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Applying the Z-Score Model to Predict Corporate Financial Distress: An Empirical Research on the Listed Firms in Vietnam Stock Market

Abstract. Assessing the risk of financial distress is an important component of effective management because it helps companies make right financial decisions, avoid potential risks and improve business operations. This study provides more empirical evidence on the role of the Z-Score model in predicting financial distress of companies in emerging markets like Vietnam. This research paper uses data from 30 companies that delisted on UPCOM due to financial distress and 30 companies with Z-score greater than 4.35 on Ho Chi Minh City Stock Exchange (HoSE) for 5 years from 2018 to 2022, corresponding to 300 observations. The selected companies have enough audited financial statement data during the research period which are collected from websites such as *cafef.vn*, *vietstock.vn*, and websites with data on companies' financial statements. The financial factors are taken from the balance sheet and income statement by the authors to calculate the Z-Score. The authors use the Independent-samples T-test with data collected delisted companies due to financial distress and stably listed firms on the Vietnam Stock Market to test whether there is a difference in Z-score and independent variables in the Z-score model between these two groups of companies. The research results show that, there is a significant difference in the Z-score and the factors in the Z-Score model between the group of listed companies and the group of delisted companies, and between companies with low level of financial distress and those with high level of financial distress. From the findings obtained, the authors have made suggestions and recommendations for relevant parties such as the State Securities Commission of Vietnam, users of financial statements, and companies in order to contribute to preventing and limiting the risk of corporate financial distress in the most effective way.

Keywords: bankruptcy risk, financial distress, financial forecasting, business failure, Z-Score.

Suggested Citation

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Застосування моделі Z-показника для прогнозування корпоративних фінансових проблем: емпіричне дослідження компаній зареєстрованих на фондовому ринку В'єтнаму

Анотація. Оцінка ризику фінансових труднощів є важливою складовою ефективного управління, оскільки допомагає компаніям приймати правильні фінансові рішення, уникати потенційних ризиків і покращувати бізнес-операції. Це дослідження надає додаткові емпіричні докази ролі моделі Z-Score у прогнозуванні фінансових труднощів компаній на ринках країн, що розвиваються, таких як В'єтнам. У цьому дослідженні використовуються дані 30 компаній, які вийшли з біржі UPCoM через фінансові труднощі, та 30 компаній із

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Z-показником понад 4,35 на фондовій біржі Хошиміна (HoSE) за 5 років з 2018 по 2022 рік, що відповідає 300 спостереженням. Дані фінансової звітності обраних компаній є достатньо перевіреними та отриманими із веб-сайтів *saef.vn*, *vietstock.vn*, і безпосередньо веб-сайтів компаній. Для розрахунку Z-показника автори взяли фінансові дані з балансу та звіту про прибутки та збитки. Було використано T-тест незалежної вибірки із зібраними даними компаній, вилучених із біржі через фінансові труднощі, і компаній, які стабільно котируються на фондовому ринку В'єтнаму, щоб перевірити, чи є різниця в Z-показнику та незалежних змінних у моделі Z-показника між цими двома групами компаній. Результати дослідження показують, що існує значна різниця в Z-показнику та факторах моделі Z-показника між групою компаній, зареєстрованих на біржі, і групою вилучених компаній, а також між компаніями з низьким рівнем фінансових труднощів і тими, які мають високий рівень фінансової скрути. На підставі отриманих результатів автори надали рекомендації для відповідних сторін, таких як Державна комісія з цінних паперів В'єтнаму, користувачі фінансової звітності та компанії, щоб зробити внесок у запобігання та обмеження ризику корпоративних фінансових проблем найбільш ефективним способом.

Ключові слова: ризик банкрутства, фінансові труднощі, фінансове прогнозування, крах бізнесу, модель Z-показника.

1. INTRODUCTION

In the context of international economic integration, the role of enterprises is increasingly clearly defined. Vietnam has a developing economy which is gradually recovering from the Covid-19 pandemic; however, unexpected factors in the macroeconomic fluctuations have caused many Vietnamese enterprises to face a lot of difficulties as well as the risk of delisting. Therefore, the researches on corporate financial distress/bankruptcy in Vietnam are very important to help the government and investors detect companies that are likely to fall into financial distress, and then provide timely solutions. Mackevičius et al. (2018) state that every business owner needs to have contingency plans and strategies to maintain stable operations, and at the same time, analyze important factors in the risk of financial distress, thereby improving business performance of companies in the long term. Especially, assessing the risk of financial distress is also very essential for companies because it helps them determine their safety and solvency. In addition, it is a powerful tool to help companies make right business and financial decisions, avoid potential risks and improve business operations.

