

# Using Altman's Z-score model to predict financial distress: construction companies listed in the Stock Exchange of Thailand

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## Abstract

Construction sector is one of the important factors of Thai economy. This research collects financial statements of all the 21 companies of construction services sector listed in the Stock Exchange of Thailand for the period between 2017- 2019 in order to study the bankruptcy risk (financial distress) by using Altman's Z – score model. And all the 21 companies of construction services sector in the Stock Exchange of Thailand are classified into safe zone, grey zone and bankruptcy zone according to the result of Z-score. The result is that 8 of the 21 construction companies has the opportunity to bankrupt and the financial ratios (Working capital/total assets ( $X_1$ ), Retained earnings/total assets ( $X_2$ ), EBIT/total assets ( $X_3$ ), and market value of equity/total liabilities ( $X_4$ )) does affect the value of Z-score.

Keywords: Altman's Z-score model; financial distress

## Introduction

Construction sector is one of the leading sectors in Thai economy. During 2009-2018, construction investment has accounted for 8.4% of Thailand's gross domestic product (GDP) so the sector's health has important consequences for employment and linkages with related sectors, such as construction materials and real estate. Since construction industry is part of the essential factor of Thai economy, the financial healthiness of the industry should also be concerned. Construction companies are particularly vulnerable to impact brought by the reform of economic system, adjustment in macroeconomic policy, changes in the structure of market demand, increasing price of raw material, etc. Financial distress is costly because it creates a tendency for firms to do things that are harmful to debt holders and non-financial stakeholders, impairing access to credit and raising stakeholder

relationships. The bankruptcy or predictive models are the early warning systems based on an analysis of selected indicators that have the ability to indicate a threat in the company's financial health. Altman's Z- score model is one of the most frequently used bankruptcy model. . Altman E.I. published the original bankruptcy model- Altman's Z- score in 1968. After that, Altman's model has been widely adopted to evaluate the risk performance of variable kinds of firms. In Thailand, this model is also widely used to analysis the financial distress by studying the relationship between key financial ratios and the Z-score that represent the company's performance in each criterion. Therefore, Altman's Z-score model is used in this study to predict the financial distress of construction companies listed in the Stock Exchange of Thailand. And the revised Altman's Z-score model-the non-productive and start-ups business one is used in this study due to the population of the research are companies listed in construction services sector in the Stock Exchange of Thailand which are non-productive companies. Thus, this study aims to use Altman's Z-score model-the non-productive and start-ups business one to analyze the financial distress of construction companies listed in the Stock Exchange of Thailand.

#### **. Research objectives**

- To study the bankruptcy risk (financial distress) of construction companies listed in the Stock Exchange of Thailand by using Altman's Z-score model
- To study whether financial ratios (Working capital/total assets ( $X_1$ ), Retained earnings/total assets ( $X_2$ ), EBIT/total assets ( $X_3$ ), and market value of equity/total liabilities ( $X_4$ )) affect the value of Z-score
- To classify construction companies listed in the Stock Exchange of Thailand
- To predict the bankruptcy risk (financial distress) of construction companies listed in the Stock Exchange of Thailand

#### **Hypotheses**

H0: Financial ratios (Working capital/total assets ( $X_1$ ), Retained earnings/total assets ( $X_2$ ), EBIT/total assets ( $X_3$ ), and market value of equity/total liabilities ( $X_4$ )) do not affect the value of Z-score.

H1: Financial ratios (Working capital/total assets ( $X_1$ ), Retained earnings/total assets ( $X_2$ ), EBIT/total assets ( $X_3$ ), and market value of equity/total liabilities ( $X_4$ )) do affect the value of Z-score.

## **Scope of the research**

### **-Information scope**

This study is based on secondary data. The financial ratios were calculated from financial statement of the Companies of construction services sector in the Stock Exchange of Thailand that the population consisted of 21 companies for the period between 2017- 2019.

Independent Variables are four financial ratios in Altman's Z-Score Model. The ratios are listed below:

1. working capital divided by total assets,
2. retained earnings divided by total assets,
3. earnings before interest and taxes (EBIT) divided by total assets,
4. the market value of equity and preferred stock divided by liabilities,

Dependent Variables are risk (Probability of bankruptcy) that calculated by Altman's Z-Score Model that calculated from the data of the Stock Exchange of Thailand

### **-Population and time scope**

There are total 23 companies listed in construction services sector in the Stock Exchange of Thailand, with one (KTECH) which is under rehabilitation, now as a non performing group and one (PAE) which has possibility to be delisted. Thus, the population of the research is the 21 companies of construction services sector in the Stock Exchange of Thailand for the period between 2017- 2019.

