Application of SEM in analysing the effect of competitiveness, operating effectiveness and risk management on the stability of Vietnamese construction corporations

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Abstract:

This research focuses on analysing the impact of competitiveness as measured through the Lerner competitiveness coefficient, operational efficiency, and risks to financial stability through the Z-score bankruptcy risk ratio of Vietnam's leading prestige construction groups in the context of economic integration. From there, the extent of the influence of factors on the long-term stability and development of corporations operating in the construction sector is inferred. The research data was collected from audited annual financial statements of 17 construction companies operating between 2013 and 2020, with a total of 136 observations. The main research method of this work is the application of SEM linear structure modelling for panel data in multivariable regression analysis. The final results of the study show that most impact variable groups have an influence on the stability of the business. In addition, the results of the study provide an answer on the competitiveness index as having a positive effect in promoting the financial stability of enterprises in the short term. Conversely, if a business abuses this index in the long term, a reaction against the expectations of managers will occur.

Keywords: **construction corporation, Lerner, panel data, PLS-SEM, Vietnam.**

Classification numbers: **2.1, 2.2**

1. Introduction

With the development of the world's construction industry in recent years, showing that the market is gradually entering a saturation cycle, it is necessary to restructure. In order to restructure, manufacturing enterprises in the field of construction investment begin to look to new potential markets with one such market being construction in developing countries. With Vietnam being a developing country, the study of its construction company activities has gradually become an important research topic. By the first 6 months of 2021, nearly 74,000 construction enterprises were operating in Vietnam. A total of 74,000 businesses operating in this field is neither a small number nor an excessive one. However, in the context of developing countries, this number can be seen as a trend toward integration and infrastructure improvement with considerable focus on the need to use modern equipment.

The construction industry in Vietnam has experienced rapid growth in recent years, driven by increased demand for infrastructure and real estate development [1, 2]. According to the General statistics office of Vietnam, the construction sector contributed 7.6% to the country's Gross domestic product (GDP) in 2020. This sector also employs a significant portion of the country's labour force, with over 5.7 million people working in construction-related occupations. Vietnamese construction corporations range from small and medium-sized enterprises to large multinational companies. The sector is dominated by state-owned enterprises, which hold a significant market share in areas such as infrastructure development and public works. However, private sector participation has been increasing in recent years, particularly in areas such as real estate development [3]. The construction industry in Vietnam faces several challenges, including issues

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related to land acquisition, access to financing, and a shortage of skilled labour. This sector is also highly regulated with a complex regulatory environment that can make it difficult for companies to navigate [4]. Despite these challenges, the construction industry in Vietnam is expected to continue growing in the coming years, driven by increased investment in infrastructure development and urbanization. This growth presents both opportunities and challenges for construction corporations operating in Vietnam as they must navigate a competitive market while also managing risks related to operational efficiency, financial stability, and regulatory compliance.

Faced with that fact, analysing the influence of competitiveness, operational efficiency, and risk management on the stability of construction corporations in Vietnam is important for several following reasons. The first reason is to enhance the competitiveness of companies operating in this field. Competitiveness is a critical factor for any business, including construction corporations in Vietnam. Analysing the influence of competitiveness on stability can help construction corporations identify areas where they need to improve to remain competitive in the market. This can include identifying ways to reduce costs, improve quality, and increase innovation. The second reason is being able to help these companies improve their operational efficiency. Efficient operations are essential for any business to achieve sustainable growth and profitability. By analysing the influence of operational efficiency on stability, construction corporations can identify areas where they can improve efficiency such as streamlining processes, reducing waste, and increasing productivity. The third reason is that in-depth research on the above topic can improve risk management for construction companies in Vietnam. Indeed, risk management is essential for any business to mitigate potential threats and ensure long-term stability. By analysing the influence of risk management on stability, construction corporations can identify areas where they need to improve their risk management practices, such as implementing effective risk management policies, procedures, and controls. The last reason is that conducting research on this topic promotes the stability of companies operating in the construction sector in Vietnam. Certainly, stability is crucial for construction corporations in Vietnam to achieve sustainable growth and profitability. By analysing the influence of competitiveness, operational efficiency, and risk management on stability, construction corporations can identify areas to focus their efforts to promote long-term stability and success. As such, analysing the influence of competitiveness, operational efficiency, and risk management on the stability of construction corporations in Vietnam is essential for ensuring the long-term success of these businesses. By identifying areas for improvement and implementing effective strategies, construction corporations can enhance their competitiveness, improve operational efficiency, manage risk effectively, and promote stability for sustainable growth and profitability.

Every year, the construction industry contributes trillions of dong to the State budget. However, research works from an economic perspective on the construction industry are quite few. Therefore, the author summarizes the previous research works from other fields with studies related to competitiveness, operational efficiency, and financial risks to serve as a premise for research. P. Bourke (1989) [5] looked at the operations of banks in 12 countries in the territories in Europe, North America, and Australia to determine profitability inside and outside the bank. Lloyd-Williams' research referred to two competing hypotheses related to market structure and performance: the traditional structure-behaviour-performance model (SCP) and the efficiency hypothesis [6]. Meanwhile, Chronopoulos' study assessed how short-term profits exist and whether that existence is affected by regulatory changes and the recent financial crisis [7]. Further, Saghi-Zedek's work studied the impact of ownership structures on the diversification of banks in Europe, demonstrating that diversifying operations (or incomes) minimizes the volatility of income and the likelihood of bankruptcy [8].

