

Using the Altman's Z-score formula to assess the bankruptcy risk of state - owned construction enterprises in Vietnam

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Abstract: In the current economic situation affected by epidemics, wars, recessions, etc., construction enterprises in Vietnam in general and state – owned construction enterprises in particular face many difficulties to maintain performance efficiency. On the other hand, the policies of restructuring and equitization of state-owned enterprises also have a strong impact on the financial management of construction enterprises in Vietnam. This study uses data from financial statements of 22 state-owned construction enterprises in Hanoi from 2017 to 2021 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. The research results show that a few enterprises are in the "safe" zone and "grey" one while most are in "distress" zone. The cause of inefficient business performance is that the revenue and profit ratio to total assets of state-owned construction enterprises to decrease sharply, the ratio of working capital to total assets is low. Moreover, the ratio of equity to total debt is the most important reason for the low Z-score, which means predicting a high risk of bankruptcy in state-owned construction enterprises. The evidence base from the research results is used to propose 5 solutions to reduce the risk of bankruptcy and improve the efficiency of financial management of enterprises.

Keywords: Altman model, Construction enterprises, Corporate governance, Finance, Financial management, State-owned construction enterprises, Z-score,

1. Introduction

Since the late 20th century, Vietnam's construction market has undergone significant development and closer management. In 2023, the country's Gross Domestic Product (GDP) experienced a robust growth rate of 5.05% compared to the previous year. Notably, the industrial and construction sector contributed significantly, with a 3.74% increase, accounting for 28.87% of the overall added value. The construction industry's growth rate in 2023 was 7.06% [1] and this positive trajectory continued into the first half of 2024, where the industry recorded a growth rate of 7.34% [2]. These figures reflect the sector's resilience and potential for further expansion. Deputy Prime Minister Tran Hong Ha recently endorsed Decision No. 179/QĐ-TTg on February 16, 2024, 2024 on approval for the construction industry development strategy to 2030, orientation to 2045. The overarching goal by 2030 is to enhance the institutional framework and management tools, ensuring coherence, modernization, and transparency. This will create an equitable environment for all stakeholders engaged in construction investment activities. Additionally, the strategy aims to enforce laws effectively across all facets of the construction industry. Furthermore, the strategy emphasizes capacity-building within the construction sector. It seeks to equip the industry to manage all stages of complex, large-scale construction projects,

fostering competitiveness both domestically and in international markets [3]. In summary, Vietnam's construction industry is poised for continued growth, driven by government initiatives, foreign direct investment, and strategic planning.

In the context, the state-owned enterprises in general and state-owned construction enterprises in particular have an important position in the economy. The bar chart below shows some of the key financial indicators of state-owned enterprises in Vietnam. The state-owned enterprises are the core force of the state economy, an important material force, and a supporting tool for the State to regulate the economy, stabilize the macro-economy, and contribute to economic development.

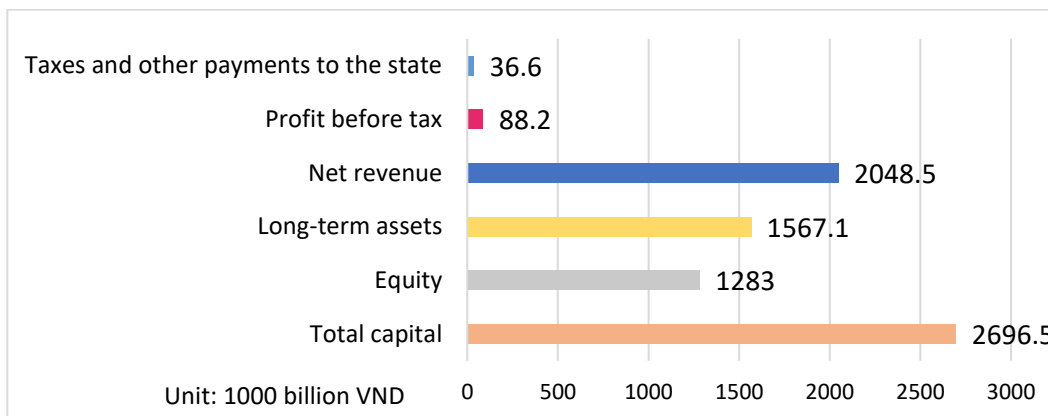


Figure 1.
Some financial indicators of state-owned enterprises in Vietnam in 2021 [4].