So which method is the most accurate method to assess the performance of companies on the stock market today? Some typical studies in the world show that financial ratios such as solvency, return on assets (ROA), return on equity (ROE) are extremely important in forecasting because they specifically reflect business performance and assess financial risks of companies. However, examination, assessment and prediction of each such financial indicator may not be accurate when the financial ratios are in conflict with each other, which affects business operations of companies. To overcome this limitation, Altman (1968) in his research paper uses the multiple discriminant analysis (MDA) method through building linear equations with 5 weighted financial variables, Z-score built with the thresholds as the basis for classifying groups of effective companies and groups of inefficient companies. Generally, some previous studies by Januri et al (2018), Nanayakkara and Azeez (2014), Al-Manaseer and Al-Oshaibat (2018) all show that Altman's Z-Score model is a highly accurate model which is suitable for forecasting corporate

financial distress in emerging markets. In addition, Vietnam is a developing country and it is very appropriate to apply the Z-Score model of Altman (1995) to developing countries.

This study provides more empirical evidence on the role of the Z-Score model in predicting financial distress of companies in emerging markets like Vietnam. This study uses a sample of 30 delisted companies due to financial distress and 30 companies listed stably on the Vietnam Stock Market from 2018 to 2022. The research results show that there is a significant difference in the Z-score and the factors in the Z-Score model between the group of listed companies and the group of delisted companies. In-depth analysis using a subsample of the group of delisted companies shows that the Z-Score and the factors in the Z-Score model are statistically different between companies with low level of financial distress and those with high level of financial distress. Based on the research results, the author has made recommendations for the State Securities Commission of Vietnam, investors, and companies in general.

2. LITERATURE REVIEW

2.1. Concept of financial distress

According to the studies of Beaver (1966) and Altman (1983), financial distress is a state when a company cannot meet its predetermined monetary commitment. The research by Beaver et al (2011) states that financial distress is a broad term and refers to insolvency. In most of the previous studies, bankruptcy is the most common term used to define financial distress. The study by Beaver (1966) suggests that a company is considered to have failed when it is unable to pay its financial obligations as they come due. Ross, Westerfield and Jaffe (1999); Altman and Hotchkiss (1993) make a point that financial distress also describes different situations when a company faces financial difficulties such as failure, illiquidity, default, bankruptcy. Failure is a situation in which cash flow is not sufficient to meet the current financial obligations (Wruck, 1990). Shrader and Hickman (1993) state that illiquidity is when a company's assets are less than the value of its financial obligations. Amiyatosh Purnanandam (2008) argues that

financial distress is a state of low cash flow and companies must bear losses without being insolvent.

Thus, it can be understood that financial distress can be defined as the state in which a company cannot continue to exist in its normal form of business. Financial distress can occur at any time in the life of a company if it fails to meet its payment obligations. Financial distress goes from business failure to illiquidity, then to default, and worst of all, officially filling for bankruptcy. This study uses the term “financial distress” to replace other terms describing the financial difficulties of companies.

2.2. Altman's Z-Score Model

The Z-Score model, also known as the bankruptcy prediction model, is a composite score summarizing the weighted results for various financial ratios, placed in a relationship of one-point value to the dataset mean or standard deviation from the mean. Z-Score can be used to measure financial health and predict the probability that a company may go bankrupt in the next 2 years. Z-scores are measures of variability of observations and can be used by traders to determine market volatility. The Z-Score model is a method used to assess financial risk of a company. Altman's first model was developed and published in the Journal of Finance in 1968. Altman used the MDA method to identify the most important financial ratios for predicting the probability of a company going bankrupt. The research results of Altman indicate that some financial ratios such as return on equity, return on assets, and independent cash flow ratio are important factors in predicting the probability of bankruptcy of a company. Then, Altman developed a Z-Score model based on five financial ratios to assess a company's risk of financial distress. Since its introduction, the Z-Score model has been greatly improved and developed. In 1966, Altman's Z-Score model was conducted with the aim of developing a quantitative model for predicting the probability of bankruptcy of companies for predicting bankruptcy of companies with high accuracy, and the Z-Score model has become a popular tool used in credit risk assessment, and operations management of companies. Finally, to test the model, Altman calculated the Z-Scores for newly-bankrupt and non-bankrupt companies. Altman found that about 95% of bankrupt companies were correctly classified as bankrupt. And about 80% of well-run companies were correctly classified as non-bankrupt. Among companies classified in the wrong group, none went bankrupt.

