Using the altman's Z-score formula to assess the financial situation of military construction enterprises in Vietnam

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ABSTRACT

Military construction enterprises are classified as defense economic enterprises and are subject to regulation by two legal systems: the State's legal system for regulating enterprises in general and provisions of law on national defense. As a result, military construction enterprises have unique characteristics that distinguish them from other enterprises. These characteristics include the organizational form, capital mobilization form, depreciation management, receivable management, and profits distribution of military construction enterprises. This study uses data from financial statements of 22 military construction enterprises from 2015 to 2019 including both joint stock companies and 100% state-owned enterprises to calculate the Altman Z-score formula. The Altman Z-score is a linear combination of four or five common business ratios, weighted by coefficients. Z-scores are used to predict corporate defaults and an easy-to-calculate control measure for the financial distress status of enterprises with high reliability. Due to the difference between military construction enterprises and conventional enterprises, the Altman model is applied in the article to evaluate the financial status of military construction enterprises. The research results show that the decrease in business efficiency causes the ratio of revenue and profit to total assets of military construction enterprises to decrease sharply, the proportion of working capital in total assets is low. Furthermore, the ratio of equity to total debt is the most important reason to make low Z-score that means prediction of a high risk of bankruptcy in military construction enterprises. An evidence base from the research results is used for making a number of proposals to reduce the risk of bankruptcy and improving the efficiency of financial management of enterprises.

1. Introduction

War, epidemics, recession, etc. are greatly affecting the growth of construction enterprises in Vietnam. In addition, due to the requirements of the market economy and economic integration the Vietnam Government has issued economic policies to strengthen the restructuring of the economy with a focus on equitization of state-owned enterprises, including military enterprises [[1]]. It can be said that the current economic situation and the State's policies have a very strong impact on military construction enterprises. Military construction enterprises face many difficulties in terms of revenue growth, low instant solvency, risks from maintaining low inventories of supplies and materials in inventory management and limitations in receivable management [[2]]. In order to identify problems in financial management of enterprises, it is necessary to have an effective but easy-to-use tool to forecast the future situation of the business, thereby helping managers to plan future business activities for the business.

Construction enterprises in the military are classified as defense economic enterprises. The activities of military construction enterprises

are subject to strict regulation by two legal systems: the State's legal system for regulating enterprises in general and provisions of law on national defense. As a result, financial management of construction enterprises in the military has unique characteristics that distinguish it from financial management of other enterprises. These characteristics include the legal organization form and the operating mechanism of military construction enterprises. The mechanism of capital mobilization for production and business, depreciation of fixed assets, revenue management, and profit distribution in military construction enterprises is different from that of normal enterprises [[3]-[4]].

The financial management of the enterprises is influenced by several factors that are common to other enterprises, including the State's economic policies, the state of the economy, financial markets, intermediary financial institutions, and international economic integration. In addition to these common factors, the financial management of military construction enterprises is also influenced by typical factors of construction production such as cost management prone to loss and waste, inventory management, and large unfinished production and business costs. Cost management in the enterprises

must take into account risk factors and is closely related to construction techniques [[3]-[4]].

2. Literature review

During the operation of an enterprise, there are many important financial indicators that are used in forecasting the performance of an enterprise such as debt ratio, return on assets, payment ratio, etc. because they can reflect the business performance and financial risk level of the enterprise. However, examining each indicator can lead to bias or difficulty to draw accurate conclusions when the indicators contradict each other.

In 2014, in the research "*Distressed Distressed Firm and Bankruptcy Prediction in an International Context: A Review and Empirical Analysis of Altman's Z-Score Model*" [[5]], Altman and his colleagues surveyed data from more than 50 million businesses from 35 countries to examine the adoption of Z-Scores. In its initial test, the Altman Z-score was found to be 75% accurate in predicting bankruptcy two years before the event. In some countries, his model was found to be approximately 80–90% accurate. This result was confirmed again in 2018 in the study "*Applications of Distress Prediction Models: What Have We Learned After 50 Years from the Z-Score Models*".[[6]]

The other studies in the world Fawad Hussain (2014) [[7]], Geratonis, N. (2009)[[8]], Ahmad Khaliq (2014)[[9]], Tidathip Panrod (2017) [[10]], etc. have shown that the Z-score model can be applied in analyzing, evaluating and forecasting the situation of enterprises, helping to give early warning of the financial situation of enterprises.