The Figure 2 below reveals investment capital for construction is increasing steadily in recent year so that the construction enterprises have abundant job resources over the years. However, the activities of state-owned construction enterprises are not really effective. War, epidemics, recession, etc. are greatly affecting the growth of construction enterprises in Vietnam. Therefore, the enterprises must continue to rearrange, innovate and improve efficiency to have a reasonable structure, focusing on key industries, fields and important areas. 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 [6]-[7].

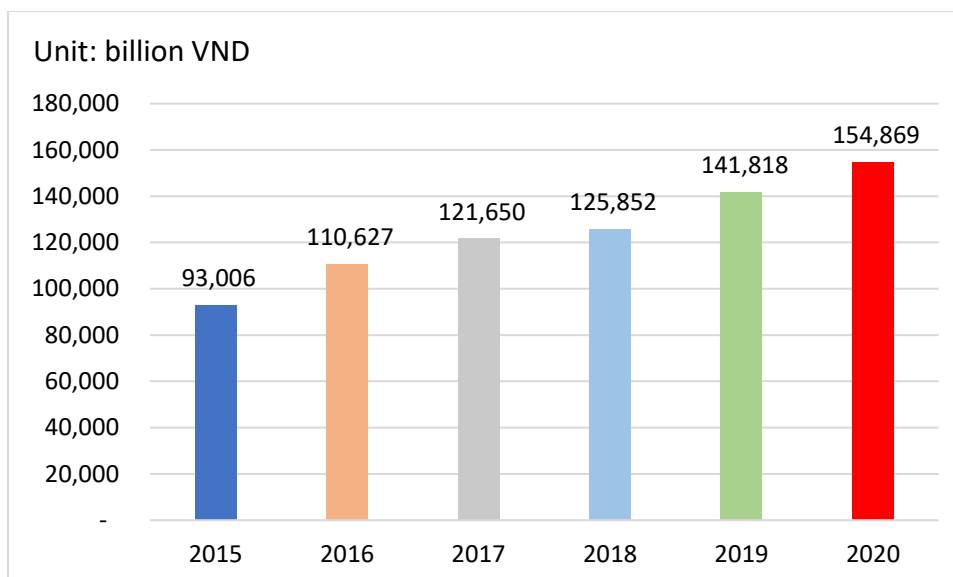


Figure 2.
Investment capital for Construction over the years [5]

It can be said that the current economic situation and the State's policies have a very strong impact on state-owned construction enterprises. State-owned 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 [9]. 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.

2. Overview of the Z-Score Model in Assessing the Financial Health of Enterprises

The concept of using financial ratios to predict business failure dates back to the early 20th century. One of the first significant contributions was made by William H. Beaver in 1966 [10]. Beaver's univariate analysis involved comparing the financial ratios of failed firms with those of non-distressed companies with the development of a single ratio, the current ratio, for a single purpose—the evaluation of credit-worthiness. Financial indicators play a crucial role in forecasting enterprise performance. Metrics like debt ratio, return on assets, and payment ratio reflect business performance and financial risk. However, analyzing each indicator individually can introduce bias and make it challenging to draw accurate conclusions, especially when indicators conflict with one another.

In 1968, Edward Altman introduced the Z-Score model, which became a cornerstone in the field of bankruptcy prediction. Altman employed multiple discriminant analysis (MDA) to combine several financial ratios into a single score, effectively predicting the likelihood of corporate bankruptcy [11]. The Z-Score model was particularly notable for its simplicity and accuracy, making it widely adopted in both academic and practical applications.

Deakin (1972)[12] and Fulmer (1984)[13] extended the foundational research conducted by Beaver (1966) and Altman (1968). Deakin's study involved the analysis and integration of 14 financial indicators to forecast business failure up to five years in advance. In contrast, the Fulmer H-Score model utilized nine financial ratios and was validated on a sample comprising both failed and non-failed firms. Both models exhibited a high degree of accuracy in predicting business failures, thereby serving as valuable tools for financial analysts and investors. Both the Fulmer H-Score and Deakin's model have their weaknesses. Both models necessitate a greater number of financial ratios compared to the Altman model. This requirement can render data collection and processing more cumbersome.