The research by Altman in 1983 was conducted to evaluate the effectiveness of the Z-Score model in predicting bankruptcy of UK companies. The results showed that Altman's Z-Score model was able to predict accurately up to 86% of bankrupt companies, and 95% of non-bankrupt companies in his random sample. This indicates that Altman's Z-Score model is an extremely useful tool to predict the probability of bankruptcy of UK companies.

Accordingly, the Z-Score model developed by Altman is divided into three types as follows:

- The Z-Score model applied to equitized companies in the manufacturing industry;
- The Z'-Score model applied to unequitized companies in the manufacturing industry;
- The modified Z''-Score model applied to companies in emerging markets.

For emerging markets, Altman added the constant +3.25 to the Z-Score model for standardization. Accordingly, this study proposes to use this standardized Z-Score model for the sample of companies on the Vietnam stock market. The formula of the standardized Z-Score model is given as follows:

$$Z'' = 3.25 + 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$$

Where X_1 : Working Capital/Total Assets (WCTA);
 X_2 : Retained Earnings/Total Assets (RETA);
 X_3 : Earnings before Interest and Taxes/Total Assets (EBITTA);
 X_4 : Market Value of Equity/ Book Value of Total Liabilities (MVETL).

How to classify companies:

- 5.85 < Z'': The companies are in a safe zone, not in danger of bankruptcy;
- 4.35 < Z'' < 5.85: The companies are in a warning zone, may be at risk of bankruptcy;
- Z'' < 4.35: The companies are in a dangerous zone and at a high risk of bankruptcy.

2.3. Overview of studies on the application of Z-Score model in financial distress prediction

A lot of models combining financial ratios have been proposed to measure corporate financial distress, in which the Z-Score model of Altman (1968) is mentioned quite commonly (Ningsih & Permatasari, 2018).

Al Zaabi and Obaid (2011) use the Z-score model of emerging markets to predict business failure and measure financial performance of large Islamic banks in the UAE. The author finds that the Z-Score model is a suitable model to measure performance of Islamic banks and the factors used in calculation of Z-Scores can be considered to provide valuable instrumental indicators. The MDA method uses a paired sample of failed companies matched with non-failed companies using financial ratios. The results show that financial ratio analysis is a useful tool for predicting failure 5 years before it happens.

Januri, Sari and Diyanti (2017) conducted a research on prediction of financial distress of cement companies listed on the Indonesia stock market by using Z-Score, Springate, and Zmijewski models. This study uses data of 3 cement companies listed on the Indonesia Stock Exchange in 5 years from 2011 to 2015. The authors design the Z-score model with 4 factors as follows: working capital to total assets (WCTA), retained earnings to total assets (RETA), earnings before interest and taxes to total assets (EBITTA), and market value of equity to total liabilities (MVETL); Springate model with four factors: WCTA, EBITTA, EBTTA, and revenue to total assets (REVTA); Zmijewski model with three factors: asset turnover ratio (ROA), financial leverage (LEV), short-term solvency ratio (current assets to current

liabilities (CACL)). Research results show that only ROA and CACL have a negative impact on the Zmijewski model while the remaining three factors have a positive impact. In addition, this study also shows that if only based on statistical data, the Z-Score model is the most accurate.

Nanayakkara and Azeez (2014) studied and developed a model to predict financial distress for Sri Lankan companies using the Z-score model for a sample of companies through MDA analysis. The study examines four accounting ratios for 134 distressed and non-distressed companies from 2002 to 2011. The study finds that the derived model including four accounting ratios is able to predict financial distress of public companies listed in Sri Lanka with the accuracy of 76.9% one year before financial distress. Moreover, the model is capable of predicting financial distress at 74.6% and 67.2% two years and three years prior to financial distress, respectively. This model can be used to help investors, creditors, managers, auditors, and governing bodies in Sri Lanka predict financial distress.

Lord et al., (2020) used the Z-Score model to predict financial distress in nursing homes. The Altman's Z-Score model used MDA analysis to simultaneously test many financial ratios to assess financial distress of a company. The study by Justin Lord, Amy Landry, Savage and Robert Weech - Maldonado includes 167,268 nursing homes between 2000 and 2015. The study indicates that all financial variables, except net asset value, significantly contribute to the discriminating power of the model. These findings will provide another tool for policymakers and practitioners to identify nursing homes at risk of financial distress.

AlAli (2018) studied a model to determine the financial soundness of healthcare companies listed on the Kuwait Stock Exchange (KSE) for 4 years from 2013 to 2016. The author used Altman's Z-Score model with 4 factors, including WCTA, RETA, EBITTA, and book value of equity to total liabilities (BVETL). The research results indicate that all factors have a positive impact on the model.