## **Contribution of the study**

The result can provide the information for creditors and/ or investors interested to invest in construction services sector in the Stock Exchange of Thailand

## **Altman's Z- score model**

Altman E.I. published the original bankruptcy model- Altman's Z- score in 1968. The aim of model was to differentiate the well-performing businesses from the other businesses, which are going to the bankruptcy (Altman, 1968). Model (Z-score) predicts the possible bankruptcy of the business based on the coefficient, which is a weighted average of selected ratios, which scales are determined by discriminant analysis, which reflects the importance of the indicator for the future business development (Taffler, 1982).

The original Altman's Z – score model:

$$Z= 1.2X1+1.4X2+3.3X3+0.6X4+0.999X5$$

X1 = The ratio of working capital to total assets.

X2 = The ratio of retained earnings to total assets,

X3 = The ratio of earnings before interest and taxes to total assets,

X4 = The ratio of the book value of equity to total liabilities,

X5 = The ratio of sales to total assets.

In 1983, Altman developed a revised Z-score model for privately held firms. The updated Z-score model includes the same ratios as the original model but a small change is by the fourth parameter, where the business's market value was replaced by book value. It also changed the weights of individual ratios and consequently the evaluation criteria (Altman, 2006).

Altman's Z-score model --- for privately held firms

$$Z = 0.717X1 + 0.847X2 + 3.107X3 + 0.420X4 + 0.998X5$$

X1 = The ratio of working capital to total assets.

X2 = The ratio of retained earnings to total assets,

X3 = The ratio of earnings before interest and taxes to total assets,

X4 = The ratio of the book value of equity to total liabilities,

X5 = The ratio of sales to total assets.

In 1993, Altman's continued research produced a further revised model, one that eliminates variables X5, sales/total assets. This modified version is designed for non-productive and start-ups business (Graham, 2000).

Altman's Z-score model --- for the non-productive and start-ups business

$$Z = 6.56X1 + 3.26X2 + 6.72X3 + 1.05X4$$

X1 = The ratio of working capital to total assets.

X2 = The ratio of retained earnings to total assets,

X3 = The ratio of earnings before interest and taxes to total assets,

X4 = The ratio of the book value of equity to total liabilities

## **Research Methodology**

### Data collection

This study is based on secondary data. The data was collected from the websites of Stock Exchange of Thailand (<http://www.settrade.com>). The financial ratios were calculated from financial statement of the Companies of construction sector that the population consisted of 21 companies from 2017 to 2019.

### Research method

- Altman's Z-Score Model

This study uses Altman's Z-Score Model (the non-productive one) to analyze the level of risk (financial distress). Altman used five weighted variables to calculate the Z-Score. These different ratios were combined into a single measure Z-Score Analysis.

The formula used to evaluate the Z-Score analysis as established by Altman is as follows:

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

Where,

Z = the discriminant score,

X<sub>1</sub> = The ratio of working capital to total assets.

X<sub>2</sub> = The ratio of retained earnings to total assets,

X<sub>3</sub> = The ratio of earnings before interest and taxes to total assets,

X<sub>4</sub> = The ratio of the market value of equity and preferred stock to total liabilities,.

Scores that add to Z-score < 1.1 have a high probability of bankruptcy or distress zone, while Z-scores > 2.6 represent financial soundness or safe zone. The gray zone of ignorance exists when firms have Z-score between 1.1 and 2.6.

- Multiple linear regression analysis

After the ratios and Z-score are computed, the data will be analyzed through multiple linear regression analysis by using SPSS program. Multiple linear regression analysis is used when predicting the value of a variable based on the value of two or more other variables (Levine et. al., 2001).

