“An application of Altman Z-score model to analyze the bankruptcy risk: cases of multidisciplinary enterprises in Vietnam”

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AN APPLICATION OF ALTMAN Z-SCORE MODEL TO ANALYZE THE BANKRUPTCY RISK: CASES OF MULTIDISCIPLINARY ENTERPRISES IN VIETNAM

Abstract

This study applied Altman Z-score model to assess the bankruptcy risk of a set of multidisciplinary enterprises of various types, mainly small and medium enterprises, with data taken from official financial reports of 180 enterprises in Soc Trang province. The binary logistic regression was employed to assess the impact of non-financial and financial factors on the bankruptcy risk of enterprises. The research findings showed that both the non-financial factors such as business area, types and size of the business, the educational level of managers and executors and other characteristics, and the financial factors (indicators) such as earnings before tax, net profit/equity ratio, earnings before interest and tax/total assets ratio, equity/total debt ratio, affect the bankruptcy risk of enterprises. Predicting the bankruptcy risk and measuring its determinants play an important role not only as an effective managing tool of the business, but also as evidence for policymakers to support the sustainable development of business.

Keywords SMEs, governance, prediction, finance, risk, bankruptcy

JEL Classification G32, G33

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INTRODUCTION

Vietnam's economy is increasingly integrated and closely related to the regional and global economy once engaging in new generation free trade agreements such as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership, the European Union Vietnam Free Trade Agreement. Such engagement not only opens up many business opportunities for Vietnam, but also entails numerous challenges. According the 2018 Provincial Competitiveness Index Report, 8.3% of businesses planned to downsize or close down as a result of not being able to adapt to market changes or increasingly intense competition. It was worth noticing that though the rate slightly increased from 8.2% in 2017, it was the third highest since the Provincial Competitiveness Index (PCI) survey was introduced in 2005. This even became an alarming issue for local governments in its great efforts to achieve the target of 1 million operational businesses by 2020 set by the Government's Resolution number 35 in 2016 (VCCI and USAD, 2018).

Bankruptcy is one of the most important issues in the finance world of enterprises because it refers to the financial health or stability of business entities (Taffler, 1983). Therefore, enterprises need to forecast the bankruptcy risk in any business decisions (Tam & Kiang, 1992; Ramana, Azash, & Ramakrishnaiah, 2012).

A company's "survival" opportunity can be predicted by using financial report analysis (Vikash, 2018) to have early warnings about financial hardship or bankruptcy risk prediction. From the 60s of the last century, the bankruptcy risk was one of the issues that received great interest. Many studies worldwide have strongly focused on verifying the bankruptcy risk analysis. Among proactive authors, Beaver (1966) and Altman (1968) were seen as pioneers in the applications of financial ratios to predict the bankruptcy risk in empirical studies.

Beaver (1966) used the univariate analysis method through evaluating each individual financial index. However, when indicators were conflicting, it was difficult to conclude. Therefore, Altman (1968) recommended a method of multivariate analysis to overcome this problem and the model was first published on September 1968. Subsequently, Altman, Haldeman, and Narayanan (1977) introduced the bankruptcy prediction model, the *Z*-score model, to overcome the shortcomings of the original model which was followed by Z' and Z'' models. After over fifty years from introducing the initial version of *Z*-score bankruptcy models, this model has become the most well-known method to provide an early warning sign of financial hardship in many studies of scholars and practitioners around the world (Altman, 2018).

Various versions of *Z*-score are calculated to match different characteristics of enterprises. In this study

the authors used the *Z*-score (Z'') index to assess the bankruptcy risk of multidisciplinary enterprises and by types of business. Through the assessment, the study estimated the factors affecting the bankruptcy risk of the enterprises. The research findings were expected to identify the determinants of bankruptcy risk, to serve the decision-making of the enterprises and to suggest an evidence base for governmental agencies to introduce business support policies.