In Vietnam, Tuyen's research codified a number of factors affecting the business performance of enterprises from which to design research models [9]. The influence of competitiveness, operational efficiency, and risk management on the stability of construction corporations in Vietnam has been a subject of interest to researchers and practitioners in recent years. There have been several studies on this topic exploring the relationship between these factors and the stability of construction corporations in Vietnam. For example, N.M. Tran, et al. (2020) [10] investigated the relationship between competitive advantage, operational efficiency, and stability of construction companies in Vietnam. The study found that both competitive advantage and operational efficiency have a significant positive impact on the stability of construction companies in Vietnam. In another study, T.T. Luu, et al. (2019) [11] examined the impact of risk management on the financial stability of construction enterprises in Vietnam. The study found that risk management has a significant positive impact on the financial stability of construction enterprises in the country. There have been other researchers who have conducted studies on the influence of competitiveness, operational efficiency, and risk management on the stability of construction corporations in Vietnam, namely, T.T.H. Le, et al. (2020), V.T. Nguyen, et al. (2021), N.D. Ngo, et al. (2021) [12-14]. These studies provide further insights into the influence of competitiveness, operational efficiency, and risk management on the stability of Vietnamese construction corporations. However, further research is needed to gain a deeper understanding of the relationships between these factors and their impact on the stability of construction corporations in Vietnam.

The studies conducted in Vietnam on the influence of competitiveness, operational efficiency, and risk management on the stability of construction corporations have yielded some important findings, specifically: i) Competitive advantage and operational efficiency have a significant positive impact on the stability of construction corporations in Vietnam [15]; ii) Risk management has a significant positive effect on the financial stability of construction corporations in Vietnam [16]; iii) Supply chain management and project management also have significant effect on the operational efficiency and performance of Vietnamese construction corporations [12, 14]; and iv) Government policies and regulations, market demand, and the internal capabilities of construction corporations also affect their stability and performance [12, 14].

Besides these notable findings, the literature review related to this topic in Vietnam also identified some gaps in the existing literature. That is, most of the existing studies focus on the relationship between individual factors and the stability of construction corporations without examining the interplay between them. Furthermore, there is a lack of studies that explore the impact of external factors such as economic and political instability, technological changes, and environmental factors on the stability of Vietnamese construction corporations. Besides this, the existing studies are mainly quantitative and lack qualitative data, which could provide a more in-depth understanding of the factors that affect the stability of construction corporations in Vietnam. However, recent quantitative studies in Vietnam only stop at regression models for panel data such as Pooled OLS, FEM, and REM, which cannot fully capture the impact of factors on the stability of enterprises and their complex relationship. In addition, these regression models are unlikely to account for measurement errors and other sources of variability. One common issue with panel data is that there may be measurement errors in the variables being studied, which can lead to biased estimates. And finally, many of the studies are based on a limited sample size and may not be representative of the entire construction industry in Vietnam.

As mentioned before, construction is a key sector of the Vietnamese economy. Therefore, the success or failure of construction corporations can have a significant impact on the overall health of the economy. By studying the factors that contribute to stability and success in this sector, policymakers and business leaders can make more informed decisions about how to allocate resources and manage risk. In recent years, Vietnam has made efforts to promote competition and efficiency in the construction sector by opening up the market to foreign investors and implementing reforms to improve the regulatory environment. Empirical studies on the relationship between competition, risk management, and stability can help policymakers and businesses understand how these efforts are impacting the sector and identify opportunities for further improvement. In addition, Vietnam has set ambitious targets for infrastructure development and attracting foreign investment is key to achieving these goals. Empirical studies on this topic can help demonstrate to foreign investors that the Vietnamese construction sector is a reliable and stable investment opportunity. Above all, construction has a significant impact on the environment and society, and promoting sustainable development in this sector is critical to achieving Vietnam's long-term development goals. By studying the operation of construction corporations, researchers can identify ways to promote sustainable practices and ensure that construction contributes to, rather than detracts from, Vietnam's sustainable development goals.

This study aims to evaluate the relationship between competitiveness, performance, and risk of construction corporations in Vietnam. With its outstanding advantages, the structural equation model (SEM) was chosen as the analytical framework for this study to estimate complex, multi-level relationships between variables in the research model. The variables included in this study are the endogenous variable (Z-score) used to measure stability, exogenous potentials used to measure efficiency, competitiveness and risk liquidity, and a number of macro factors that are added to measure external risks. Furthermore, the PLS-SEM method is used in this study because of the characteristics of the sample data set. The estimated results obtained from the model show that. Based on the obtained results, policy suggestions are proposed to improve competitiveness, enhance risk management effectiveness as well as maintain stability for construction corporations in Vietnam.

2. Theoretical basis

2.1. Competitiveness

The concept of competitive advantage was first proposed by M.E Porter, an American economist, in his 1985 book *"Competitive Advantage: Creating and Sustaining Superior Performance"* [15]. Porter argued that companies could gain a competitive advantage by either achieving lower costs or by differentiating their products or services in a way that customers value. He also introduced the concept of the value chain, which is a framework for analysing a company's activities to understand where it can create value and gain a competitive advantage.

