because the implementation is quite simple. To assess financial indicators rigorously, a set of financial indicators is incorporated into the analysis to predict the bankruptcy potential. Theoretically, if researchers analyze these financial indicators in a multivariate framework, they will have a greater statistical significance than a sequential comparison of each financial indicator.

From 1985, Altman's models have been widely accepted by auditors, management accounting, courts, and data systems used for credit evaluation. The models have been used extensively in many countries, although they were originally designed for manufacturing companies with assets of more than USD 1 million before changes were made to suit both private and non-manufacturing companies.

1.3. Previous studies

Malik, Awais, Timsal, and Hayat (2016) studied the Z-score model for 97 textile companies listed on the Karachi Stock Exchange in Pakistan from 2007 to 2012. This period is divided into 2 phases: the crisis period (2007–2009) and the recovery period (2010–2012). The authors employed the Z-score model with five factors: WCTA, RETA. EBITTA, MVETL, and REVTA. The results show that these factors have significant contributions to the model. Specifically, WCTA and RETA have negative average values during the study period, showing that the companies in the sample face financial distress and bankruptcy risks. This study has reached a high level of accuracy when 85% of companies predicted to face financial difficulties have confirmed this position. Januri, Sari, and Diyanti (2017) studied the possibility of bankruptcy risk forecast of cement companies listed on the Indonesia stock market by using the Z-score model, Springate model, and Zmijewski model. The study used data of 3 cement companies listed on the Indonesian Stock Exchange for a period of 5 years from 2011 to 2015. The authors designed the Z-score model with four factors: WCTA, RETA, EBITTA, and MVETL; Springate model with four factors: WCTA, EBITTA, EBTTA, and REVTA; Zmijewski model with three factors: asset turnover ratio (ROA), financial leverage (LEV), short-term debt solven-

cy ratio (CACL). The research results show that only ROA and CACL have a negative effect on the Zmijewski model, while the remaining factors have a positive impact on the other three. Besides, the research shows that if only relying on statistics, the Z-score model is the most accurate. However, after considering the accuracy level by comparing it to reality, the Zmijewski model is the most accurate model for determining the bankruptcy risk. Babatunde, Akeju, and Malomo (2017) researched bankruptcy prediction of 10 listed companies on the Nigerian Stock Exchange (NSE) in 2015. The researchers employed the Z-score model with five factors: WCTA, RETA, EBITTA, MVETL, and REVTA. The authors have demonstrated that Z-score is an important tool in detecting inefficient manufacturing companies in Nigeria. Similarly, Shaher, Salem, and Khasawneh (2012) carried out another study in emerging markets. The authors used data from 20 textile companies listed on the Amman Stock Exchange (Jordan) from 2001 to 2008 and employed 18 financial factors as independent variables. The research results show that six factors are affecting the research model, including TLTA, DEQ, Operating turnover (OC), Net working capital (NWC), and Payment in cash index (CR), which have a positive impact on the model, while the interest rate ratio (TIE) is negatively associated. AlAli (2018) studied the model of determining the financial soundness of health care companies listed on the Kuwait Stock Exchange (KSE) for four years from 2013 to 2016. The author employed Altman Z-score with four factors, including WCTA, RETA, EBITTA, and Book value of equity value per total debt (BVETL). Research results show that all factors have a positive effect on the model. Al-Manaseer and Al-Oshaibat (2018) used the Altman Z-score model with four factors (WCTA, RETA, EBITTA, and MVETL) for non-manufacturing companies to study the financial risk prediction of 21 insurance companies listed on the Amman Stock Exchange (ASE) in Jordan during the period from 2011 to 2016. The results show that all of these factors have a positive impact on the model, and the authors recommended investors to use the Z-score model as a tool to predict corporate financial distress.

2. METHODOLOGY AND DATA

2.1. Data collection

This research uses the data from 30 delisted companies by the announcement on VSM (visited website www.hsx.vn on December 15, 2019) due to financial distress reasons and 30 listed companies with Z-score more than 4.35 (e.g., companies are not classified as financially distressed) on VSM's VN100 in 4 years from 2015 to 2018, corresponding to 240 ob-

Source: Compiled by the authors.