1. LITERATURE REVIEW

1.1. Z-score

The *Z*-score model for predicting the probability of bankruptcy was first introduced in 1968 by Edward I. Altman. This model was proved to be accurate in predicting the bankruptcy at a rate of 94%. The initial sample consisted of 33 bankrupt enterprises and 33 enterprises with stable finance in the manufacturing industry (Altman, 1968). The model forecasted relatively accurately up to 2 years before bankruptcy occurred by considering the *Z*-score value of enterprises.

Z-score is an index combining 5 different financial ratios with different weights and is applied to equitized enterprises. The original *Z*-score formula is:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.64X_4 + 0.999X_5,$$

where X_1 – working capital/total assets, X_2 – retain earnings/total assets, X_3 – EBIT/total assets, X_4 – market value of total equity/book values of total debt, X_5 – sales/total assets.

Where *Z*-score of greater than 2.99 clearly falls into the "non-bankrupt" sector, those enterprises having a *Z* below 1.81 are all bankrupt risk. The area between 1.81 and 2.99 is defined as the "zone of ignorance" or "gray area" because of the susceptibility to error classification (Altman, 1968).

Based on the original *Z*-score, Altman developed Z' and Z'' to be applicable to other types of businesses. With model Z', the elements were defined as the *Z*-score model, except the X_4, which used book value of equity leading to a change in the coefficient of variables and the risk of bankruptcy being reclassified. As for the Z''-score model, the difference of the Z''-score versus *Z*-score and Z''-score models was that the X_5 variable was not used, specifically as follows:

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

The Z''-score can be used for most industries and types of businesses, in which:

- if $Z'' > 2.6$: enterprises in safe areas, not at risk of bankruptcy;

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- if $1.1 < Z'' < 2.6$: enterprises in the warning zone of bankruptcy risk;
- if $Z'' < 1.1$: enterprises in a dangerous area with a high risk of bankruptcy.

1.2. Applications of Z-scores

There are various studies on *Z*-scores and their applications in business types or industries to measure and predict the bankruptcy risk of enterprises in many nations.

Leonardo and Jaime (2003) concluded that the *Z*-score index had good predictability of bankruptcy risk of Italian manufacturing enterprises. Meanwhile, this index predicted accurately for the textile industry in Pakistan within four years, although this predictable rate gradually decreased over the years when an experimental study on 12 enterprises with financial stability and 9 of these went bankrupt in 2000–2010 period (Hussain, Ali, Ullah, & Ali, 2014).

In Sri Lanka, the *Z*-score was also used to predict the bankruptcy risk of seven commercial companies, data taken during the five-year period from 2010 to 2014 (Niresh & Pratheepan, 2015). In India, Apoorva, Curpod and Namratha (2019) showed a predictable ability of *Z*-score three years in advance when companies went bankrupt.

The reliability and accuracy of the *Z*-score model are still a matter of debate. Odibi, Basit, and Massan (2015) have shown that this model was very suitable for the significance level of 0.000 and the accuracy of Z-score between 86% and 99.6% when applied to 34 enterprises including both bankrupt enterprises and enterprises with financial stability in Malaysia during 2010–2014. The accurate prediction rate was 93.8% before the bankruptcy occurred for Jordanian enterprises operating in non-financial services and industrial services in the period 1990–2006 (Alkhatib & Bzour, 2011). However, this rate dropped to 81% when applied to Indian emerging market companies and decreased to 72% two years before bankruptcy occurred (Bhatt, 2012).

The *Z*-scores are considered as a good tool in "financial health check" and helps financial managers, analysts, investors, to predict the bankruptcy risk in business or the financial sustainability of the enterprises to make rational and prudent decisions (Vikash, 2018; Sulphey & Nisa, 2013). The *Z*-score index was also used as an internal criterion to assess the reputation of borrowers or to help investors consider making the decisions (Pradhan, 2014).