According to D. Dollar, et al. (1993) [16], the concept of competition is as follows: "Competition is a situation in a market in which companies or sellers try to get consumer feedback to achieve specific business goals". Through the competitive process, companies are forced to become efficient and offer more products and services at lower prices to increase the welfare of the economy (Mankiw theory of economics). So, without competitive pressure, the economy does not achieve allocation efficiency, production efficiency, or dynamic efficiency.

Besides the definition of competitiveness, another concept is market power, specifically: "Market competitiveness refers to the company's ability to increase and maintain prices in the context of economic competitiveness" [16]. Other than monopolies, market power refers to all situations in which companies are likely to raise prices higher than the balance in competitive conditions. That is, competitiveness can arise not only when there is a monopoly but also when there is no monopoly. In the banking sector, typical manifestations of market competitiveness are the ability of banks to earn exclusive profits by offering higher lending rates and lower deposit rates.

2.2. Adjusted Lerner index

J.F. De Guevara, et al. (2005) [17] argued that the use of the Lerner index to measure market power is still mechanical and that it is necessary to consider some issues in the estimation method when evaluating its meaning. Previously, D.B. Humphrey, et al. (1997) [18] pointed out that the conventional approach to calculating the Lerner index with both assumptions of profitability and cost-effectiveness is unrealistic. Thus, the corrected Lerner index proposed by M. Koetter, et al. (2012)[19] is presented in the following form:

$$Adjusted\ Lerner_{it} = \frac{(\pi_{it} + TC_{it} - MC_{it} \times TA_{it})}{(\pi_{it} + TC_{it})}$$

where π_{it} is the forecast pre-tax profit of the business i at year t, MC_{it} is the long-term marginal cost, TA_{it} is the total assets, and TC_{it} *is the total cost. The result of the adjusted Lerner i*ndex is a value between 0 and 1, with larger values corresponding to greater competitiveness and vice versa. Then, H. Liu (2013) [20] proposed a formula to measure the Lerner index more easily for businesses that find it difficult to determine their output price, as follows:

$$Lerner_{it} = \frac{Net\ profit_{it}}{Total\ revenue_{it}}$$

2.3. Financial performance

Financial efficiency measures the performance of the business. The operational efficiency of the enterprise is an integrated economic indicator with the purpose of measuring the effective use of input materials to create finished products. In addition, financial efficiency is also a measure that reflects the level of ingenuity and makes the most of integrated resources such as machinery, equipment, and especially human resources.

In essence, financial performance is a comparison between the outputs and the inputs in a given economic period. If we call H financial performance, we have the following formula for measuring financial performance:

$$H = \frac{Output}{Input\ factor}$$

The above formula provides the number of co-outputs produced for every one of the inputs of the business. The higher the H-index, the higher the financial efficiency of the business and vice versa.

2.4. Measures of financial performance (Table 1)

Table 1. Measures of financial performance.

Measure of financial performance	Research
DY dividend yield	T.D.C. Ming, et al. (2008) [21]
Return on total ROA assets	Y. Hu, et al. (2008) [22]
ROE return on equity	Y. Hu, et al. (2008) [22]
Profit margin on ROS revenue	M. Jenkins, et al. (2017) [23]
Return on ROI investment	S.Z.A. Shah, et al. (2011) [24]
Marris market value coefficient	L. Tian, et al. (2008) [25]

Source: Authors' compilation.

There are many indicators used to evaluate the financial performance of an enterprise, of which the two most widely used indicators are the financial performance indicator according to accounting, also known as the financial performance indicator, and profitability measure and market value indicator, also known as the asset growth indicator. For the group of coefficients measured according to accounting results, the study of Y. Hu, et al. (2008) [22] showed that the most commonly used profit indicators to measure financial performance include financial ratios, for example, return on total assets (ROA) and return on equity (ROE). In addition, research by T.D.C. Minh, et al. (2008) [21] also used the dividend yield (DY) assessment index. Besides these, the study by S.Z.A. Shah, et al (2011) [24] used the return on total investment index to evaluate financial performance. According to research by L. Tian, et al. (2008) [25] for the group of market value coefficients, the Marris index is used to assess the financial performance of enterprises by calculating the total market value of equity ownership relative to the book value of equity.

Overall, there are many indicators to assess the financial performance of a business, but ROA and ROE are the two most widely used indicators that measure the performance of a business during an economic period.

2.5. Risk of corporate bankruptcy

A representative indicator for measuring the stability or financial health of a business is the Z-score. E.I. Altman (1968) [26] published the Z-score model as follows:

Z-score = 1.2X + 1.4Y+ 3.3Z + 0.64W + 0.999V

where X: Working capital ratio to total assets; Y: Retained return ratio on total assets; Z: Ratio of profit before interest and tax on total assets; W: Market value of equity on the book value of total debt; and V: Ratio of sales to total assets.

Meaning of Z-score: 2.99 < Z-score indicates a healthy financial position; 1.81 < Z-score < 2.99 indicates the company has no problems in the short term, however, it is necessary to carefully consider its financial condition; Z-score < 1.81 indicates the enterprise has serious financial problems; and with a Z-score of zero, the probability of bankruptcy is 50%.