Compared with other models for forecasting corporate financial status, the Altman model has many advantages. Altman and his colleagues analyzed data from over 50 million businesses across 35 countries to investigate the adoption of Z-Scores in 2014. The initial test of the Altman Z-score revealed a 75% accuracy rate in predicting bankruptcy two years ahead of the actual event. Notably, in certain countries, the model demonstrated an even higher accuracy range of approximately 80–90% [14]. This finding was reaffirmed in 2018 through the study ‘*Applications of Distress Prediction Models: What Have We Learned After 50 Years from the Z-Score Models*’ [15]. The model combines five key financial ratios, providing a holistic view of a company’s financial health by considering profitability, leverage, liquidity, solvency, and activity. It serves as an early warning system for financial distress, allowing stakeholders to take preventive measures before a company reaches a critical point. The Altman Z-Score has demonstrated a high level of accuracy, with studies showing it can predict bankruptcy with 80-90% reliability.

Other global studies [16]–[18] have demonstrated that the Z-score model is applicable for analyzing and forecasting enterprise conditions. It serves as an early warning system for assessing the financial health of businesses. Hussain et al. analysis focuses on 21 textile companies listed on the Karachi Stock Exchange from 2000 to 2010, including 12 stable and 9 bankrupt companies. The study investigates the predictive accuracy of the Z-score model for up to four years before bankruptcy. The findings indicate that the Z-score model is quite accurate overall, demonstrating its effectiveness in predicting the financial health of both bankrupt and non-bankrupt companies in Pakistan’s textile sector [16]. Khaliq et al. examine financial distress among 30 Government-Linked Companies (GLCs) listed on Bursa Malaysia over a five-year period (2008–2012). The study assesses financial distress using the Z-score model and identifies key determinants such as the current ratio and debt ratio. The results reveal a significant relationship between these variables and Z-scores, indicating their effectiveness in determining the financial distress of GLCs [17]. Tidathip Panrod studies to analyze the level of financial distress in agribusiness companies listed on the Stock Exchange of Thailand and to examine the relationship between financial ratios and the systematic risk (β) of these firms using the Altman score [18].

In the context of Vietnam, several researchers have explored, tested, and implemented the Z-score model. Notable studies include: (1) *Retesting Altman’s Z-Score*: Le Cao Hoang Anh and Nguyen Thu Hang (2012) [19] conducted a comprehensive study to retest Altman’s Z-Score model for predicting the failure of 293 companies listed on the Ho Chi Minh Stock Exchange (HOSE). Their research highlighted that the Z-score model is well-suited for emerging markets like Vietnam, which are characterized by limited access to capital, smaller firm sizes, and higher liquidity risks. This study provided strong evidence supporting the model’s effectiveness in such environments; (2) *Application to Vietnamese Enterprises*: Pham Thi Tuong Van (2015) [20] and Diep Thanh Tung, Vo Thi Hoang Phung (2019) [21] focused on applying the Z-score model to Vietnamese enterprises. Their studies involved detailed analyses of various companies, demonstrating how the Z-score model can be used to assess financial health and predict potential failures. These applications underscored the model’s versatility and relevance in the Vietnamese business landscape; (3) *Risk Management in Vietnamese Banks*: Nguyen Phuc Canh and Vu Xuan Hung (2014) [22] explored the application of the Z-score model in the context of risk management for Vietnamese commercial banks. Their research emphasized the model’s effectiveness in evaluating the financial stability of borrowers during the lending process. By incorporating the Z-score model, banks were able to better manage credit risks and make more informed lending decisions; (4) *Construction Industry Health*: Trissan Nguyen and Trung Dung Doan (2018) [23] investigated the health of the construction industry in Vietnam using the Z-score model. Their findings indicated that the model remains suitable for assessing the financial health of companies in developing countries like Vietnam. This study provided valuable insights into the financial stability of the construction sector and highlighted the model’s broader applicability; (5) *Predicting Enterprise Default*: Dinh Duc Minh (2019) [24] analyzed data from 932 Vietnamese enterprises over the period from 2014 to 2016 to predict enterprise defaults. Despite encountering some errors in predicting the

probability of default, the study found that the Z-score model was still valuable for assessing the overall financial situation of enterprises and identifying those at risk of default. This research reinforced the model's utility in financial analysis and risk assessment. Collectively, these studies demonstrate the robust applicability and reliability of the Z-score model in various sectors within the Vietnamese context. They highlight the model's potential to provide valuable insights into financial health, risk management, and the prediction of business failures, making it a crucial tool for stakeholders in Vietnam's economic landscape.