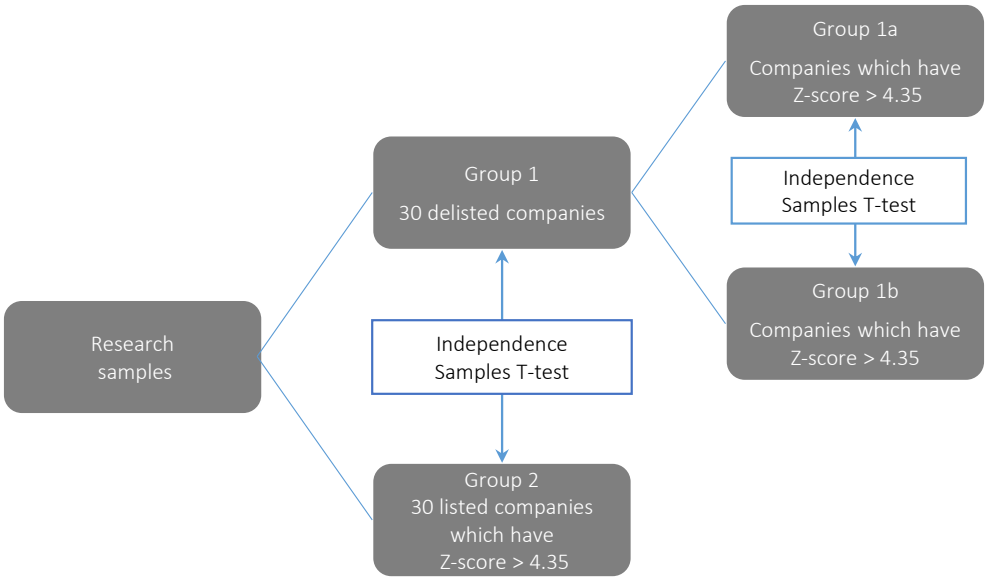

Figure 1. Elements of the sample

http://dx.doi.org/10.21511/imfi.17(2).2020.29

servations. Selected companies are those with full financial-statements data during the research period, and data are collected from the website www.vietstock.vn. The detailed steps are as follows.

The research data are firstly collected from the audited financial statements of the companies in the samples. Financial factors are taken from the balance sheets and the statements of profit or loss to calculate Z-score. The sample companies are divided into two groups, including a group of financially distressed companies – Group 1 (delisted companies due to financial problems) and a group of normal companies – Group 2 (listed companies). From Group 1, the authors continued to divide it into two groups basing on Z-score value: Group 1a which consists of companies with a low level of financial distress (e.g., companies with Z-score greater than 4.35) and Group 1b which consists of companies with a high level of financial distress (e.g., companies with Z-score lower than 4.35). Figure 1 shows the elements of the research sample.

2.2. Calculation of Altman (2000) Z-score

In this study, the authors employ the research model of Altman (2000) for emerging economies:

$$Z\text{-score} = 3.25 + 6.56 \cdot WCTA + \\ +3.26 \cdot RETA + 6.72 \cdot EBITTA + \\ +1.05 \cdot MVETL, \quad (2)$$

where *WCTA* is working capital on total assets, which is equal to current assets minus current liabilities, all scaled by total assets; *RETA* is the ratio of retained earnings to total assets; *EBITTA* is the ratio of earnings before taxes and interests to total assets; *MEVTL* is the ratio of market capitalization to total liabilities, where market capitalization is equal to numbers of shares outstanding time share values.

2.3. Research hypotheses

Based on previous studies (AlAli, 2018; Al-Manaseer & Al-Oshaibat, 2018; Babatunde, Akeju, & Malomo, 2017; Januri, Sari, & Diyanti, 2017; Malik, Awais, Timsal, & Hayat, 2016; Shaher, Salem, & Khasawneh, 2012), the following hypotheses are developed:

H1a: The WCTA index has a significant difference between Group 1 and Group 2.

H1b: The WCTA index has a significant difference between Group 1a and Group 1b.

H2a: The RETA index has a significant difference between Group 1 and Group 2.

H2b: The RETA index has a significant difference between Group 1a and Group 1b.

H3a: The EBITTA index has a significant difference between Group 1 and Group 2.

H3b: The EBITTA index has a significant difference between Group 1a and Group 1b.

H4a: The MVETL index has a significant difference between Group 1 and Group 2.

H4b: The MVETL index has a significant difference between Group 1a and Group 1b.