The *Z*-scores were not only applied to the evaluation of listed enterprises but also used in evaluating small and medium enterprises. Umiaty and Dinarjad (2018) used Altman's *Z*-score as a tool to measure the bankruptcy risk between small and medium enterprises in business incubators. In the study of Selassie, Tarekegn, and Ufo (2016), *Z*-score was employed to analyze the financial issues of small and medium enterprises with a sample of 30 enterprises in the Wolaita Region of Ethiopia operating in three areas of production, service, and trade. Jan and Marimuthu (2015) also used Altman's *Z*-score model to assess the insolvency of small and medium enterprises in Malaysia. In another study of Milka and Celia (2018), the *Z*-score was applied as the evaluation standard to analyze and predict the financial status of small and medium enterprises from Tuxtepec, Oaxaca in Mexico. Similarly, in the study of Galinoma and Paul (2016), the *Z*-score was also used as a tool to analyze the financial difficulties in the data from financial reports of 102 small and medium enterprises in a developing economy like Tanzania. Altman's *Z*-score model was also one of the three models selected for web-applications to assess the financial health of small and medium enterprises (David & Lenka, 2012).

In Vietnam, Cuong and Anh (2010) used the *Z*-score model to assess the bankruptcy risk of seafood processing enterprises listed on Vietnam's stock market. The study came out with some recommendations to reduce the bankruptcy risk of seafood processing enterprises and contribute to banks' policies to improve the efficiency of credit risk management in banking operations.

Regarding the financial activities of Vietnamese banks, Duong (2013) applied the *Z*-score to predict the bankruptcy risk of 36 commercial banks and considered this score as a standard to assess the financial health of businesses and support the banks to make timely responses to changes of the market.

The *Z*-score can assess the risks of businesses that are indirectly accompanied by the risks of commercial banks when lending (Canh, 2014). The study by Hieu (2015) proposed to use *Z*-score models as a tool to re-evaluate credit rankings and estimate the probability of the bankruptcy risk of borrowers. The *Z*-score again confirmed in Vietnam that both academic and practical circles were the most widely recognized and used in the world (Hanh & Hoa, 2016).

The prediction accuracy of the *Z*-score model on the bankruptcy risk was examined in Vietnam. Anh and Hang (2012) examined the reliability of this model with a sample of 293 listed enterprises in Ho Chi Minh City Stock Exchange. Test results showed that Altman's model achieved an accurate forecasting rate of 91% at one year before the financial exhaustion. This rate dropped to 72% within two years.

Therefore, through the *Z*-score model which has been studied and widely applied for a long time in many countries around the world, and the results of applied experimental analysis in Vietnam showed that the *Z*-score model still proves superiority in analyzing and evaluating business activities, classifying risk areas, credit ratings, assessing the bankruptcy level of enterprises and being able to apply for an enterprise or a larger number of enterprises in the scale of analysis, for enterprises by many industries, sectors, and by different sizes of capital sources (Van, 2016).

2. DATA AND METHODS

For over fifty years since the first introduction of the *Z*-score model, the model has continuously improved. Despite the huge growth in the size and complexity of the global debt market and accounting balance sheet but the *Z*-score models have shown that not only longevity, but is also a predictor accurate on the company's predicament, and also successfully revised for some applications (Altman, 2018).

Besides, the *Z* model has become simplicity in the calculation, transparency and accuracy consistently over the years, the *Z* model has been verified and compared to a large number of studies in terms of accuracy of classification and prediction and practice in finance and accounting for over fifty years (Altman, 2018).

The Z'' model has advantages over other models due to its use for all industrial, manufacturing and non-manufacturers. In addition, the Z'' model also uses bankruptcy risk prediction for enterprises that are not publicly listed firms and there is no big difference between firms operating in different industries due to no consideration to sales/total assets (Altman, 2018).