Research conducted globally and empirical tests within Vietnam highlight the effectiveness of the Z-score model in assessing the financial health of enterprises. Specifically, the Z-score method provides valuable insights into the governance and financial stability of companies. Calculating the Z-score provides a straightforward and effective method for assessing corporate finance.

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

3. Research Method and Data

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

Model 1: Z-score bankruptcy model for manufacturing companies

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

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 bankruptcy model for private firms

$$Z' = 0,717X_1 + 0,847X_2 + 3,107X_3 + 0,42X_4 + 0,998X_5 \quad (2)$$

Zones of discrimination:

$Z > 2.9$ – "safe" zone

$1.23 < Z < 2.9$ – "grey" zone

$Z < 1.23$ – "distress" zone

Model 3: Z-score bankruptcy model for emerging markets

The "Z" below can be used for most industries and types of businesses. Because of the large variation in X_5 across industries, X_5 was taken out of the formula.

The formula "Z" index is adjusted as follows:

$$Z'' = 6,56X_1 + 3,26X_2 + 6,72X_3 + 1,05X_4 \quad (3)$$

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 state - owned construction enterprises in Hanoi in the period from 2017 to 2021, 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 state - owned construction enterprises are in Vietnam, an emerging market.

4. Data Analysis

According to the financial report data of state - owned construction enterprises in the period 2017-2021, the Z" index of enterprises over the years is shown in the following graph 3.

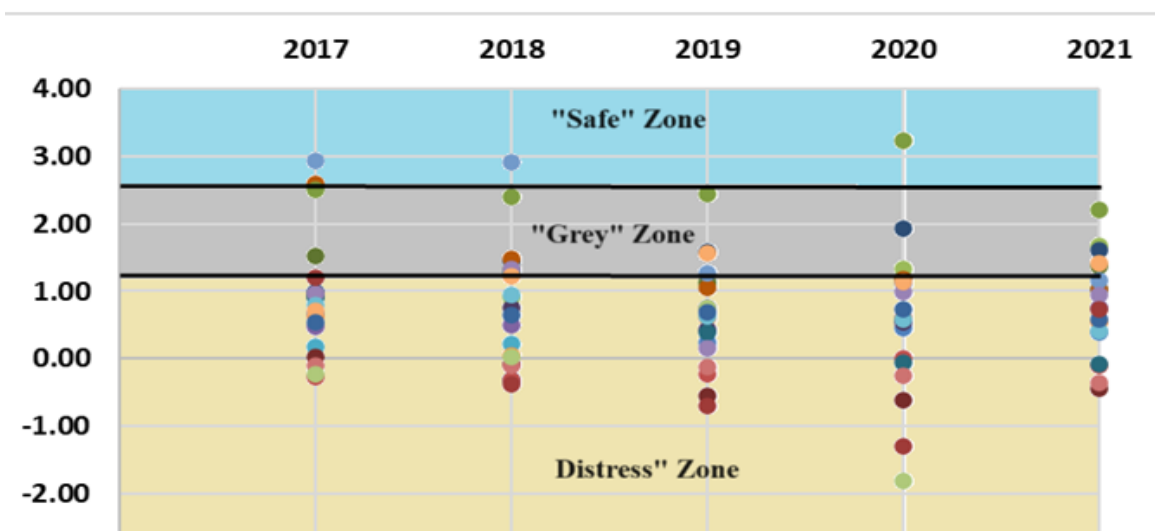


Figure 3.
Z" index of state - owned construction enterprises from 2017 to 2021.
Source: Financial statements of State - owned Construction Corporations and the authors' calculation.

The data shows that a few enterprises are in the "safe" zone and "grey" one while most are in "distress" zone. This proves that construction enterprises using state capital are inefficient. The performance of the 100% state-owned construction enterprises has not been commensurate with their resources. There are still low-efficient production and business enterprises and projects with prolonged losses showed in Figure 4 and 5.