2.4. Independence Samples T-test

The research uses quantitative methods and Independence Samples T-test to test the research model. The Independent Samples T-test compares the means of two independent groups to determine whether there is statistical evidence that the associated population means are significantly different. The Independent Samples T-test is a parametric test. This research uses this method to test the differences between Group 1 and Group 2, as well as between Group 1a and Group 1b.

3. EMPIRICAL RESULTS

3.1. Independence Samples T-test between Group 1 and Group 2

3.1.1. Group description

Table 1 shows descriptive statistics of the research sample. In Group 1, the descriptive statistics show that WCTA index has an average value of –0.946

Table 1. Descriptive statistics of Group 1 and Group 2

Variables	Group	Samples	Mean	Std. deviation
WCTA	1	120	–.946	4.0095
	2	120	.282	.1820
RETA	1	120	–2.957	16.2299
	2	120	.137	.0869
EBITTA	1	120	–.300	2.3295
	2	120	.142	.0826
MVETL	1	120	2.417	4.6202
	2	120	4.343	6.0329
Z	1	120	–12.079	83.1236
	2	120	11.008	7.2254

Note: The table shows descriptive statistics of characteristics between Group 1 and Group 2. WCTA is working capital on total assets, equal to current assets minus current liabilities, all scaled by total assets. RETA is the ratio of retained earnings to total assets. EBITTA is the ratio of earnings before taxes and interests to total assets. MEVTL is the ratio of market capitalization to total liabilities, where market capitalization is equal to numbers of shares outstanding time share values. $Z\text{-score} = 3.25 + 6.56 \cdot WCTA + 3.26 \cdot RETA + 6.72 \cdot EBITTA + 1.05 \cdot MVETL.$

and a standard deviation of 4.0095; RETA index has an average value of –2.957 and a relatively large standard deviation of 16.2299; the EBITTA index has an average value of –0.300 and a standard deviation of 2.3295; MVETL index has an average value of 2.417 and a standard deviation of 4.6202. The statistics indicate that the Z-score of the Group 1 has a low average value of –12.079 (much smaller than 4.35) with a large standard deviation of 83.1236, suggesting that the average of the companies in this group is at high risk of financial failure and that there is a large difference in Z-score within the Group 1.

In Group 2, the statistics show that WCTA index has an average value of 0.282 and a standard deviation of 0.1820; the RETA index has an average value of 0.137 and a standard deviation of 0.0869; the EBITTA index has an average value of 0.142 and a standard deviation of 0.0826; MVETL index has an average value of 4.343 and a standard deviation of 6.0329. Especially, the Z-score of this group has a high average value of 11.008, which is about 2.5 times greater than the benchmark value of 4.35 for the distress zone, suggesting that the companies in this group are not financially distressed. A small standard deviation of Z-score indicates that the difference in Z-score within this group is insignificant.

3.1.2. Independence Samples T-test results of Group 1 and Group 2

Table 2 reports the results of the Independence Samples T-test results of Group 1 and Group 2. The table shows that *p*-values (sig. values) of WCTA, RETA, EBITTA, MVETL and Z-score in the Levene's test (F-statistics) have a value of 0.000, 0.001, 0.007, 0.033, and 0.000, respectively, and they are less than 0.05, which indicates that the variances of the two groups of companies are statistically different as the authors use the T-test result in a row "Equal variances not assumed." As a result, the *p*-values in the T-test of the above factors are 0.001, 0.039, 0.040, 0.006, and 0.003 respectively, which are all less than 0.05, indicating that there is a statistically significant difference in the above indexes between Group 1 (delisted companies) and Group 2 (listed companies). Therefore, with 95% reliability, it can be concluded that the prediction of financial distress is different between Group 1 and Group 2.