Signs of bankruptcy risks in construction enterprises are assessed in 5 aspects: growth rate, debt use level, balance in financing policy, solvency, and operational performance according to the results of a study by Dang Phuong Mai, et al. (2020) [27], which was carried out on research data from 40 enterprises operating in the construction industry.

2.6. PLS - SEM modeling

Within the scope of this study, the author uses the technique of analysing a structural model based on the variance using least square estimation. The PLS-SEM modeling is applied for the following reasons. First, PLS-SEM is a structural equation model based on minimizing the residual variance, which makes the model's predictive power more accurate [28]. Second, PLS-SEM is generally considered more suitable when the sample size is relatively small, and the focus is on predictive accuracy rather than model fit. PLS-SEM is also useful when the relationships among the latent variables are complex or nonlinear [29]. Third, the PLS-SEM is used to estimate models with secondary data such as the present research [30]. Fourth, previous research in the field of marketing has demonstrated that PLS estimates are useful for experimenting with panel data models [31]. Finally, PLS is a variance-based SEM technique that has been prominently used in IS research before. It is suitable for estimating weighting significance, density, and regression coefficients with data of less than 200 observations [32].

The PLS-SEM modeling consists of two components: the internal structure model that includes the path coefficients between the latent variables and the measurement model, which involves estimating the factor loadings for the observed variables, and the latent variable scores. The PLS-SEM algorithm is an iterative procedure that simultaneously estimates the latent variable scores and model parameters using a combination of regression and covariance estimation methods. The algorithm is designed to provide a flexible and robust approach to modelling complex relationships among latent variables. The estimation algorithm of the PLS-SEM model includes 6 steps. Initially, the PLS-SEM algorithm starts by initializing the values of the model parameters including the loadings, path coefficients, and error variances. The next step is to estimate the measurement model. This is done using a series of regression equations that relate each observed variable to its corresponding latent variable. Next, the PLS-SEM algorithm estimates these coefficients using partial least squares regression. This involves calculating the covariance between the latent variables and then projecting these covariances onto a set of orthogonal latent variables, called the PLS components. The path coefficients are then estimated as the regression coefficients between the PLS components. Then, the PLS-SEM algorithm iteratively updates the parameter estimates based on the results of the previous estimation steps. The algorithm continues to iterate until the parameter estimates converge to stable values. Once the parameter estimates have converged, the PLS-SEM algorithm can be used to generate bootstrap resamples of the data. This involves randomly sampling observations from the original data set and then re-estimating the model parameters for each resample. This allows researchers to estimate the standard errors of the parameter estimates, and to test the statistical significance of the estimated relationships. Finally, the PLS-SEM algorithm provides a set of fit indices to evaluate the overall fit of the model to the data. These indices include measures of model fit, such as the root mean square error of approximation (RMSEA) and the goodness-of-fit index (GFI).

3. Data and research models

3.1. Data

The data was collected from audited annual financial statements of 17 enterprises in the construction industry operating between 2013 and 2020. The dataset is a balanced panel with 136 observed variables that have been synthesized, processed, and designed using Excel. As such, the sample size of this study is considered large enough and statistically significant. With this data, we use Stata 15.0 to perform estimation and necessary inspections besides performing tests such as multi-colinear, heteroskedasticity as well as similar phenomena. Finally, once the results of the study are obtained, we use the theories studied in combination with objective facts to explain the economic implications of the correlation between explanatory variables and independent variables to clarify the study results.

The variables used in the research model include:

Dependency variable:

- Z-Score: this index is often used to measure the stability of a business.

Independent variables:

- Competitiveness measurement variable group:

○ Lerner: Competitiveness coefficient (Lerner index)

○ LernerS: Square competitiveness coefficient (Lerner square index)

- Bank efficiency variable group - Eff:

○ ROA: Return on total assets

○ ROE: Return on equity

○ Size: Enterprise size

- Financial risk group - Risk: Liquidity risk (LIQ).

- The impact of macro factors - INF: Inflation rate.

3.2. Modelling approach

This analysis inherits the research approaches of several authors on measuring the stability of financial enterprises [33-35] to further develop new impact variables to the research topic. The reseach model illustrated in Fig. 1 is represented by the folloving equations:

$$Lener_{it} = Lerner_{it-1} + Eff_{it} + Risk_{it} + \varepsilon_{it} \quad (1)$$

$$Eff_{it} = Eff_{it-1} + Lerner_{it} + Risk_{it} + \varepsilon_{it} \quad (2)$$

$$Risk_{it} = Risk_{it-1} + Eff_{it} + Lerner_{it} + \varepsilon_{it} \quad (3)$$

The model that captures the effects between competitiveness, operational efficiency, and risks on the stability of Vietnamese construction corporations is presented as follows:

$$\text{Z-score}_{it} = + \text{Lerner}_{it} + \text{LernerS}_{it} + \text{ROA}_{it} + \text{ROE}_{it} + \text{Size}_{it} + \text{LIQ}_{it} + \text{INF}_{it} + \varepsilon_{it}$$