Babatunde, Akeju and Malomo (2017) carried out a research on bankruptcy prediction of 10 companies listed on the Nigerian Stock Exchange (NSE) in 2015. The researchers used the Z-score model with 5 factors: WCTA, RETA, EBITTA, MVETL and REVTA. They demonstrate that Z-Score model is an important tool in detecting inefficient manufacturing enterprises in Nigeria.

Al-Manaseer and Al-Oshaibat (2018) used the Z-Score model with 4 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 from 2011 to 2016. The results show that all the aforementioned factors have a positive impact on the model, and the authors recommend investors to use the Z-Score model as a tool to predict corporate financial distress.

Sajjan (2016) investigated the use of Altman's Z-Score model to predict bankruptcy of selected companies in India for 5 years from 2011 to 2015. The

study reveals that Altman's Z-Score model is effective in predicting corporate financial distress in India.

Hayes et al. (2010) investigated the effectiveness of Altman's Z-Score model in predicting bankruptcy of specialty retailers in the United States. The results point out that Z-Score model is effective in predicting financial distress in retail companies. Z-Score model correctly predicts 94% of companies that declare bankruptcy, and 90% of cases of financial distress.

Alexeer and Kim (2008) conducted a study on Korean companies using Altman's Z-Score model. Research evidence indicates that a low Z-score is an important predictor of financial distress.

Alkhatib and Al Bzour (2011) carried out a research to report the impact of financial ratios in predicting bankruptcy of the listed companies in Jordan through the use of Altman and Kida's model. The research sample includes 16 industrial companies and non-financial services between 1990 and 2006. According to their results, out of two models, Altman's Z-Score model is more advantageous in predicting corporate bankruptcy with an average predictive ability of 93.8% in 5 years prior to liquidation while the average prediction of the Kida model is 69%.

Le and Nguyen (2012) conducted a study to retest Altman's Z-Score model in predicting business failure of Vietnamese companies. The results show that the Z-Score model accurately predicts 91% at the time of one year before companies are in financial distress, this rate decreases to 72% within two years. This is a high forecasting rate, showing that the Z-Score model is really a reliable model suitable for the Vietnamese market.

3. RESEARCH METHODOLOGY

3.1. Data collection

This research paper uses data from 30 companies that delisted on UPCoM due to financial distress and 30 companies with Z-score greater than 4.35 on Ho Chi Minh City Stock Exchange (HoSE) (for example: Companies are not classified as financially distressed) for 5 years from 2018 to 2022, corresponding to 300 observations. The selected companies have enough audited financial statement data during the research period which are collected from websites such as *cafef.vn*, *vietstock.vn*, and websites with data on companies' financial statements. Research data is first collected from the audited financial statements of companies in the sample; The financial factors are taken from the balance sheet and income statement by the author to calculate the Z-Score. The companies in the sample are divided into 2 groups, including the group of financially distressed companies, as follows:

Group 1: Companies delisted on the stock exchange due to financial distress. And Group 1 is divided into 2 groups as follows:

Group 1a: Companies with low level of financial distress (for example, companies with Z-Score greater than 4.35. Why do companies with high Z-Score delist on the stock exchange?);

Group 1b: Companies with high level of financial distress (for example, companies with Z-Score lower than 4.35).

Group 2: Companies with stable financial position, listed on the stock exchange (for example, companies with Z-Score greater than 4.35).

3.2. Research model

On the basis of empirical results from relevant domestic and foreign studies, the author uses the modified Z-score model (Emerging Market Score) of Altman and Hotchkiss (2006) for companies in emerging markets like Vietnam on two stock exchanges, HoSE and UPCoM. The modified Z-score model is as follows:

$$Z'' = 3.25 + 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$$

Where: WCTA: Working Capital / Total Assets;

RETA: Retained Earnings / Total Assets;

EBITTA: Earnings before Interest and Taxes/Total Assets;

MVETL: Market Value of Equity / Book Value of Total Liabilities.

4. HYPOTHESIS

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

Hypothesis 1 (H1a): There is a significant difference in WCTA between Group 1 and Group 2.

H₀: There is no significant difference in WCTA between Group 1 and Group 2

H₁: There is a significant difference in WCTA between Group 1 and Group 2

Hypothesis 2 (H1b): There is a significant difference in WCTA between Group 1a and Group 1b.

H₀: There is no significant difference in WCTA between Group 1a and Group 1b

H₁: There is a significant difference in WCTA between Group 1a and Group 1b

Hypothesis 3 (H2a): There is a significant difference in RETA between Group 1 and Group 2.

H₀: There is no significant difference in RETA between Group 1 and Group 2

H₁: There is a significant difference in RETA between Group 1 and Group 2

Hypothesis 4 (H2b): There is a significant difference in RETA between Group 1a and Group 1b.