3.2. Independence Samples T-test between Group 1a and Group 1b

3.2.1. Group descriptions

Table 3 shows descriptive statistics of characteristics between the Group 1a and Group 1b. The statistics in Group 1a show that WCTA index has an average value of 0.359 and a standard deviation of 0.1841; RETA index has an average value of 0.114 and a standard deviation of 0.1006; EBITTA index has an average value of 0.111 and a standard deviation of 0.1056; MVETL index has an average value of 4.250 and a standard deviation of 5.7067. Next, the Z-score of this group has a high average value of 11.172 (2.5 times greater than 4.35) with a low standard deviation of 6.9961. The results suggest

http://dx.doi.org/10.21511/imfi.17(2).2020.29

Table 2. Independence Samples T-test results of Group 1 and Group 2

Variables		Levene's test for equality of variances		T-test for equality of means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Std. error difference	95% confidence interval of the difference	
									Lower	Upper
WCTA	Equal variances assumed	29.407	.000	–3.350	238	.001	–1.2275	.3664	–1.9493	–.5057
	Equal variances not assumed	–	–	–3.350	119.490	.001	–1.2275	.3664	–1.9530	–.5020
RETA	Equal variances assumed	11.886	.001	–2.088	238	.038	–3.0933	1.4816	–6.0121	–.1746
	Equal variances not assumed	–	–	–2.088	119.007	.039	–3.0933	1.4816	–6.0270	–.1596
EBITTA	Equal variances assumed	7.400	.007	–2.076	238	.039	–.4417	.2128	–.8609	–.0225
	Equal variances not assumed	–	–	–2.076	119.299	.040	–.4417	.2128	–.8630	–.0203
MVETL	Equal variances assumed	4.614	.033	–2.776	238	.006	–1.9258	.6937	–3.2924	–.5593
	Equal variances not assumed	–	–	–2.776	222.862	.006	–1.9258	.6937	–3.2928	–.5588
Z	Equal variances assumed	15.441	.000	–3.031	238	.003	–23.0875	7.6167	–38.0923	–8.0827
	Equal variances not assumed	–	–	–3.031	120.798	.003	–23.0875	7.6167	–38.1671	–8.0079

Note: The table shows the Independence Samples T-test results of Group 1 and Group 2. WCTA is working capital on total assets, equal to current assets minus current liabilities, all scaled by total assets. RETA is the ratio of retained earnings to total assets. EBITTA is the ratio of earnings before taxes and interests to total assets. MEVTL is the ratio of market capitalization to total liabilities, where market capitalization is equal to numbers of shares outstanding time share values. $Z\text{-score} = 3.25 + 6.56 \cdot WCTA + 3.26 \cdot RETA + 6.72 \cdot EBITTA + 1.05 \cdot MVETL.$

Table 3. Descriptive statistics of Group 1a and Group 1b

Variable	Type	N	Mean	Std. deviation
WCTA	1a	64	.359	.1841
	1b	56	–2.437	5.5223
RETA	1a	64	.114	.1006
	1b	56	–6.466	23.3751
EBITTA	1a	64	.111	.1056
	1b	56	–.770	3.3627
MVETL	1a	64	4.250	5.7067
	1b	56	.323	.7143
Z	1a	64	11.172	6.9961
	1b	56	–38.652	116.3857

Note: The table shows descriptive statistics of characteristics between the Group 1a and Group 1b. WCTA is working capital on total assets, equal to current assets minus current liabilities, all scaled by total assets. RETA is the ratio of retained earnings to total assets. EBITTA is the ratio of earnings before taxes and interests to total assets. MEVTL is the ratio of market capitalization to total liabilities, where market capitalization is equal to numbers of shares outstanding time share values. $Z\text{-score} = 3.25 + 6.56 \cdot WCTA + 3.26 \cdot RETA + 6.72 \cdot EBITTA + 1.05 \cdot MVETL.$

that the companies in this group are not at risk of bankruptcy, and the difference in Z-score within the group is very small.

Regarding Group 1b, WCTA index has an average value of –2.437 and a standard deviation of 5.5223; RETA index has an average value of –6.466 and a large standard deviation of 23.3751; EBITTA index has an average value of –0.77 and a standard deviation of 3.3627; MVETL index has an average value of 0.323 and a standard deviation of 0.7143. The Z-score of this group has a low average value of –38.652 (which is far lower than the benchmark of 4.35 for distress zone) and a large standard deviation of 116.3857. The findings indicate that the companies in this group are at high risk of bankruptcy, and the difference in Z-score within the group is also significant.