## Results

### Financial ratios and Z-score

According to the result, Z-scores of BJCHI are 32.29706 in 2017, 30.46823 in 2018 and 8.892931 in 2019. Z-scores of BKD are 8.502316 in 2017, 9.769476 in 2018 and 9.768473 in 2019. Z-scores of CK are 1.891656 in 2017, 1.415738 in 2018 and 1.527756 in 2019. Z-scores of CNT are 2.342182 in 2017, 0.410878 in 2018 and 0.912635 in 2019. Z-scores of EMC are -3.41468 in 2017, 0.986227 in 2018 and -0.20237 in 2019. Z-scores of ITD are 0.773107 in 2017, 0.653182 in 2018 and 0.035005 in 2019. Z-scores of NWR are 1.579776 in 2017, 2.148017 in 2018 and 0.072325 in 2019. Z-scores of PLE are 2.268928 in 2017, 1.532299 in 2018 and 1.819323 in 2019. Z-scores of PREB are 6.37796 in 2017, 4.460167 in 2018 and 4.054993 in 2019. Z-scores of PYLON are 41.69843 in 2017, 18.9619 in 2018 and 10.24097 in 2019. Z-scores of SEAFCO are 6.625033 in 2017, 6.090916 in 2018 and 5.378337 in 2019. Z-scores of SQ are 0.146803 in 2017, -0.82078 in 2018 and -0.37342 in 2019. Z-scores of SRICHA are 32.06134 in 2017, 25.94378 in 2018 and 12.44909 in 2019. Z-scores of STEC are 1.875807 in 2017, 1.17892 in 2018 and 0.325452 in 2019. Z-scores of STPI are 6.33618 in 2017, 4.129983 in 2018 and 7.411463 in 2019. Z-scores of SYNTEC are 5.236047 in 2017, 3.842075 in 2018 and 3.174735 in 2019. Z-scores of TPOLY are 0.98555 in 2017, 1.045091 in 2018 and 0.54297 in 2019. Z-scores of TRC are 5.68053

in 2017, -4.29269 in 2018 and 0.041504 in 2019. Z-scores of TRITN are 1.760069 in 2017, 7.147158 in 2018 and 5.21332 in 2019. Z-scores of TTCL are 1.877831 in 2017, 0.555575 in 2018 and 1.111477 in 2019. Z-scores of UNIQ are 2.49694 in 2017, 2.181942 in 2018 and 1.99162 in 2019.

### Hypothesis testing

The results from the Model Summary Table indicate that the correlation coefficient (R) is equal to 1.000; this means that financial ratios (Working capital/total assets ( $X_1$ ), Retained earnings/total assets ( $X_2$ ), EBIT/total assets ( $X_3$ ), and market value of equity/total liabilities ( $X_4$ )) significantly affect the value of Z-score. The results from the t-statistic table, shows the results as following:

-Working capital/total assets ( $X_1$ ): the significance is equal to 0.000, which is less than 0.01(0.000<0.01). The calculated unstandardized coefficient B value equals 6.560; this means that when Working capital/total assets ( $X_1$ ) was changed 1 unit, the value of Z-score was expected to have a positive change of 6.56 units. Thus, the null hypothesis was rejected and Working capital/total assets ( $X_1$ ) significantly affect the value of Z-score at the 0.01 significant level. (Beta= 0.137)

- Retained earnings/total assets ( $X_2$ ): the significance is equal to 0.000, which is less than 0.01(0.000<0.01). The calculated unstandardized coefficient B value equals 3.260; this means that when Retained earnings/total assets ( $X_2$ ) was changed 1 unit, the value of Z-score was expected to have a positive change of 3.26 units. Thus, the null hypothesis was rejected and Retained earnings/total assets ( $X_2$ ) significantly affect the value of Z-score at the 0.01 significant level. (Beta= 0.094)

- EBIT/total assets ( $X_3$ ): the significance is equal to 0.000, which is less than 0.01(0.000<0.01). The calculated unstandardized coefficient B value equals 6.720; this means that when EBIT/total assets ( $X_3$ ) was changed 1 unit, the value of Z-score was expected to have a positive change of 6.72 units. Thus, the null hypothesis was rejected and EBIT/total assets ( $X_3$ ) significantly affect the value of Z-score at the 0.01 significant level. (Beta= 0.093)

- Market value of equity/total liabilities ( $X_4$ ): the significance is equal to 0.000, which is less than 0.01(0.000<0.01). The calculated unstandardized coefficient B value equals 1.050; this means that when Market value of equity/total liabilities ( $X_4$ ) was changed 1 unit, the value of Z-score was expected to have a positive change of 1.05 units. Thus, the null hypothesis was rejected and Market value of equity/total liabilities ( $X_4$ ) significantly affect the value of Z-score at the 0.01 significant level. (Beta=0.870)

As the result, from high to low, the rank is that  $X_4$  affects Z-score most (87%), followed with  $X_1$  (13.7%) and  $X_2$  (9.4%) and the last one is  $X_3$  (9.3%).