H₀: There is no significant difference in RETA between Group 1a and Group 1b

H₁: There is a significant difference in RETA between Group 1a and Group 1b

Hypothesis 5 (H3a): There is a significant difference in EBITTA between Group 1 and Group 2.

H₀: There is no significant difference in EBITTA between Group 1 and Group 2

H₁: There is a significant difference in EBITTA between Group 1 and Group 2

Hypothesis 6 (H3b): There is a significant difference in EBITTA between Group 1a and Group 1b.

H₀: There is no significant difference in EBITTA between Group 1a and Group 1b

H₁: There is a significant difference in EBITTA between Group 1a and Group 1b

Hypothesis 7 (H4a): There is a significant difference in MVETL between Group 1 and Group 2.

H₀: There is no significant difference in MVETL between Group 1 and Group 2

H₁: There is a significant difference in MVETL between Group 1 and Group 2

Hypothesis 8 (H4b): There is a significant difference in MVETL between Group 1a and Group 1b.

H₀: There is no significant difference in MVETL between Group 1a and Group 1b

H₁: There is a significant difference in MVETL between Group 1a and Group 1b

Hypothesis 9 (H5a): There is a significant difference in Z-Score between Group 1 and Group 2.

H₀: There is no significant difference in Z-Score between Group 1 and Group 2

H₁: There is a significant difference in Z-Score between Group 1 and Group 2

Hypothesis 10 (H5b): There is a significant difference in Z-Score between Group 1a and Group 1b.

H₀: There is no significant difference in Z-Score between Group 1a and Group 1b

H₁: There is a significant difference in Z-Score between Group 1a and Group 1b

5. RESEARCH METHOD

The study uses the Independent-samples T-test to test the research model. The T-test compares the means of two independent samples to determine if there is statistical evidence that the means of two populations are significantly different or not. The Independent-samples T-test is a parametric test. This study uses this method to examine the differences between Group 1 and Group 2, as well as between Group 1a and Group 1b.

6. RESULTS AND DISCUSSION

6.1. Independent T-Test results between companies in Group 1 and Group 2

6.1.1. Description of the study sample

Descriptive statistics of the variables used in the model are shown in Table 1 below.

Table 1. Descriptive statistics of the variables in Group 1 and Group 2

Variables	Group	Obs	Mean	Std. Deviation
WCTA	1	150	0.0123	0.2897
	2	150	0.3638	0.1873
RETA	1	150	-0.1426	0.2477
	2	150	0.0762	0.1868
EBITTA	1	150	0.0174	0.0915
	2	150	0.0929	0.0655
MVETL	1	150	0.8242	1.1803
	2	150	3.0673	3.4124
Z-SCORE	1	150	3.8483	3.7134
	2	150	9.7300	4.1688

Source: Authors' processing.

According to the data in Table 1, in Group 1, WCTA has a mean of 0.0123 and a standard deviation of 0.2897; RETA has a low mean of -0.1426 and a standard deviation of 0.2477; EBITTA has a mean of 0.0174 and a standard deviation of 0.0915; MVETL has a mean of 0.8242 and a standard deviation of 1.1803. Z-Score of Group 1 has a low mean of 3.8483 (much less than 4.35) and a standard deviation of 3.7134, showing that companies in this group have a high risk of business failure, and Z-scores of companies in group 1 are significantly different.

In Group 2, descriptive statistics show that WCTA has a mean of 0.3638 and a standard deviation of 0.1873; RETA has a mean of 0.0762 and a standard deviation of 0.1868; EBITTA has a mean of 0.0929 and a standard deviation of 0.0655; MVETL has a high mean of 3.0673 and a standard deviation of 3.4124. Especially, Z-Score of group 2 has a high mean of 9.7300 (much greater than the standard value of 4.35) and a standard deviation of 4.1688, which indicates that companies in group 2 are not financially distressed and there is a significant difference in Z-Score among companies in this group.

6.1.2. Independent-samples T-test results between Group 1 and Group 2

The T-test results of WCTA, RETA, EBITTA, MVETL, Z-SCORE between group 1 and group 2 are presented in Table 2 below.

The results of Levene's test in Table 2 show that WCTA, RETA, and MVETL have P-value of 0.044, 0.003, 0.001, respectively (< 0.05); accordingly, the authors rejects hypothesis H_0 . Thus, the variances of the two groups are different. The T-test results of WCTA, RETA, and MVETL with equal variances not assumed in Table 2 indicate that the P-value is 0.000, 0.000, 0.002, respectively (< 0.05); accordingly, the authors rejects hypothesis H_0 . Hence, there is a difference in WCTA, RETA, and MVETL between Group 1 (delisted companies) and Group 2 (listed companies). Therefore, with the 95% confidence interval, it can be concluded that prediction of financial distress is different between Group 1 and Group 2.