In Vietnam, many authors have researched, tested and applied the Z-score. Le Cao Hoang Anh and Nguyen Thu Hang (2012) have retested Altman's Z-Score in predicting the failure of 293 companies listed on HOSE. Altman's Z-score has proven to be suitable for emerging markets with typically feature such as pnarrow access to capital, small size, and high liquidity risk [[11]]. Author Phạm Thị Tường Vân (2015) [[12]] and Diệp Thanh Tùng, Võ Thị Hoàng Phụng (2019) [[13]] have studied and applied the Z-score model to Vietnamese enterprises and drawn conclusions about the superiority of using Z-score in assessing the financial situation of enterprises. The results all show that Z-score is a reliable indicator, suitable for the Vietnamese market.

In particular, Trissan Nguyen and Trung Dung Doan (2018) [[14]] studied the health of the construction industry in Vietnam. The results showed that the Z-score model is suitable when the formula is applied in developing countries like Vietnam. Author Dinh Duc Minh (2019) [[15]] used data from 932 Vietnamese enterprises during the period from 2014 to and 2016 showed that although there are some errors in applying the Z-score model in predicting the probability of enterprises default, the model can be used to assess the financial situation of enterprises and find out the enterprises that are likely to default.

Based on researches in the world and tests when Z-score was applied in Vietnam, it can be seen that the Z-score can be used as an effective method of assessing the financial status of enterprises. In terms of governance, the Z-score shows five factors that directly affect the failure of enterprises: liquid assets in relation to the size of the company (X_1), profitability earning power. (X_2), operating efficiency apart from tax and leveraging factors (X_3), decide on capital structure (X_4) and total asset turnover (X_5). Calculating the Zscore with the above influencing factors is a simple and effective method in considering the status of corporate finance, assessing the current situation of corporate financial management.

The Altman formula has been successfully applied in Vietnam to assess the financial risk status of businesses . This formula can also be applied to military construction businesses in Vietnam to review their financial status.

The article aims at two main research objectives: i) Using the Z-score model to assess the financial sitution of military construction enterprises and ii) Suggesting some measures to adjust the Z-score in order to improve the quality of financial management of military construction enterprises.

3. Research method and data

The Z-score uses multiple enterprises income and balance sheet values to measure the financial health of a enterprises.

Model 1: Z-score financial situation model for manufacturing companies

$$Z = 1{,}2X_1 + 1{,}4X_2 + 3{,}3X_3 + 0{,}64X_4 + 0{,}999X_5 \qquad \textbf{(1)}$$

X_1 = working capital (Current Assets − Current Liabilities) / total assets

X_2 = retained earnings / total assets

X_3 = earnings before interest and taxes / total assets

X_4 = market value of equity / total liabilities

X_5 = sales / total assets

Zones of discrimination:

Z > 2.99 – "safe" zone

1.81 < Z < 2.99 – "grey" zone

Z < 1.81 – "distress" zone

Model 2: Z-score financial situation model for private firms

$$Z' = 0{,}717X1 + 0{,}847X2 + 3{,}107X3 + 0{,}42X4 + 0{,}998X5 \qquad (2)$$

Zones of discrimination:

Z > 2.9 – "safe" zone

1.23 < Z < 2.9 – "grey" zone

Z < 1.23 – "distress" zone

Model 3: Z-score financial situation model for emerging markets

The Z" below can be used for most industries and types of businesses. Because of the large variation in X5 across industries, X5 was taken out of the formula.