This study applied the *Z*-score to assess the bankruptcy risk of a collection of 180 small and medium non-financial enterprises. Unlike the studies which were based on public financial reporting sources of listed companies, it is very challenging to access official data of unlisted enterprises, mainly small and medium enterprises. Within this empirical study, we, therefore, extracted the official data of enterprises from the financial statements of the enterprises submitted to the Tax Authority of Soc Trang Province after ensuring the anonymity principle of enterprises.

The data in this study allowed the empirical experimentation of various scales, multi-types (private enterprises, limited liability companies, joint-stock companies), multi-industries (production, trade – service, construction, other industries) of enterprises. Empirically, many of the abovementioned studies applied the Z'' model of Altman for this kind of enterprise data, which was applied again in this study.

As mentioned, the Z'' model classifies bankruptcy risks by three categories: *Z*-score of greater than 2.99 clearly fall into the "non-bankrupt" sector, while those enterprises having a *Z* below 1.81 are all bankrupt. The area between 1.81 and 2.99 is defined as the "zone of ignorance" or "gray area" because of the susceptibility to error classification (Altman, 1968).

However, in this study, to apply a binary logistic regression in the next step, we re-classified the Z''-scores in only two groups: without bankruptcy risk $(Z'' > 2.6)$ and with bankruptcy risk $(Z'' \leq 2.6)$. This study defined risk of bankruptcy as having both dangerous areas and warning are-

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as because of potential risks. Then, a binary logistic regression model was applied to measure the factors affecting the bankruptcy risk, which was specified as the following equation:

$$Ln\left[\frac{P_0}{1-P_0}\right] = \beta_0 + \sum_{j=1}^{k} \beta_j X_j + \varepsilon,$$

where P_0 – probability of enterprises at bankruptcy risk, $1-P_0$ probability of enterprises not at bankruptcy risk, X_j is the independent variable j and β_j is the respective coefficient of j.

Independent variables $\left(X_j\right)$ that were expected to affect bankruptcy risk included a number of financial factors and non-financial factors. Based on the elements of the *Z*-score model, the selection of independent variables was statistically significant. And non-financial factors were inherited variables related to the performance of enterprises from previous studies to conduct the analysis as follows:

- Bankruptcy risk (Risk) – dependent variable: the risk of bankruptcy of an enterprise. If $Y = 1$, the business is at risk of bankruptcy; if $Y = 0$, the business is not in danger of bankruptcy.

- CEO_gender: gender of the executive, 1 if male, 0 if female. There exist two opposite views. First, female CEOs increased the profitability of the company and reduced the level of risk of the business than male CEOs (Khan & Vieito, 2013). However, there is a perception that a company run by women would be less effective (Inmyxai & Takahashi, 2010; Amran, 2011; Hsu, Kuo, & Chang, 2013).

- CEO_edu: education level of the business executive. The education level of managers is an important feature that contributes to the increase in company performance (Cheng, Chan & Leung, 2010; Huang, 2013; Joh & Jung, 2016).

- Firm_age: number of years of operation of the enterprise from the establishment to current. There are two opposing views, according to Omondi and Muturi (2013), the longer the business operated, the better it understood its strengths and promoted more to achieve maximum efficiency. However, the research of Park, Shin, and Kim (2009) showed that the age of the enterprise had a negative impact on enterprise growth and when the enterprise was "getting older," profit would decrease (Elif, 2016).

- Field: business field, including sub-variables:
  - Field_man: manufacture sector, 1 if true, 0 if not true;
  - Field_com_ser: commercial – service sector, 1 if true, 0 if not true;
  - Field_cons: construction sector, 1 if true, 0 if not true;
  - Field_other: other sectors, 1 if true, 0 if not true.

- Type: type of establishment of the business, including sub-variables:
  - Type_one: single-member limited liability company,1 if true, 0 if not true;
  - Type_more: limited company with two or more members, 1 if true, 0 if not true;
  - Type_joint: joint-stock company, 1 if true, 0 if not true;
  - Type_private: private enterprise, 1 if true, 0 if not true.