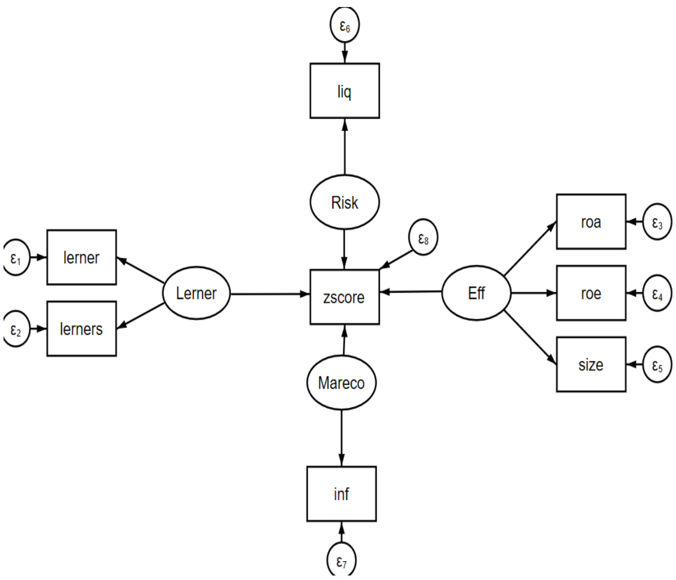

Fig. 1. Research diagram. Source: The audited annual financial statements of 17 enterprises on the construction industry operating between 2013 and 2020.

Table 2. Table describing variables and their measurements.

Variables name	How to measure	Sign of expectation	Sources of reference
Dependent variable			
Z-score			E.I. Altman (1968) [26]
Independent variables			
Lerner	Net profit / Total revenue	+	H. Liu (2013) [20]
LernerS	(Lerner)	-	C. Müller, et al. (2018) [36]
ROA	Net profit/ Total assets	+	S.M.K. Rahman, et al. (2021) [37]
ROE	Net profit / Equity	-	B.K. Guru, et al. (1999) [38]
Size	Logarithm total assets)	-	D.K. Chronopoulos, et al. (2015) [39]
LIQ	Short-term assets / Total assets	+	N. Al-Fayoumi, et al. (2019) [40]
INF	Secondary data	-	K. Bourkhis, et al. (2013) [41]

Source: Data processed from the audited annual financial statements of 17 enterprises on the construction industry operating between 2013 and 2020.

4. Results

4.1. Check stationarity in panel datasets

Table 3. The result of stationarity in panel data.

Variables	Levin-Lin-Chu accreditation		Result
	t- Statistic	*P-value*	
Z-score	-9.9778	0,0000	Stationary
Lerner	-12.1669	0.0000	Stationary
LernerS	-14.8302	0.0000	Stationary
ROA	-3.6048	0.0002	Stationary
ROE	-19.2800	0.0000	Stationary
Size	-12.2100	0.0000	Stationary
LIQ	-20.0979	0.0000	Stationary
INF	-9.6081	0.0000	Stationary

Source: Data processed from the audited annual financial statements of 17 enterprises on the construction industry operating between 2013 and 2020.

In order to check the stability of the data, a unit root test panel was made using Levin-Lin-Chu testing [42]. The test results presented in Table 3 show that all the time series are stationary because their p-values are approximately zero.

4.2. Descriptive statistics

Table 4. Descriptive statistics.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Z-score	136	1.969711	0.9500395	0.0972227	4.871875
Lerner	136	0.0833735	0.0854404	-0.0121704	0.7998243
LernerS	136	0.2668314	0.1169139	0.0332431	0.894329
ROA	136	0.0537743	0.0484118	-0.016815	0.2273578
ROE	136	0.136788	0.1047946	-0.032557	0.5250654
Size	136	14.59806	1.255926	11.93862	16.94897
LIQ	136	0.707377	0.2052286	0.1692643	2.043244
INF	136	0.0213875	0.0134314	0.0025	0.0354

Source: Data processed from the audited annual financial statements of 17 enterprises on the construction industry operating between 2013 and 2020.

Table 4 presents the calculation results based on 136 observations (17 enterprises x 8 years) including values of mean, median, standard deviation, minimum, and maximum. The results in Table 4 indicate that the data of both the size and

INF are relatively stable because all observations are within the range of two times the standard deviation compared to the average. The volatility in the data of the remaining variables is very strong and all variables contain outliers. Although the mean of the Z-score is 1.96, which proves that the enterprise has no problems in the short term, the range of the data is very large. There are businesses with Z-score coefficients both smaller and larger than 1.96. Therefore, it is necessary to carefully consider the financial condition of these construction businesses. On the liquidity side of construction companies, the average value reaches a threshold of 0.7. From a theoretical perspective, the index LQ = 0.7 reflects the liquidity of the business enterprise as being relatively good in the short term. This is because a loan of 1 unit guarantees a payment of 0.7 unit from the property with the same currency. Note that this is only the average liquidity of the observed businesses. Due to the variation of liquidity (0.169264; 2.04324), some businesses are at risk of liquidity.

4.3. Correlation- coefficient matrix

Table 5. Pearson correlation-coefficient matrix (r).