The results of Levene's test in Table 2 show that EBITTA and Z-SCORE have P-values of 0.088, 0.925, respectively (> 0.05); consequently, there is no basis to reject hypothesis H_0 . Thus, the variances of the two samples are equal. The T-test results in Table 2 (in case of equal variances assumed) indicate that the P-value is 0.001, 0.000, respectively (< 0.05); so the authors rejects hypothesis H_0 . Thus, there is a difference in EBITTA and Z-SCORE between Group 1 (delisted companies) and Group 2 (listed companies). Therefore, with the 95% confidence interval, it can be concluded that prediction of financial distress is different between Group 1 and Group 2.

Table 2. T-test results of WCTA, RETA, EBITTA, MVETL, Z-SCORE between Group 1 and Group 2

Independent Samples Test										
		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	
1		2	3	4	5	6	7	8	9	10
WCTA_TB	Equal variances assumed	4.257	0.044	-5.581	58	0.000	-0.3515	0.0630	-0.4776	-0.2255
	Equal variances not assumed			-5.581	49.634	0.000	-0.3515	0.0630	-0.4781	-0.2250

1	2	3	4	5	6	7	8	9	10	
RETA_TB	Equal variances assumed	9.316	0.003	-3.863	58	0.000	-0.2188	0.0566	-0.3322	-0.1054
	Equal variances not assumed			-3.863	53.932	0.000	-0.2188	0.0566	-0.3324	-0.1053
EBITTA_TB	Equal variances assumed	3.015	0.088	-3.672	58	0.001	-0.0754	0.0205	-0.1166	-0.0343
	Equal variances not assumed			-3.672	52.560	0.001	-0.0754	0.0205	-0.1167	-0.0342
MVETL_TB	Equal variances assumed	13.324	0.001	-3.403	58	0.001	-2.2430	0.6592	-3.5626	-0.9234
	Equal variances not assumed			-3.403	35.841	0.002	-2.2430	0.6592	-3.5802	-0.9058

Source: Authors' processing.

6.2. Independent T-Test results between Group 1a and Group 1b

6.2.1. Description of the study sample

Descriptive statistics of the variables used in the model are shown in Table 3 below.

Table 3. Descriptive statistics of the variables in Group 1a and Group 1b

Variables	Group	Obs	Mean	Std. Deviation
WCTA	1a	50	0.3485	0.1427
	1b	100	-0.1558	0.1709
RETA	1a	50	0.0987	0.1133
	1b	100	-0.2633	0.2039
EBITTA	1a	50	0.1134	0.0513
	1b	100	-0.0305	0.0653
MVETL	1a	50	1.7102	1.6976
	1b	100	0.3813	0.3762
Z-SCORE	1a	50	8.4156	1.6409
	1b	100	1.5647	1.8175

Source: Authors' processing.

Table 3 presents descriptive statistics of the study on characteristics between Group 1a and Group 1b. In Group 1a, WCTA has a mean of 0.3485 and a standard deviation of 0.1427; RETA has a mean of 0.0987 and a standard deviation of 0.1133; EBITTA has a mean of 0.1134 and a standard deviation of 0.0513; MVETL has a mean of 1.7102 and a standard deviation of 1.6976. Statistical data show that Z-Score of Group 1a has a high mean of 8.4156 (much greater than 4.35) and a standard deviation of 1.6409, indicating that the companies in this group are not at risk of bankruptcy, and the difference in Z-score within the group is very small.

In Group 1b, WCTA has a low mean of -0.1558 and a standard deviation of 0.1709; RETA has a low mean of -0.2633 and a standard deviation of 0.2039; EBITTA has a low mean of -0.0305 and a standard deviation of 0.0653; MVETL has a mean of 0.3813 and a standard deviation of 0.3762. Especially, Z-Score of this group has a very low mean of 1.5647 (much less than the standard value of 4.35) and a standard deviation of 1.8175. Descriptive statistics point out that companies in this group have a very high risk of bankruptcy, and the difference in Z-score within the group is also significant.

6.2.2. Independent T-Test results between Group 1a and Group 1b

The T-test results of WCTA, RETA, EBITTA, MVETL, Z-SCORE between group 1a and group 1b are presented in Table 4 below.