Table 4. Independence Samples T-test results of Group 1a and Group 1b

Variables		Levene's test for equality of variances		T-test for equality of means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Std. error difference
WCTA	Equal variances assumed	33.163	.000	4.052	118	.000	2.7969	.6903
	Equal variances not assumed	–	–	3.788	55.107	.000	2.7969	.7383
RETA	Equal variances assumed	12.283	.001	2.253	118	.026	6.5801	2.9202
	Equal variances not assumed	–	–	2.107	55.002	.040	6.5801	3.1237
EBITTA	Equal variances assumed	8.485	.004	2.095	118	.038	.8806	.4203
	Equal variances not assumed	–	–	1.959	55.095	.045	.8806	.4496
MVETL	Equal variances assumed	73.908	.000	5.112	118	.000	3.9268	.7682
	Equal variances not assumed	–	–	5.456	65.252	.000	3.9268	.7197
Z	Equal variances assumed	18.592	.000	3.420	118	.001	49.8237	14.5695
	Equal variances not assumed	–	–	3.198	55.348	.002	49.8237	15.5773

Note: The table shows the Independence Samples T-test results of Group 1a and Group 1b. WCTA is working capital on total assets, equal to current assets minus current liabilities, all scaled by total assets. RETA is the ratio of retained earnings to total assets. EBITTA is the ratio of earnings before taxes and interests to total assets. MEVTL is the ratio of market capitalization to total liabilities, where market capitalization is equal to numbers of shares outstanding time share values. $Z\text{-score} = 3.25 + 6.56 \cdot WCTA + 3.26 \cdot RETA + 6.72 \cdot EBITTA + 1.05 \cdot MVETL.$

3.2.2. *Independence Samples T-test results of Group 1a and Group 1b*

Table 4 shows the Independence Samples T-test results of Group 1a and Group 1b. The results indicate that the *p*-values of the WCTA, RETA, EBITTA, MVETL and Z-score in the Levene's test (F-test) have a value of 0.000, 0.001, 0.004, 0.000, and 0.000, respectively, and they are less than 0.05, implying that the variances of the two groups of companies are different as we use the T-test result when "Equal variances not assumed." As a result, the *p*-values in the T-test of the above factors are 0.001, 0.040, 0.045, 0.000, and 0.002, respectively (which are less than 0.05), indicating a significant difference in the average of the above indexes between the group of companies with a low level of financial distress (Group 1a) and the group of companies with a high level of financial distress (Group 1b). Therefore, with 95% reliability, it can be concluded that the prediction of financial distress is different between Group 1a and Group 1b.

4. DISCUSSION AND POLICY IMPLICATION

4.1. Discussion

According to the research results, the differences between Z-score following four independent variables: WCTA, RETA, EBITTA, and MVETL are discussed as follows:

4.1.1. *Working capital on total assets (WCTA)*

There is a significant difference in this index between the group of financially distressed companies and the group of normal companies. This result is consistent with the studies of Malik, Awais, Timsal, and Hayat (2016), Bhavani and Tabi (2017), and Januri, Sari, and Diyanti (2017). This can be explainable that the higher the WCTA index, the more short-term assets are available to meet the business's short-term debt obligations and meet the operational business requirement. As a result, the possibility of bankruptcy is very low.

4.1.2. *Retained earnings on total assets (RETA)*

There is a significant difference in this index between the group of financially distressed companies and the group of normal companies. This result is also consistent with the studies of Malik, Awais, Timsal, and Hayat (2016), Bhavani and Tabi (2017) and Januri, Sari, and Diyanti (2017). The results show that the higher the retained earnings, the more profitable a company can make from its assets, and the stronger the business is, the greater the index will be. Therefore, the risk of bankruptcy is considerably low.

http://dx.doi.org/10.21511/imfi.17(2).2020.29

4.1.3. Earnings before taxes and interests on total assets (EBITTA)

There is a significant difference in this index between the group of financially distressed companies and the group of normal companies. This result is also consistent with the studies of Malik, Awais, Timsal, and Hayat (2016), Bhavani and Tabi (2017), and Januri, Sari, and Diyanti (2017). Not mentioning the enterprise's capital structure and tax rate, this result helps investors easily compare the level of revenue generation of the companies and the efficiency in the production and business activities. Therefore, the risk of bankruptcy, as well as information manipulation, will be lower.

4.1.4. Market capitalization on total liabilities (MVETL)

There is a significant difference in this index between the group of financially distressed companies and the group of normal companies. This result is also consistent with the studies of Malik, Awais, Timsal, and Hayat (2016), Bhavani and Tabi (2017), and Januri, Sari, and Diyanti (2017). This shows that the higher the market capitalization value, the higher the companies' market value, and the total debt of such companies could be covered. Besides, this index also shows high expectations of the market towards businesses; therefore, the possibility of bankruptcy and information manipulation is very low.