Variables	Z-score	Lerner	LernerS	ROA	ROE	Size	LIQ	INF
Z-score	1.0000							
Lerner	0.1386	1.0000						
LernerS	0.2162	0.9241	1.0000					
ROA	0.7700	0.3815	0.5139	1.0000				
ROE	0.4648	0.2477	0.3650	0.7839	1.0000			
Size	-0.3058	0.0014	-0.1153	-0.2962	-0.0618	1.0000		
LIQ	0.2627	-0.1330	-0.1641	-0.0053	-0.0044	0.1194	1.0000	
INF	0.0452	0.1492	0.1274	-0.0645	-0.0534	0.2300	0.1324	1.0000

Source: Data processed from the audited annual financial statements of 17 enterprises on the construction industry operating between 2013 and 2020.

The correlation coefficient of each pair of variables is presented in Table 5. Most of the observation variables are not correlated with each other because the correlation coefficient of their pairs is quite low with exception for the variable pairs ROA and Lerner's, ROA and LernerS, ROA and ROE, and ROE and LernerS. Therefore, there may be multi-collinearity in the research model. However, tests of multi-collinearity between exogenous variables will be performed in the subsequent section to detect and handle problems of the model (if any).

4.4. Multicollinearity test

Table 6. Results of multicollinear test.

Variables	Lerner	LernerS	ROA	ROE	Size	LIQ	INF	Mean VIF
VIF	9.59	8.08	3.7	2.83	1.34	1.12	1.1	**3.96**
1/VIF	0.10428	0.12376	0.27027	0.35336	0.74627	0.89286	0.90909	

Source: Data processed from the audited annual financial statements of 17 enterprises on the construction industry operating between 2013 and 2020.

The variance inflation factor (VIF) is often used as a general diagnostic measure of multicollinearity and is a significantly better approach than using simple correlation coefficients. Calculated results of the VIF are presented in Table 6. Because all VIF values for the pairs are less than 10 and the mean VIF = 3.96, there is no multicollinearity between the variables in the model [43].

4.5. Estimation results of PLS-SEM

4.5.1. Estimated results of the parameters in the model

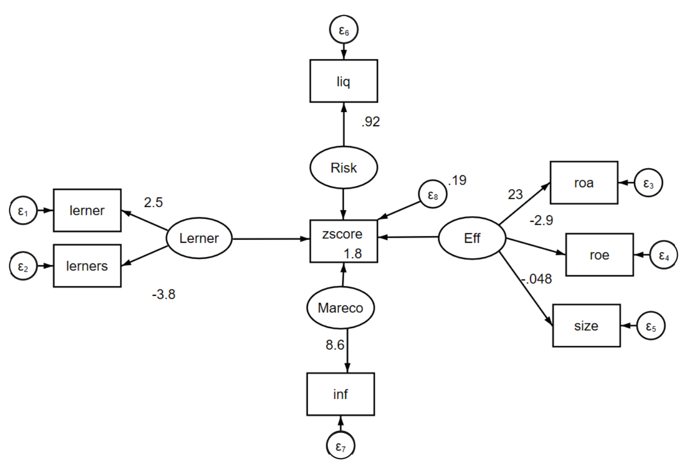

Fig. 2. Research diagram after SEM estimate. Source: Data processed from the audited annual financial statements of 17 enterprises on the construction industry operating between 2013 and 2020.

The estimated results of PLS-SEM are shown in Fig. 2 and illustrated in more detail in Table 7 below. The regression parameters of the variables Lerner and LernerS are both statistically significant at the 5% level, so competition considerably affects the stability in the operation of construction corporations in Vietnam. Furthermore, the values of the estimated coefficients show that the Lerner index has a positive effect on the Z-score with decreasing amplitude (because the coefficient of LernerS is negative).

Table 7. Estimated results of the measurement model.

Structural	Coef.	z	P value
Z-score			
Lerner	2.48605	1.96	0.050**
LernerS	-3.838651	-3.80	0.000*
ROA	23.445	15.38	0.000*
ROE	-2.919639	-4.72	0.000*
Size	-0.0483496	-1.36	0.172
LIQ	0.9244342	4.76	0.000*
INF	8.569036	2.86	0.0004*

Note: (*) and (**) correspond respectively to 5% and 1%. Source: Data processed from the audited annual financial statements of 17 enterprises on the construction industry operating between 2013 and 2020.

Based on Table 7, the PLS-SEM with Z-score as the dependent variable is presented in the following form:

$$\text{Z-score}_{it} = 1.778 + 2.486\text{Lerner}_{it} - 3.838\text{LernerS}_{it} + 23.445\text{ROA}_{it} - 2.919\text{ROE}_{it} - 0.048\ \text{Size}_{it} + 0.924\text{LIQ}_{it} + 8.569\text{INF}_{it} + \varepsilon_{it}$$

The results in Table 7 also show that the macro environment represented by inflation, liquidity risk, and return on total assets all have a positive effect on the stability of these construction corporations since all of their estimated coefficients are greater than 0 and statistically significant at the 5% level. In contrast, ROE has a negative effect on the Z-score at a 5% significance level, while the size of these construction corporations does not affect the stability of their operations.

4.5.2. Checking the stability of the model

To ensure accuracy and reliability of the model, some tests were performed and the results obtained are shown in Table 8. The Chi-squared test statistic (χ^2), which indicates the overall fit of the model, is 206.626 with a p-value of 0.00. This shows that the model goodness of fit at the 5% significance level.