Table 4. T-test results of WCTA, RETA, EBITTA, MVETL, Z-SCORE between Group 1a and Group 1b

Independent Samples Test										
		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_TB	Equal variances assumed	0.000	0.982	8.021	28	0.000	0.5043	0.0629	0.3755	0.6332
	Equal variances not assumed			8.530	21.339	0.000	0.5043	0.0591	0.3815	0.6272
RETA_TB	Equal variances assumed	7.576	0.010	5.197	28	0.000	0.3620	0.0697	0.2193	0.5046
	Equal variances not assumed			6.242	27.542	0.000	0.3620	0.0580	0.2431	0.4808
EBITTA_TB	Equal variances assumed	0.397	0.534	6.077	28	0.000	0.1439	0.0237	0.0954	0.1924
	Equal variances not assumed			6.596	22.513	0.000	0.1439	0.0218	0.0987	0.1891
MVETL_TB	Equal variances assumed	9.590	0.004	3.394	28	0.002	1.3289	0.3916	0.5268	2.1310
	Equal variances not assumed			2.446	9.445	0.036	1.3289	0.5434	0.1085	2.5493
Z_SCORE_TB	Equal variances assumed	0.060	0.808	10.035	28	0.000	6.8508	0.6827	5.4524	8.2492
	Equal variances not assumed			10.394	19.884	0.000	6.8508	0.6591	5.4754	8.2262

Source: Authors' processing.

The results of Levene's test in Table 4 show that RETA and MVETL have P-value of 0.010, 0.004, respectively (< 0.05); accordingly, the authors rejects hypothesis H_0 . Thus, the variances of the two groups are different. The T-test results of RETA and MVETL with equal variances not assumed in Table 4 indicate that the

P-value is 0.000, 0.036, respectively (< 0.05); accordingly, the authors rejects hypothesis H_0 . Hence, there is a difference in RETA and MVETL between Group 1a (group of companies with low level of financial distress) and Group 1b (group of companies with high level of financial distress). Therefore, with the 95%

confidence interval, it can be concluded that prediction of financial distress is different between Group 1a and Group 1b.

The results of Levene's test in Table 4 show that WCTA, EBITTA and Z-SCORE have P-values of 0.982, 0.534, 0.808, respectively (> 0.05); consequently, there is no basis to reject hypothesis H_0 . Thus, the variances of the two samples are equal. The T-test results in Table 4 (in case of equal variances assumed) indicate that the P-value is 0.000, 0.000, 0.000, respectively (< 0.05); so the authors reject hypothesis H_0 . Thus, there is a difference in WCTA, EBITTA and Z-SCORE between Group 1a (group of companies with low level of financial distress) and Group 1b (group of companies with high level of financial distress). Therefore, with the 95% confidence interval, it can be concluded that prediction of financial distress is different between Group 1a and Group 1b.

7. CONCLUSION AND RECOMMENDATIONS

7.1. Conclusion

According to the research results, there is a significant difference in four variables: WCTA, RETA, EBITTA, MVETL in the Z-Score model between the group of distressed companies and the group of non-distressed companies. The difference in each independent variable is assessed as follows:

7.1.1. Working Capital to Total Assets (WCTA)

This result proves that the higher the WCTA is, the more the current assets are to meet the short-term debt payment obligations and the business performance requirements of companies. Therefore, the probability of financial distress and bankruptcy risk is low.

7.1.2. Retained Earnings to Total Assets (RETA)

This result demonstrates that the higher the retained earnings are, the more profit a company can generate from its assets; and the stronger the business performance is, the higher this index will be. Therefore, the probability of financial distress and bankruptcy risk is low.

7.1.3. Earnings Before Interest and Taxes to Total Assets (EBITTA)

This result does not mention the capital structure as well as the tax rate of companies, which will help investors easily compare the degree of revenue generation and the business performance of companies. Therefore, the possibility of financial distress, and bankruptcy risk as well as the risk of information manipulation will be lower.

7.1.4. Market Value of Equity to Total Liabilities (MVETL)

Research results indicate that the higher the market value of equity is, the higher the market value of company is, and the total liabilities of that company can be settled. In addition, this ratio also expresses high expectations of the market for companies. Therefore, the possibility of financial distress, and bankruptcy risk as well as the risk of information manipulation will be lower.

The research results present that there is a statistically significant difference in the ratios in the Z-Score model between the group of distressed companies and the group of non-distressed companies. In terms of using subsamples, the study also shows that there is a statistical difference in characteristics and Z-scores between the group of companies with low level of financial distress and the group of companies with high level of financial distress.