The formula Z" index is adjusted as follows:

$$Z'' = 6{,}56X_1 + 3{,}26X_2 + 6{,}72X3 + 1{,}05X_4 \qquad (3)$$

Zones of discrimination:

Z" > 2.6 – "safe" zone

1.1 < Z" < 2.6 – "grey" zone

Z < 1.1 – "distress" zone

The article uses data from the financial statements of 22 military construction enterprises in the period from 2014 to 2018, using mathematical statistics tools with the support of EXCEL software to calculate and analyze the criteria in the model. The authors apply

model 3 because military construction enterprises include both joint stock and state-owned companies.

4. Data analysis

According to the financial report data of construction enterprises in the military for the period 2015-2019, the Z" index of enterprises over the years is shown in the following spreadsheets:

Table 1. Z" index of military construction enterprises in 2015.

No.	Name of construction enterprises	X1	X2	X3	X4	Z"
1	319 Construction Corporations	0,044	0,018	0,026	0,134	0,66
2	Truong Son Construction Corporations	-0,118	0,023	0,029	0,213	-0,28
3	ACC Aviation Construction Corporation	0,087	0,015	0,016	0,179	0,92
4	Lung Lo Construction Corporations	0,012	0,016	0,020	0,195	0,48
5	Thanh An Construction Corporations	0,005	0,006	0,007	0,082	0,18
6	789 Construction Corporations	0,015	0,024	0,030	0,231	0,62
7	129 One member Company Limited	0,051	0,010	0,013	0,498	0,98
8	Duyen Hai One member Company Limited	-0,024	0,011	0,014	0,057	0,03
9	Truong Thanh One member Company Limited	0,169	0,013	0,017	0,256	1,53
10	207 One member Company Limited	0,085	0,021	0,028	0,117	0,94
11	Tay Bac One member Company Limited	0,042	0,006	0,008	0,526	0,90
12	ADCC One member Company Limited	0,247	0,059	0,077	0,251	2,59
13	59 One member Company Limited	0,350	0,045	0,057	0,096	2,93
14	Ha Thanh One member Company Limited	-0,021	0,003	0,004	0,008	-0,09
15	Viet Bac One member Company Limited	0,038	-0,033	-0,033	-0,158	-0,24
16	36 Corporation – JSC	0,113	0,011	0,015	0,100	0,98
17	Van Tuong Investment and Construction Joint Stock Company	0,032	0,016	0,020	0,382	0,80
18	Truong An Development and Investment Construction Joint Stock Company	0,021	0,015	0,020	0,373	0,71
19	Tay Ho Investment and Construction Joint Stock Company	0,047	0,012	0,014	0,092	0,53
20	389 Construction Joint Stock Company	0,105	0,003	0,004	0,444	1,19
21	Lam Son Construction Joint Stock Company	0,253	0,036	0,046	0,404	2,51
22	Hung Vuong Construction Infrastructure Development Investment Joint Stock Company	-0,121	-0,152	-0,152	-0,079	-2,39

(Source: Financial statements of Military Construction Corporations and the authors' calculation)

Table 2. Z" index of military construction enterprises 2016.