4.2. Policy implications

4.2.1. For State Securities Commission (SSC)

According to this study, it was found that most companies under a high level of financial distress have the negative values of Z-score, WCTA, RETA, and EBITTA for many consecutive years before delisting. Thereby, the SSC is proposed to establish a standardized scale basing on the Z-score model to detect financially distressed companies. Along with this, a strong regulatory system to strictly control and regular supervision by competent authorities should be maintained to ensure the effectiveness and efficiency of the companies' operating activities. Specifically, the SSC shall impose delisting for companies that have negative values of working capital, retained earnings, pre-tax, and interest income for three consecutive years.

4.2.2. For the users of financial statements

Users of financial statements such as investors shall 'not only' rely on the information in the capital market or the market trend 'but also' pay attention to companies that have the Z-score value smaller than 4.35 for consecutive years. Thereby, investors can avoid investing in such companies as well as be able to make more rational decisions to avoid economic losses. Also, the quality of financial information disclosed is strongly associated with auditors' performance. Therefore, auditors should pay close attention to accounting fraud's red flag in such companies' financial statements. To do so, the auditors shall calculate Z-score according to the model mentioned in this research. After determining the Z-score, the auditor could base on this result to make initial judgments about the enterprise's financial situation so that a suitable audit plan could be put in place. Furthermore, creditors such as commercial banks could also use the Z-score as a benchmark for making prudent credit granting procedures.

CONCLUSION

The reduction of companies' financial distress will make a great contribution to improve the firm value and create a positive brand reputation. Accordingly, the quality of the capital market is also improved, and thereby, it can attract more investment resources, which are essential for economic development. In this paper, the Altman Z-score model is employed to study the financial distress of companies in Vietnamese stock markets. The authors used the data collected from 30 listed companies, and 30 delisted companies due to financial problems on VSM in four years from 2015 to 2018, with a total of 240 observations. The research results show that there are statistically significant differences in the factors of Altman Z-score between the group of normal companies and the group of financially distressed companies. Using subsamples, it is also found that the groups of companies with a low level of financial

distress and those with a high level of financial distress have statistically different characteristics and Z-score. In particular, it is found that WCTA and EBITTA have the biggest influence on the model with a coefficient of 6.56 and 6.72, respectively. The findings suggest that the more working capital and the higher profitability a company has, the greater the stability in the financial health of businesses. Such businesses will be less likely to face bankruptcy risk. Based on these results, several suggestions have been made to assist practitioners in detecting, preventing, and strictly controlling businesses at high risk of financial distress.

AUTHOR CONTRIBUTIONS

Conceptualization: Dang Anh Tuan.
Data curation: Tran Ngoc Anh Thu.
Formal analysis: Tran Quoc Thinh.
Funding acquisition: Dang Anh Tuan.
Investigation: Nguyen Thanh Huy.
Methodology: Nguyen Thanh Huy.
Project administration: Tran Quoc Thinh.
Resources: Dang Anh Tuan.
Software: Nguyen Thanh Huy.
Supervision: Tran Quoc Thinh.
Validation: Tran Ngoc Anh Thu.
Visualization: Tran Ngoc Anh Thu.
Writing – original draft: Tran Quoc Thinh.
Writing – review & editing: Dang Anh Tuan.