Among them, the authors find that WCTA and EBITTA have the greatest influence on the model with coefficients of 6.56 and 6.72, respectively. The findings show that the more working capital and profitability the companies have, the more stable their financial health is. Such companies will face less risk of financial distress and bankruptcy. Based on these results, some recommendations have been made to assist companies in detecting, preventing and strictly controlling high risk of financial distress.

7.2. Recommendations

7.2.1. For companies in general

Firstly, companies need to clearly and transparently disclose the data in financial statements. The data in the financial statements of listed companies are audited and posted on reliable and reputable websites. However, it is difficult to verify the truthfulness of the data on the financial statements of listed companies. Therefore, establishing a reputable database system to aim at consolidation in management and supply of official and transparent data of companies, is very necessary.

Secondly, companies should focus on measures to improve the efficiency of asset utilization in order to minimize the risk of financial distress and bankruptcy. Companies need to optimize their asset structure reasonably and suitably for their business activities. Companies can increase investment in the assets that are highly-liquid and less risky, and reduce investment in the assets that are difficult to sell and are easily recovered. Besides, companies need to take measures such as liquidation or sale of assets that are ineffectively used or have low efficiency. The business scale of companies will not be affected by the liquidation or sale of these assets; on the contrary, it may increase the net working capital because a certain amount of money will be collected when selling. Therefore, an increase in WCTA and a decrease in depreciation expense also causes profit to be increased, leading to an increase in the numerators of RETA and EBITTA.

Thirdly, companies need to consider and manage liabilities in their capital structure. A lot of previous studies point out that the majority of companies that are at risk of financial distress leading to bankruptcy risk have liabilities much larger than equity, or their liabilities have too much impact on their capital structure (low MVETL). Companies need to be careful when using leverage to ensure stability in capital structure. Because inefficient use of leverage can lead to an increase in financial risk, insolvency risk, thereby leading to the risk of financial distress, and the worst case scenario of

bankruptcy. If companies manage their liabilities well, it is acceptable for them to have high leverage.

Fourthly, companies should pay attention to their liquidity because this is a factor that strongly affects their financial health. Effective management of cash funds and short-term assets helps companies ensure liquidity and avoid financial risks. Companies need to have a good management policy of short-term assets, or in other words, a reasonable sales policy to be able to appropriately forecast the amount of inventory and receivables. In addition, financial expenses will increase if companies use too much financial leverage in the short term, and the higher the expenses are, the more difficult it will be for companies.

Fifthly, companies need to increase their retained earnings and improve their business performance. The increase in this financial indicator has a direct impact on the RETA variable and helps to improve the Z-score. Besides, increasing the retained earnings and improving business performance also assists companies in increasing equity, affecting capital structure, and creating a safe protection layer for companies. The retention of profits over the years helps the Z'-Score model improve two ratios, RETA and MVETL. Most importantly, when companies want to retain profits, they themselves need to be profitable in the years of operation. Therefore, it is extremely important for companies to improve business performance, increase revenue, and save costs.

Sixthly, companies should save costs to increase pre-tax profits. With the largest proportion in the Z'-Score model (6.72), the fluctuation of EBITTA has a great impact on the Z-score. The fact that companies do not manage business activities well can lead to negative profits and business losses, then they will fall into very serious financial risks. Therefore, companies need to regularly analyze market needs, grasp customer segmentation, create a potential customer market to increase revenue in a sustainable and healthy way.

7.2.2. For the State Securities Commission of Vietnam

This research paper indicates that most of the companies with a high level of financial distress have negative Z-Score and ratios such as WCTA, RETA, and EBITTA for many consecutive years before delisting. Accordingly, it is recommended that the State Securities Commission of Vietnam builds a standard scoring scale based on the Z-Score model to detect financially distressed companies. Along with that, it is necessary to maintain a legal system which is strong enough to strictly control and regularly supervise competent authorities in order to ensure effective and efficient operations of companies. Specifically, the State Securities Commission of Vietnam needs to apply delisting to companies with negative working capital, retained earnings, pre-tax income, and interest income for 3 consecutive years.

7.2.3. For users of financial statements

Users of financial statements like investors will not only rely on capital market information or market trends, but also pay attention to the companies with Z-score values less than 4.35 for several consecutive years. Thereby, investors can avoid investing in such companies as well as can make more rational decisions to avoid economic losses. Moreover, the quality of the financial information disclosed is closely related to auditors' performance. Therefore, auditors should pay attention to signs of accounting fraud in the financial statements of that company. Accordingly, auditors will calculate the Z-Score based on the model in this study. After determining the Z-Score, based on this result, auditors can make initial judgments about the financial position of company, thereby making an appropriate audit plan. In addition, creditors such as commercial banks can also use the Z-score as a benchmark to carefully carry out credit granting procedures.

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