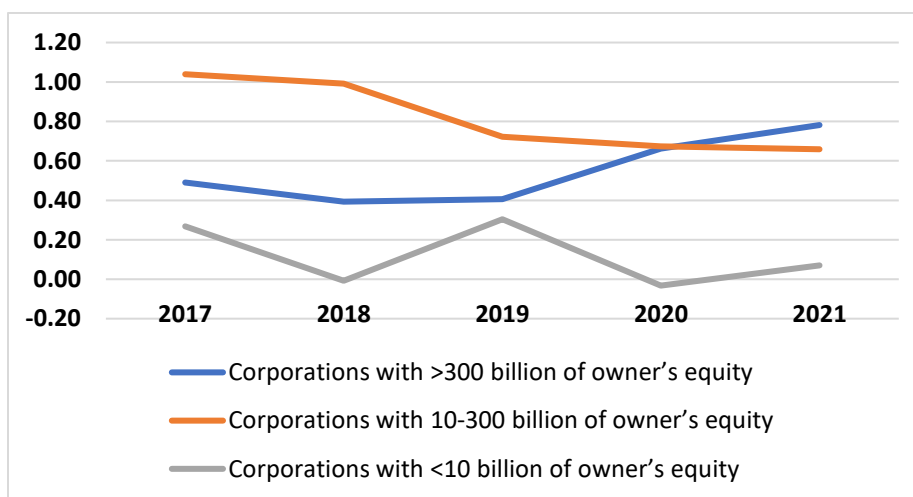


Figure 4.

Average Z-score over the years of state-owned construction enterprises by size of equity.

Source: Financial statements of State - owned Construction Corporations and the authors' calculation.

Figure 4 shows that construction enterprises with over 300 billion and less than 10 billion of owner's equity have the average Zscore decreasing over the years while construction enterprises with 10-300 billion of owner's equity have this index increasing slightly but not significantly. This proves that Zscore has not improved over the years and the business is inefficient.

To determine how efficient a company is at generating profits and more clearly the financial status of construction enterprises, Return on Assets (ROA) and Return on Equity (ROE) are considered. Graph 5 and Graph 6 show the ROA and ROE of state-owned construction enterprises by size of equity between 2017 and 2021, respectively.

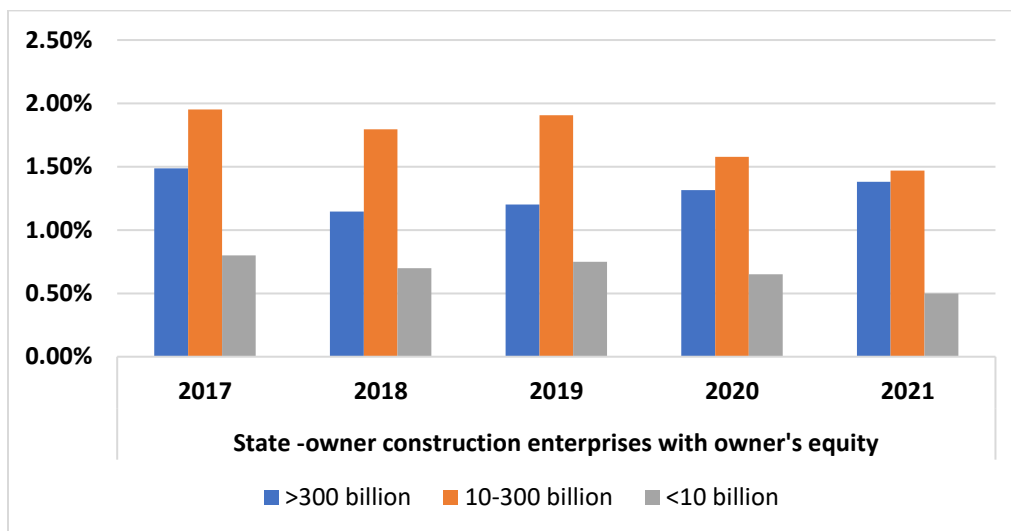


Figure 5.

Average Return on Assets (ROA) over the years of state-owned construction enterprises by size of equity.

Source: Financial statements of State - owned Construction Corporations and the authors' calculation.