REFERENCES

1. Ahmed, M. A. R., & Govind, D. (2018). *An evaluation of the Altman Z-Score model in predicting corporate bankruptcy for Canadian publicly listed firm* (M.Sc. Thesis). Simon Fraser University, Canada. Retrieved from https://www.semanticscholar.org/paper/An-Evaluation-of-the-Altman-Z-Score-Model-in-for-Ahmed-Govind/8fb3c6a030c7353a05dcbd94bf7fa72f5ec6f746
2. AlAli, M. S. (2018). The application of Altman's Z-Score model in determining the financial soundness of healthcare companies listed in Kuwait Stock Exchange. *International Journal of Economic Papers, 3*(1), 1-5. Retrieved from https://www.researchgate.net/publication/325265054_The_Application_of_Altman's_Z-Score_Model_in_Determining_the_Financial_Soundness_of_Healthcare_Companies_Listed_in_Kuwait_Stock_Exchange
3. Al-Manaseer, S. R., & Al-Oshaibat, S. D. (2018). Validity of Altman Z-Score model to predict financial failure: Evidence from Jordan. *International Journal of Economics and Finance, 10*(8), 181-189. https://doi.org/10.5539/ijef.v10n8p181
4. Altman, E. I. (1968). Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy. *Journal of Finance, 23*(4), 189-209. https://doi.org/10.4337/9780857936097.00027
5. Altman, E. I. (2000). Predicting financial distress of companies: Revisiting the Z-Score and ZETA models. *Journal of Banking & Finance, 1,* 1977. Retrieved from http://pages.stern.nyu.edu/~ealtman/Zscores.pdf
6. Aziz, M. A., & Dar, H. A. (2006). Predicting corporate bankruptcy: where we stand? *Corporate Governance, 6*(1), 18-33. https://doi.org/10.1108/14720700610649436
7. Babatunde, A. A., Akeju, J. B., & Malomo, E. (2017). The effectiveness of Altman's Z-Score in predicting bankruptcy of quoted manufacturing companies in Nigeria. *European Journal of Business, Economics and Accountancy, 5*(5), 74-83. Retrieved from https://pdfs.semanticscholar.org/4ca5/033f6e7dae390c3a2adcdbf2685e7ddbf5b9.pdf
8. Beaver, W. (1966). Financial ratios predictors of failure. *Journal of Accounting Research, 4,* 71-111. Retrieved from https://www.jstor.org/stable/2490171
9. Bhavani, B., & Tabi C. (2017). M-Score and Z-Score for detection of Accounting Fraud. *Accountancy Business and the Public Interest,* 68-86. Retrieved from https://www.researchgate.net/publication/318489930_M-Score_and_Z-Score_for_detection_of_Accounting_Fraud
10. Hu, Y., & Ansell, J. (2006). *Developing financial distress*

http://dx.doi.org/10.21511/imfi.17(2).2020.29

prediction models: A study of US, Europe and Japan Retail Performance. Management School and Economic of University of Edinburgh, The United Kingdom. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.486.8512&rep=rep1&type=pdf

11. Ijaz, M. S., Hunjra, A. I., & Azam, R. I. (2017). Forewarning bankruptcy: An indigenous model for Pakistan. *Business & Economic Review, 9*(4), 259-286. https://dx.doi.org/10.22547/BER/9.4.12

12. Januri, Sari, E. N., & Diyanti, A. (2017). The analysis of the bankruptcy potential comparative by Altman Z-Score, Springate and Zmijewski methods at cement companies listed in Indonesia Stock Exchange. *IOSR Journal of Business and Management, 19*(10), 80-87. Retrieved from https://www.researchgate.net/publication/326913570_The_Analysis_of_the_Bankruptcy_Potential_Comparative_by_Altman_Z-Score_Springate_And_Zmijewski_Methods_at_Cement_Companies_Listed_In_Indonesia_Stock_Exchange

13. Malik, M. S., Awais, M., Timsal, A., & Hayat, F. (2016). Z-Score Model: Analysis and Implication on Textile Sector of Pakistan. *International Journal of Academic Research, 4*(2), 140-158. Retrieved from https://www.researchgate.net/publication/305699727_Z-Score_Model_Analysis_and_Implication_on_Textile_Sector_of_Pakistan

14. Muller, G. H., Steyn-Bruwer, B. W., & Hamman, W. D. (2012). What is the best way to predict financial distress of companies? *Leaders' Lab Finance, 12*(2), 24-25. Retrieved from http://hdl.handle.net/10019.1/85389

15. Ohlson, J. A. (1980). Financial ratios and the probabilistic prediction of bankruptcy. *Journal of accounting research, 18*(1), 109-131. Retrieved from https://www.jstor.org/stable/2490395

16. Saini, V. (2018). Evaluating financial health of Gujarat State Fertilizers through 'Z' Score Model. *International Journal of Research – Granthaalayah, 6*(7), 115-120. https://dx.doi.org/10.5281/zenodo.1323027

17. Shaher, T. A., Salem, R., & Khasawneh, O. (2012). Predicting corporate failure in emerging market: Empirical evidence from Jordan (2001–2008). *Archives Des Sciences, 65*(10), 34-43. Retrieved from https://www.ammanu.edu.jo/English/pdf/StaffResearch/business/652/Predicting%20corporate%20failure%20In%20Emerging%20Market%20Empirical%20Evidence%20from%20jordan%20(2001-2008).pdf

APPENDIX A

Table A1. List of 30 listed companies on Vietnamese stock market from 2015 to 2018

Source: State Securities Commission, Vietnam (https://www.ssc.gov.vn).