The result of the hypothesis test is that  $H_1$ : Financial ratios (Working capital/total assets ( $X_1$ ), Retained earnings/total assets ( $X_2$ ), EBIT/total assets ( $X_3$ ), and market value of equity/total liabilities ( $X_4$ )) does affect the value of Z-score is accepted and  $H_0$ : Financial ratios (Working capital/total

assets ( $X_1$ ), Retained earnings/total assets ( $X_2$ ), EBIT/total assets ( $X_3$ ), and market value of equity/total liabilities ( $X_4$ )) does not affect the value of Z-score is rejected.

#### Classification

All the 21 construction companies can be classified into 3 zones, which are safe zone, grey zone and bankruptcy zone according to the computed Z-score. The result is shown as Table 6.

Of all the 21 companies, 9 companies are in the safe zone, 8 companies are in the grey zone and only 4 companies are in the bankruptcy zone during 2017. In 2018, there are 9 companies in the safe zone, 5 companies in the grey zone and 7 companies in the bankruptcy zone. As for the year of 2019, the 9 companies in the safe zone stays the same as 2018, 4 companies are in the grey zone and 8 companies are in the bankruptcy zone.

#### Bankruptcy risk prediction

During the period of 2017-2019, 9 construction companies (BJCHI, BKD, PREB, PYLON, SEAFCO, SRICHA, STPI, SYNTEC and TRITN) remained in good condition, whereas 8 of the 9 companies (BJCHI, BKD, PREB, PYLON, SEAFCO, SRICHA, STPI, SYNTEC) has stayed in safe zone for all the 3 years. 3 companies (CK, PLE, UNIQ) has stayed in grey zone from 2017 to 2019, while TTCL was in grey zone in 2017, dropped to bankruptcy zone in 2018 and backed to grey zone in 2019. NWR and STEC were in grey zone during 2017 and 2018 but both dropped to bankruptcy zone in 2019. As for TRC, the company was in great condition in 2017 but suddenly dropped to bankruptcy zone since 2018. And for the left 5 companies, four of them (EMC, ITD, SQ, TPOLY) has stayed in bankruptcy zone for all the 3 years, while CNT was in grey zone in 2017 but dropped into bankruptcy zone since 2018.

#### Conclusion

This research collects financial statements of all the 21 companies of construction services sector in the Stock Exchange of Thailand for the period between 2017- 2019 and computes 4 financial ratios (Working capital/total assets ( $X_1$ ), Retained earnings/total assets ( $X_2$ ), EBIT/total assets ( $X_3$ ), and market value of equity/total liabilities ( $X_4$ )) and the value of Z-score of all the 21 companies for the period between 2017- 2019 in order to study the bankruptcy risk (financial distress). According to the results of Z-score, 21 companies were classified into three zones (safe zone, grey zone and bankruptcy zone) and there are 8 companies (CNT, EMC, ITD, NWR, SQ, STEC, TPOLY and TRC) in bankruptcy zone in 2019. The hypothesis is tested by multiple linear regression analysis and the result is that the financial ratios (Working capital/total assets ( $X_1$ ), Retained earnings/total assets ( $X_2$ ), EBIT/total assets ( $X_3$ ), and market value of equity/total liabilities ( $X_4$ )) do affect the value of Z-score.

## **Implications**

Although the result can provide the information for creditors and/ or investors interested to invest in construction services sector in the Stock Exchange of Thailand, creditors and/ or investors should also take other factors into considerations. That is, when creditors and/ or investors want to invest in construction services sector in the Stock Exchange of Thailand, they should use not only the result of this research but also other information such as political, economic and social factors, fundamental analysis, and timing to make their decisions.

## **Limitations and Future research**

One of the limitations of this research is that Altman's Z-score model is the only method to predict financial distress in this study. To include other methods of financial distress would have strengthened the results. The other limitation is the specific selected sector and period, construction sector and the period between 2017- 2019. This research can form a basis for further research to include other methods to predict financial distress to strengthen the result and keep doing the research for the following years.

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