The RMSEA and SRMR indices are also considered important indicators to determine the fit of the model [44]. According to these authors, if the RMSEA and SRMR indices are less than 0.05, the model is a good fit. The results in Table 8 show that both RMSEA and SRMR are close to 0, so this estimated model is reliable. In addition, the pclose index, which is the probability that the RMSEA is less than or equal to 0.05, is approximately equal to 1. This shows that the RMSEA is always less than 0.05. In other words, the model has high reliability with very small prediction error.

Table 8. Test statistics of the model.

Fit statistic	Value	Description
Likelihood ratio		
chi2_ms(29)	0.000	Model vs. saturated
chi2_bs(48)	206.626	Baseline vs. saturated
p > chi2	0.000	
Population error		
RMSEA	0.000	Root mean squared error of approximation
90% CI, lower bound	0.000	
upper bound	0.000	
pclose	1.000	Probability RMSEA <= 0.05
Information criteria		
AIC	-1838.60	Akaike's information criterion
BIC	-1812.52	Bayesian information criterion
Baseline comparison		
CFI	1.000	Comparative fit index
TLT	1.000	Tucker - Lewis index
Size of residuals		
SRMR	0.000	Standardized root mean squared residual
CD	0.786	Coefficient of determination

Source: Data processed from the audited annual financial statements of 17 enterprises on the construction industry operating between 2013 and 2020.

In addition, the two indicators CFI and TLI both support the results from the previously reviewed indicators. Their values are all greater than 0.95, which confirms that the model fits very well. The coefficient of determination of the model is 0.786, showing that the model has explained nearly 79% of the total variation of stability in the operation of randomly selected construction corporations in Vietnam.

Next, the fit of the structural regression model is also considered. Indicators for evaluation have been calculated and are presented in Table 9. In Table 9, the result of the overall index is 0.7860447. This means that the effect between competitiveness, operational efficiency, and financial risk explained about 78.6% of the stability through the Z-score index of Vietnamese construction corporations with the observational data for the period 2013-2020.

Table 9. The results of testing the fit of the structural regression model.

Dep. Var.	fitted	Variance predicted	Residual	R-squared	mc	mc^2
observed						
Z-score	0.9030982	0.7098755	0.1932226	0.7860447	0.8865916	0.7860447
Overall				**0.7860447**		

Source: Data processed from the audited annual financial statements of 17 enterprises on the construction industry operating between 2013 and 2020.

In general, all the indicators to evaluate the fit of the model show that the model is suitable. Thus, the results obtained from the model can be considered reliable. Some analysis and discussion is presented in the next section by looking at the estimated results of the model.

5. Discussion

Some analysis was done based on economic-financial theories and the estimation results of the internal structure model is illustrated in Table 10.

Table 10. Estimation results of the internal structure model.

Structural	Coeff.	z	P value
Z-score			
Lerner	2.48605	1.96	0.050**
ROA	23.445	15.38	0.000*
LIQ	0.9244342	4.76	0.000*
INF	8.569036	2.86	0.0004*

Note: (*) and (**) correspond respectively to 5% and 1%. Source: Data processed from the audited annual financial statements of 17 enterprises on the construction industry operating between 2013 and 2020.

First, the authors discuss the Lerner index that represents competitiveness. This variable has a positive effect (+) on the Z-score variable, i.e., in the short term, increasing this competitive index by focusing on increasing sales will have a positive effect on the stability of the business. Therefore, in the short term, focusing on competitiveness through a number of ways such as expanding market share and entering new markets has a positive effect on the value of a business by contributing to improving the financial stability of the company. The results of this study are also in line with the author's expectations. Regarding the short-term payment ratio, which represents liquidity risk, this variable has a positive effect (+) on the Z-score variable, i.e., when the short-term payment ratio increases, the Z-score index falls and with 99% reliability. This can be explained in the following way: an increase in short-term payment ratio means that the business can ensure the ability to pay short-term debts and contribute to reducing financial risk. The results of this study are also in line with the author's expectations. Third, the profitability ratio of total assets (ROA), which represents the performance of construction corporations, has a positive effect (+) on the Z-score variable, that is, when the return rate of total assets increases, the Z-score index drops, and it has a statistically significant level of 1%. According to the author, as businesses improve their profitability, this will help them increase their equity as well as increase their ability to pay their debts, motivate the business to increase investments to scale/grow and capture market share, thus reducing financial risk. The results of this study are also in line with the author's expectations. Finally, the authors discuss inflation index variables (INF), which represents the macroeconomic environment. Inflation has a positive effect on the stability of a construction corporations in the period 2013-2020 in Vietnam. This may not be appropriate without further analysis and context. This is because inflation can affect different industries and businesses in depending on their characteristics, market conditions, and strategies. For example, in a highly competitive industry such as the construction industry, an increase in inflation may lead to higher costs of materials and labour, which can affect negatively the profitability and stability of businesses that cannot pass on these costs to their customers. On the other hand, businesses that are able to adjust their prices and negotiate better deals with suppliers may be able to mitigate the negative effects of inflation and even take advantage of the situation to gain a competitive edge. Therefore, to properly evaluate the relationship between inflation and the stability of a business in Vietnam, it is important to consider various factors such as the industry, market conditions, business strategies, and the specific period under study.

The results obtained from the estimation model, which are presented in Table 11, also show a number of factors that have a negative effect on the stability of these construction enterprises.