No.	Name of company	Code
1	An Phat Xanh Plastic Joint Stock Company	AAA
2	Binh Dien Fertilizer Joint Stock Company	BFC
3	Binh Minh Plastic Joint Stock Company	BMP
4	CMC Corporation	CMG
5	Southern Basic Chemicals Joint Stock Company	CSV
6	Coteccons Construction Joint Stock Company	CTD
7	DHG Pharmaceutical Joint Stock Company	DHG
8	PetroVietnam Fertilizer and Chemicals Corporation	DPM
9	FLC Group Joint Stock Company	FLC
10	FPT Corporation	FPT
11	Vietnam Gas Corporation	GAS
12	Vietnam Electrical Equipment Joint Stock Corporation	GEX
13	Gemadept Corporation	GMD
14	Ha Noi Securities Corporation	HDG
15	Hoa Phat Group Joint Stock Company	HPG
16	Kinh Bac Urban Development Corporation	KBC
17	LIX Detergent Joint Stock Company	LIX
18	Masan Group Joint Stock Company	MSN
19	Mobile World Investment Joint Stock Company	MWG
20	Nam Long Investment Joint Stock Company	NLG
21	Phu Nhuan Jewelry Joint Stock Company	PNJ
22	POMINA Steel Joint Stock Company	POM
23	PetroVietnam Transportation Joint Stock Corporation	PVT
24	Refrigeration Electrical Engineering Corporation	REE
25	FLC Faros Construction Joint Stock Company	ROS
26	Saigon Beer – Alcohol – Beverage Joint Stock Corporation	SAB
27	Song Da Urban and Industrial Zone Investment and Development Joint Stock Company	SJS
28	SSI Securities Corporation	SSI
29	Vinh Hoan Corporation	VHC
30	Vietnam Dairy Products Joint Stock Company	VNM

Table A2. List of 30 canceled listing companies on Vietnamese stock market from 2015 to 2018

Source: www.hsx.vn

No.	Name of company	Code
1	Ntaco Joint Stock Company	ATA
2	Viet An Joint Stock Company	AVF
3	21st Century Joint Stock Company	C21
4	Urban Design and Development Consulting JSC	CDO
5	Kien Giang Construction and Investment Consulting JSC	CKG
6	Network and Communication Technology JSC	CMT
7	Creat Capital Vietnam Joint Stock Company	CRC
8	Chang Yih Ceramic Joint Stock Company	CYC
9	Gia Lai Hydroelectric Joint Stock Company	GHC
10	Thuan Thao Corporation	GTT
11	Huu Lien Asia Joint Stock Company	HLA
12	JSC General Materials and Biochemical Fertilizers	HIS
13	Khanh Hoi Investment and Services JSC	KHA
14	Minh Phu Seafood Joint Stock Company	MPC
15	MT Gas Joint Stock Company	MTG
16	Pymepharco Joint Stock Company	PME
17	Long Son Petroleum Industrial Zone Investment JSC	PXL
18	Quy Nhon Port Joint Stock Company	QNP
19	Saigon Ground Service Joint Stock Company	SGN
20	Saigon Import Export Seafood Joint Stock Company	SSN
21	Saigon Tourist Shipping Joint Stock Company	STT
22	Sonadezi Chau Duc Joint Stock Company	SZC
23	Thai Duong Petroleum Joint Stock Company	TDG
24	Tan Tien Plastic Packaging Joint Stock Company	TTP
25	Power Engineering Consulting Joint Stock Company	TV1
26	Vinh Long Food Joint Stock Company	VLF
27	Vinaship Shipping Joint Stock Company	VNA
28	Vietnam Investment Corporation	VNH
29	Vietnam Real Estate Investment Joint Stock Company	VNI
30	Vietnam Shipping and Chartering Joint Stock Company	VST

http://dx.doi.org/10.21511/imfi.17(2).2020.29