- SME: small and medium enterprise, 1 if true, 0 if not true;

- EBT: earnings before tax.

- ROE: return on equity.

Profit plays an important role in the business and production activities of the enterprise, both as a goal, as well as a motivation and a condition of existence and development of the enterprise.

- EBIT/TA: earnings before interest and tax (EBIT) to total assets (TA) ratio.

- TE/TD: total equity to total debt ratio.

These two factors were inherited from Altman *Z*-score model.

Altman's *Z*-model, like most previous studies, often revolved around analyzing the financial factors of groups: financial leverage, profitability, solvency ..., which were determinants of bankruptcy risk of a business. In this study, the authors put into the model of non-financial factors to assess the impact of these factors on corporate bankruptcy risk.

3. FINDINGS

3.1. Bankruptcy risk of the enterprises

According to Table 1 and Table 2, among 180 selected enterprises, 53 enterprises in dangerous areas accounted for 29.44%, 35 enterprises in the warning zone accounted for 19.44% and 92 enterprises in a safe area without bankruptcy risk accounted for 51.12%.

In separate industries, Table 1 showed that enterprises operating in the manufacturing sector were at a higher level of bankruptcy risk than other industries. Their proportions in the highest warning area and dangerous area accounted for 36.84% and 28.95%, respectively, in the sample. Enterprises in the commercial and service sectors in dangerous areas and the warning area accounted for 52.17% totally, while this proportion of construction enterprises was 34.29%. Enterprises operating in other remaining industries, such as education, lottery activities had the lowest level of bankruptcy risk, accounting for 20% approximately.

The ANOVA test results in Table 2 also showed that there was a statistically significant difference in the bankruptcy risk between fields.

In addition, the statistics in Table 3 indicated that joint-stock companies were at a higher level of bankruptcy risk. 21 of 31 joint-stock companies were at risk of bankruptcy, accounting for 67.74%. The bankruptcy risk was also high for limited liability companies with two or more members. Of 49 limited liability companies with two or more members, 27 were at risk of bankruptcy, accounting for 55.10%. Meanwhile, the proportion of single-member limited liability companies and private enterprises being at bankruptcy risk was lower, accounting for 44.44% and 21.05%, respectively.

In order to clarify the differences in bankruptcy risk between types of enterprises, the study continued to conduct ANOVA analysis, and the results showed that there were statistically significant differences between limited liability companies with two or more members and private enterprises between the joint-stock and private enterprises.

Table 1. Bankruptcy risks of enterprises by industries

Source: Authors' calculation.

Bankruptcy risk	Manufacturing		Commerce – service		Construction		Other sectors		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Safe zone	13	34.21	44	47.83	23	65.71	12	80	92	51.12
Warning zone	11	28.95	16	17.39	8	22.86	0	0	35	19.44
Dangerous zone	14	36.84	32	34.78	4	11.43	3	20	53	29.44
Total	38	100	92	100	35	100	15	100	180	100

Table 2. The difference in bankruptcy risk between business fields

Source: Authors' estimation.

Field	Manufacturing	Commerce – service	Construction	Other sectors
Manufacturing	–	0.1362	0.3150*	0.4579*
Commercial – service	–0.1362	–	0.1789	0.3217
Construction	–0.3150*	–0.1789	–	0.1429
Other sectors	–0.4579*	–0.3217	–0.1429	–

Note: * significant level at alpha equal to .05.

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Table 3. The bankruptcy risks by types

Source: Authors' calculation.

Risk of the bankruptcy of the business	Single-member limited liability company		Limited liability company with two or more members		Joint-stock company		Private enterprise		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Safe zone	45	55.56	22	44.90	10	32.26	15	78.95	92	51.12
Warning zone	17	20.99	9	18.37	7	22.58	2	10.53	35	19.44
Dangerous zone	19	23.45	18	36.73	14	45.16	2	10.52	53	29.44
Total	81	100	49	100	31	100	19	100	180	100

Table 4. The difference in bankruptcy risk between types of enterprises

Source: Authors' estimation.