Table 11. Variables with a negative effect on Z-score.

Structural	Coef.	z	P value
Z-score			
LernerS	-3.838651	-3.80	0.000*
ROE	-2.919639	-4.72	0.000*
Size	-0.0483496	-1.36	0.172

Note: (*) and (**) correspond respectively to 5% and 1%. Source: Source: Data processed from the audited annual financial statements of 17 enterprises on the construction industry operating between 2013 and 2020.

Regarding to the squared competitiveness index (Lerner Square), this index has a negative effect (-) on the Z-score variable. Although the estimated coefficient of the LernerS index is negative, as mentioned above, the total Lerner effect on the Z-score is positive but with a decreasing margin over time. Indeed, in the long run, increasing or abusing the over-competitive index will have a negative effect on the stability of the business. In other words, the better the competitiveness, the risk is pushed back, leading to increased financial stability. However, when competitiveness increases beyond the equilibrium point, enhancing competitiveness will result in increased risk. The reason is that when Doan focuses on increasing sales but does not balance cash flow, the cost of using WACC capital leads to stillness because of potential debts, so, in the long run, this will negatively effect the financial stability of the business. ROE has a negative effect (-) on the Z-score variable, that is, when the return rate of equity decreases, the risk of the Z-score index increases meaning there is a risk to the business and it has a statistically significant level of 1%. Basically, ROE, which represents the performance of a business, can potentially have a negative effect on the stability of construction corporations in Vietnam in this period if it is low. A low ROE could indicate that the company is not generating enough profit from its assets or investments, which could lead to financial difficulties and instability. Additionally, if a company is consistently generating low returns, it may struggle to compete with other firms in the industry, which could also lead to instability. However, if ROA and ROE are high and consistent, it could indicate that the company is operating efficiently and effectively, which could contribute to stability. Considering the size of the company, the results of the study indicated that the size of the corporate bank in this case has no impact on the Z-score index due to the P-value size = 0.172>5%, inferring that the size variable is not statistically significant. It is possible that in some cases, the size of the construction business may not have a significant effect on the stability of construction corporations in Vietnam in the period 2013-2020. This may occur when the construction corporations are well-managed and have efficient operations and risk management strategies, regardless of their size. Additionally, it may also depend on the specific context and characteristics of the construction industry in Vietnam, as well as the overall economic conditions and regulatory environment. For example, smaller construction corporations may be more agile and able to adapt quickly to changes in the market, while larger corporations may have greater access to resources and economies of scale. Ultimately, the relationship between enterprise size and stability is complex and may vary depending on a range of factors.

6. Conclusions

This study applied PLS-SEM to analyse the impact between competitiveness, operational efficiency, and risks on the stability of Vietnamese construction corporations. This study succeeded in taking advantage of panel data combined with the advantage of reducing the number of dimensions of the observed variables as well as being able to capture the complex relationship between the factors included in PLS-SEM. At the same time, the criteria to evaluate the fit of the model was implemented in this study to check the stability of the proposed model. The test results have shown that the model is reliable and therefore, the results drawn from it should be considered to provide suitable solutions for the operation of construction corporations in Vietnam from 2013 to 2020. This study has found the effects of competitiveness, liquidity risk, and operational efficiency on the stability of construction corporations under the condition that they have to regularly respond to macroeconomic shocks.

This study has contributed to systematize and clarify theories and concepts related to competitiveness, operational efficiency, and control of financial risks of construction corporations in Vietnam from 2013 to 2020. In addition, it has also partly assessed the positive and negative effects of factors on the stability of enterprises. Specifically, the study revealed the positive effect of the competitiveness index (Lerner), short-term pay out ratio (LIQ), and gross profit margin (ROA) as well as the negative effect of return on equity (ROE).

As a result, this research model can provide information about whether the short-term and long-term competitiveness of enterprises is really effective through the Lerner index and the squared Lerner index. Based on that information, managers, policy makers, and investors can make more appropriate decisions at each stage of business operations. Moreover, with the information obtained from the negative effect of ROE, construction enterprises can partially improve their operating and management policies in the context of economic integration and the industrial revolution 4.0, as well as a response to the COVID-19 pandemic. Several strategies that can improve their stability include:

1. To improve operational efficiency: construction companies can focus on improving their efficiency by streamlining processes, reducing waste, and optimizing resource utilization. This will increase productivity, reduce costs, and improve profitability, which in turn can lead to higher ROA and ROE.

2. To invest in technology and innovation: by adopting new technologies and processes, construction companies can increase their efficiency, reduce costs, and improve the quality of their products and services. This can differentiate them from competitors and improve their competitiveness.

3. To implement effective risk management strategies: construction companies should have effective risk management strategies in place to identify, assess, and mitigate risks that may impact their operations. This can help reduce the likelihood of financial losses, which can negatively impact ROA and ROE.

4. To focus on customer satisfaction: construction companies should focus on delivering high-quality products and services that meet the needs of their customers. This can help to improve customer satisfaction and loyalty, which can lead to increased revenue and improved financial performance.

Overall, improving operational efficiency, investing in technology and innovation, implementing effective risk management strategies, and focusing on customer satisfaction can all facilitate construction companies in Vietnam to improve their stability by increasing their ROA and ROE.

CRediT author statement

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COMPETING INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this article.

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