No.	Name of construction enterprises	X1	X2	X3	X4	Z"
1	319 Construction Corporations	-0,088	0,010	0,013	0,142	-0,30
2	Truong Son Construction Corporations	-0,108	0,013	0,016	0,238	-0,30
3	ACC Aviation Construction Corporation	0,088	0,012	0,014	0,188	0,91
4	Lung Lo Construction Corporations	0,021	0,016	0,021	0,172	0,51
5	Thanh An Construction Corporations	-0,005	0,009	0,010	0,142	0,21
6	789 Construction Corporations	-0,062	0,023	0,030	0,174	0,05
7	129 One member Company Limited	0,097	0,020	0,026	0,538	1,44
8	Duyen Hai One member Company Limited	-0,038	0,011	0,014	0,046	-0,07
9	Truong Thanh One member Company Limited	0,143	0,015	0,019	0,204	1,33
10	207 One member Company Limited	0,061	0,022	0,028	0,097	0,76
11	Tay Bac One member Company Limited	0,105	0,000	0,000	0,553	1,27
12	ADCC One member Company Limited	0,095	0,052	0,065	0,226	1,47
13	59 One member Company Limited	0,373	0,033	0,043	0,067	2,92
14	Ha Thanh One member Company Limited	-0,020	0,002	0,003	0,008	-0,10
15	Viet Bac One member Company Limited	0,033	-0,001	-0,001	-0,171	0,03
16	36 Corporation – JSC	0,178	0,009	0,011	0,066	1,34
17	Van Tuong Investment and Construction Joint Stock Company	0,056	0,015	0,019	0,372	0,94
18	Truong An Development and Investment Construction JSC	0,129	0,011	0,015	0,240	1,23
19	Tay Ho Investment and Construction Joint Stock Company	0,064	0,010	0,012	0,110	0,65
20	389 Construction Joint Stock Company	-0,078	0,005	0,006	0,071	-0,38
21	Lam Son Construction Joint Stock Company	0,219	0,050	0,063	0,352	2,39
22	Hung Vuong Construction Infrastructure Development Investment Joint Stock Company	-0,202	-0,059	-0,059	-0,142	-2,06

(Source: Financial statements of Military Construction Corporations and the authors' calculation)

Table 3. Z" index of military construction enterprises in 2017.

No.	Name of construction enterprises	X1	X2	X3	X4	Z"
1	319 Construction Corporations	-0,023	0,015	0,018	0,218	0,25
2	Truong Son Construction Corporations	-0,099	0,012	0,015	0,263	-0,23
3	ACC Aviation Construction Corporation	0,109	0,014	0,016	0,228	1,11
4	Lung Lo Construction Corporations	0,048	0,014	0,017	0,257	0,75
5	Thanh An Construction Corporations	No data				
6	789 Construction Corporations	0,011	0,030	0,038	0,177	0,61
7	129 One member Company Limited	0,126	0,016	0,020	0,543	1,58
8	Duyen Hai One member Company Limited	-0,095	0,001	0,002	0,046	-0,56
9	Truong Thanh One member Company Limited	0,121	0,015	0,019	0,158	1,13

No.	Name of construction enterprises	X1	X2	X3	X4	Z"
10	207 One member Company Limited	0,036	0,013	0,016	0,052	0,44
11	Tay Bac One member Company Limited	0,030	0,001	0,002	0,169	0,39
12	ADCC One member Company Limited	0,014	0,059	0,073	0,265	1,06
13	59 One member Company Limited	0,088	0,050	0,063	0,097	1,27
14	Ha Thanh One member Company Limited	-0,023	0,001	0,001	0,009	-0,13
15	Viet Bac One member Company Limited	0,071	0,044	0,044	-0,151	0,75
16	36 Corporation – JSC	0,001	0,006	0,007	0,075	0,15
17	Van Tuong Investment and Construction Joint Stock Company	0,030	0,011	0,014	0,284	0,63
18	Truong An Development and Investment Construction JSC	0,130	0,024	0,024	0,440	1,56
19	Tay Ho Investment and Construction Joint Stock Company	0,076	0,006	0,008	0,115	0,69
20	389 Construction Joint Stock Company	-0,079	-0,021	-0,021	0,026	-0,70
21	Lam Son Construction Joint Stock Company	0,257	0,027	0,034	0,413	2,43
22	Hung Vuong Construction Infrastructure Development Investment Joint Stock Company	-0,182	0,006	0,006	-0,129	-1,26

(Source: Financial statements of Military Construction Corporations and the authors' calculation)

Table 4. Z" index of military construction enterprises in 2018.