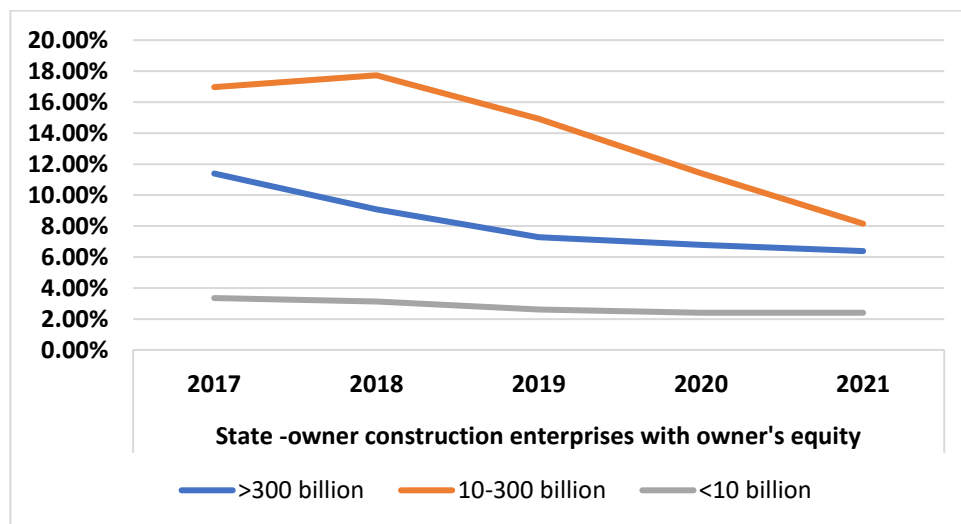


Figure 6.

Average Return on Equity (ROE) over the years of state-owned construction enterprises by size of equity

Source: Financial statements of State - owned Construction Corporations and the authors' calculation.

These measures are both decrease gradually in all state-owned construction enterprises by size of equity. This is completely consistent with the comments from the Zscore analysis above: State-owned construction enterprises operate inefficiently, and their financial management still has many problems.

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 state - owned construction enterprises decline sharply, and the low proportion of regular working capital in total assets. However, the most important reason that most construction enterprises of the state are in the warning zone of "high risk of bankruptcy and bankruptcy" is because the ratio of equity to total debt (X_4) is very small or even negative.

5. Approaches to Enhancing the Financial Performance of State-Owned Construction Enterprises in Vietnam

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

Firstly, state - owned 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 state - owned construction enterprises.

To increase the Z-index, state - owned 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 X_4 - 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 controlled.

The financial structure with high debt reflects 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 state - owned 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, state-owned 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, state - owned 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 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.

Fifthly, it is vital that the State and the Ministry have policies to accelerate the restructuring of state-owned construction enterprises. Corporate restructuring is the the act of organizing of part or all of an enterprise for the purpose of achieving significant improvements in business processes and operations. According to the authors Michael Hammer and James Champy [25], restructuring is to abandon the old system, reorganize the enterprise with a completely new system. Restructuring of state-owned construction enterprises should follow the directions: (i) *Divestment*: complete the divestment of state capital in enterprises with less than 50% state capital; (ii) *Advanced governance*: applying an advanced management regime suitable to the market economy and implementing a strict, public, and transparent inspection and supervision; (iii) *Increase the role and responsibility of the Boards of Directors*; (iv) *Equitization*: The equitization of of state-owned construction enterprises is a central content restructuring, which is the process of divesting part or all of the state capital out of 100% state capital enterprises.

In conclusion, to increase the Z-index is depending on the situation of the state - owned 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.

6. Conclusions

The article outlines the prevailing operational context of state-owned construction enterprises, characterized by the continuous expansion of the construction industry, the Government’s strategic initiatives for industry development, and the restructuring and equitization policies affecting these enterprises. Additionally, the inherent challenges in financial management faced by these entities was highlighted. The article evaluates various models employing both domestic and international financial indicators to swiftly assess the financial health of enterprises, emphasizing the Altman model as a straightforward and effective tool for this purpose. Analyzing the financial data of state-owned construction enterprises in Vietnam reveals that a minority of these enterprises are in a secure financial position where while the majority situated in the “grey zone” or “distress zone” primarily due to a low or negative equity-to-total debt ratio (X4). The author concludes by proposing five strategic solutions aimed at enhancing the financial management quality of state-owned construction enterprises.

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