No.	Name of construction enterprises	X1	X2	X3	X4	Z"
1	319 Construction Corporations	0,015	0,011	0,014	0,220	0,46
2	Truong Son Construction Corporations	-0,058	0,007	0,009	0,287	0,00
3	ACC Aviation Construction Corporation	0,108	0,028	0,033	0,296	1,33
4	Lung Lo Construction Corporations	0,054	0,001	0,001	0,235	0,61
5	Thanh An Construction Corporations	0,026	0,018	0,021	0,205	0,59
6	789 Construction Corporations	0,006	0,028	0,035	0,221	0,60
7	129 One member Company Limited	0,132	0,010	0,012	0,907	1,93
8	Duyen Hai One member Company Limited	-0,105	0,002	0,003	0,042	-0,62
9	Truong Thanh One member Company Limited	0,126	0,012	0,015	0,194	1,17
10	207 One member Company Limited	0,046	0,015	0,019	0,061	0,54
11	Tay Bac One member Company Limited	-0,015	-0,001	-0,001	0,048	-0,06
12	ADCC One member Company Limited	0,040	0,057	0,070	0,257	1,19
13	59 One member Company Limited	0,025	0,069	0,086	0,151	1,12
14	Ha Thanh One member Company Limited	-0,039	0,000	0,000	0,015	-0,24
15	Viet Bac One member Company Limited	-0,089	-0,099	-0,099	-0,234	-1,82
16	36 Corporation – JSC	0,094	0,014	0,017	0,204	0,99
17	Van Tuong Investment and Construction Joint Stock Company	0,024	0,010	0,013	0,294	0,58
18	Truong An Development and Investment Construction JSC	0,118	-0,013	-0,013	0,466	1,13
19	Tay Ho Investment and Construction Joint Stock Company	0,087	0,001	0,001	0,135	0,73
20	389 Construction Joint Stock Company	-0,130	-0,046	-0,046	0,004	-1,30
21	Lam Son Construction Joint Stock Company	0,360	0,016	0,020	0,657	3,24
22	Hung Vuong Construction Infrastructure Development	-0,058	0,008	0,008	0,052	-0,25

	Investment Joint Stock Company					

(Source: Financial statements of Military Construction Corporations and the authors' calculation)

Table 5. Z" index of military construction enterprises in 2019.

No.	Name of construction enterprises	X1	X2	X3	X4	Z"
1	319 Construction Corporations	0,002	0,016	0,017	0,203	0,39
2	Truong Son Construction Corporations	-0,067	0,004	0,005	0,291	-0,09
3	ACC Aviation Construction Corporation	0,147	0,023	0,028	0,417	1,66
4	Lung Lo Construction Corporations	0,073	0,001	0,001	0,245	0,75
5	Thanh An Construction Corporations	0,074	0,020	0,023	0,306	1,03
6	789 Construction Corporations	0,000	0,023	0,029	0,254	0,54
7	129 One member Company Limited	0,122	0,006	0,008	0,693	1,60
8	Duyen Hai One member Company Limited	-0,075	0,001	0,001	0,041	-0,44
9	Truong Thanh One member Company Limited	0,151	0,013	0,016	0,226	1,38
10	207 One member Company Limited	No data				
11	Tay Bac One member Company Limited	-0,018	0,002	0,002	0,018	-0,09
12	ADCC One member Company Limited	0,049	0,039	0,048	0,255	1,04
13	59 One member Company Limited	0,011	0,077	0,097	0,180	1,16
14	Ha Thanh One member Company Limited	-0,054	-0,001	-0,001	0,019	-0,35
15	Viet Bac One member Company Limited	-0,344	-0,094	-0,094	-0,270	-3,48
16	36 Corporation – JSC	0,076	0,019	0,023	0,224	0,95
17	Van Tuong Investment and Construction Joint Stock Company	0,011	0,000	0,000	0,318	0,41
18	Truong An Development and Investment Construction JSC	0,121	0,008	0,008	0,512	1,41
19	Tay Ho Investment and Construction Joint Stock Company	0,079	-0,007	-0,007	0,121	0,58
20	389 Construction Joint Stock Company	0,001	0,066	0,066	0,064	0,73
21	Lam Son Construction Joint Stock Company	0,247	0,017	0,021	0,369	2,20
22	Hung Vuong Construction Infrastructure Development Investment Joint Stock Company	0,076	0,012	0,012	0,202	0,83

(Source: Financial statements of Military Construction Corporations and the authors' calculation)

The data shows that the military construction enterprises are in the warning zone of high risk of finance.

5. Conclusion

The reason for the low "Z" coefficient is due to the decrease in business performance, which makes the ratio of revenue and profit to total assets of construction enterprises in the military decline sharply, and the low proportion of regular working capital in total assets. However, the most important reason that most construction enterprises in the military are in the warning zone of "high risk of finance" is because the ratio of equity to total debt (X4) is very small or even negative.

From the research results, the authors have some suggestions as follows:

Firstly*,* military construction enterprises can use the Z-score as a tool to detect early signs of bankruptcy to take timely measures.

Secondly, it is crucial to use and manage effectively assets of military construction enterprises.

To increase the Z-index, military construction enterprises need to increase the numerator and decrease the denominator of each X-index in formula (3). Observing 4 X indices, it can be seen that Total Assets is the denominator of 3 indices X_1, X_2, X_3 so total assets can be reduced while the enterprises maintain their size and operating efficiency, the Z-index will certainly increase significantly. Therefore, the enterprises need to scrutinize carefully to find inactive assets that do not contribute directly or indirectly to revenue. The enterprise will reduce the denominators of the three X-indexes mentioned above by selling inactive assets, and at the same time increase the numerators of some indexes. On the other hand, when assets with no debt or little debt are sold, the business will receive more cash, then Working Capital - the numerator of X_1 will increase. Besides, depreciation expense decreases to lead to rate of return increase that means the numerator of X_2, and X_3 will improve accordingly. In the case of assets in currently debt are sold, working capital may not escalate immediately, but not only total debt - denominator X4 - will decrease and lead interest expenses and depreciation become less. The rate of profit will therefore ascend that means the numerator of X_2, X_3 enhance and lead to more cash if businesses are well managed. More

cash means working capital - the numerator X_1 will rise up accordingly. Obviously, selling inactive assets will affect on the growth of the X-indexes. Of course, not every asset sold can raise the Z" index. There are assets that are sold will greatly affect revenue and indirectly affect the numerators of X_2, X_3. Therefore, enterprises must be very careful in classifying assets.

Thirdly, it is vital to improve the self-financing capacity of enterprises by adjusting the debt-to-equity ratio and debt-to-total capital to a safe level.

According to the analysis above, the enterprises with a very small or negative equity-to-total debt ratio (X_4) cause low Z-score. Therefore, one of the solutions to improve the Z coefficient is adjusting the debt ratio to the safety level so that the risk of bankruptcy of enterprises is controled.

The financial structure with high debt reflect limited financial autonomy, high level of risk, low ability to raise more capital for development investment, and affecting operational efficiency. Therefore, changing the financial structure in the direction of increasing equity is completely in line with the development goals of military construction enterprises that have requirement to increase business efficiency, increase scale and stability in the near future.

First of all, to increase equity, enterprises need to fully exploit endogenous capital from retained earnings. This is a financial resource that helps businesses proactively meet their capital needs, promptly seize business opportunities, retain control, and reduce pressure of payment. However, in order to exploit this capital, military construction enterprises need to take measures to improve business performance, overcome difficulties, and maximize profits.

In addition to mobilizing the maximum internal capital from retained profits, military construction enterprises need to find other ways to raise equity, such as calling for capital contribution to joint ventures, associations for 100% state-owned or issuing more shares for joint stock companies.

Fourthly, it is important to increase the market value of equity for joint stock companies or the net asset value for state – owned enterprises. However, this is not an easy job to do. There is a simpler way to reduce debt by using cash to pay debts, but should be careful if choosing this solution, because then working capital will be reduced, which may indirectly affect revenue and profit.

In conclusion, to increase the Z-index is depending on the situation of the military construction enterprises that will decide to implement one or more of the above solutions. However, any solution will lead to a difficult situation, the enterprises must "tighten their belt" for a while.

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