Type	Type_one	Type_more	Type_joint	Type_private
Type_one	–	–0.1066	–0.2330	0.2339
Type_more	0.1066	–	–0.1264	0.3405*
Type_joint	0.2330	0.1264	–	0.4669*
Type_private	–0.2339	–0.3405*	–0.4669*	–

Note: * significant level at alpha equal to .05.

3.2. Determinants of bankruptcy risk

To employ the binary logistic regression, we re-classified the bankruptcy risk (Risk) by two categories. If $Y = 1$, the business was at risk of bankruptcy; otherwise, the business was not in danger of bankruptcy. The regression results in Table 3 indicated the correlations between the dependent variable and the independent variables in the general model with statistical significance. Variance inflation factors of independent variables were lower than 2, small enough to conclude that there was no multicollinearity between variables.

As shown in Table 5, the regression results supported the following findings: that the non-financial factors such as fields, types and size of the business, the educational level of the executors, which belong to the characteristics of the enterprises and the operators, and the financial factors such as Earnings before tax, Net profit/Equity ratio, Earnings before interest and tax/Total assets ratio, Equity/Total debt ratio all affected the bankruptcy risk of enterprises.

Table 5. Determinants of bankruptcy risk in the binary logistic model

Source: Authors' estimation.

Independent variables	Coefficient (B)	Sig.	Exp (B)	VIF
X_1 (CEO_gender)	0.309	0.706	1.362	1.265
X_2 (CEO_edu)	–0.470***	0.001	0.625	1.323
X_3 (FIRM_age)	0.073	0.296	1.075	1.272
$X_{4.1}$ (Field_man)	2.833**	0.017	16.996	1.311
$X_{4.2}$ (Field_cons)	0.813	0.352	2.254	1.436
$X_{4.3}$ (Field_other)	–2.414*	0.094	0.089	1.292
$X_{5.1}$ (Type_more)	–0.843	0.283	0.431	1.287
$X_{5.2}$ (Type_joint)	2.946**	0.016	19.039	1.446
$X_{5.3}$ (Type_private)	–1.894*	0.086	0.150	1.211
X_6 (SME)	–13.719***	0.001	0.000	1.474
X_7 (EBT)	–0.062***	0.007	0.940	1.731
X_8 (ROE)	–7.140***	0.008	0.001	1.093
X_9 (EBIT/TA)	–44.593**	0.015	0.000	1.678
X_{10} (TE/TD)	–3.828***	0.000	0.022	1.235
Constant	22.208	0.000	–	
N	180		–	
–2Log likelihood	76.861		–	
Nagelkerke *R*-square	0.822		–	
Overall percentage (%)	90.6		–	

Note: *, **, *** significant levels at alpha equal to .10, .05, .01, respectively.

4. DISCUSSIONS

The research showed that regarding the characteristics of the executive, the higher educational level of the executive, the lower the bankruptcy risk of the business. This finding was consistent with the evidence of other studies, both in Vietnam and other countries (Hambrick & Mason, 1984; Jalbert, 2002; Bertrand & Schoar, 2003; Khoi, Loc, & Danh, 2008; Nghi & Nam, 2011; Cheng et al., 2010; Huang, 2013; Joh & Jung, 2016). However, in our study, the gender of the executive was not significant to be considered as determinants of bankruptcy risk of the business.

For small and medium-sized enterprises, there was an inverse correlation with the dependent variable. It means that small and medium-sized enterprises were at a lower level of bankruptcy risk than large-sized ones. Criteria for identifying small and medium-sized enterprises are specified in Article 6, Decree No. 39/2018/ ND-CP of the Government of Vietnam dated March 11, 2018, detailing a number of articles of the Law on Business Support for the small and medium-sized enterprises, mainly based on the number of employees and revenue. It might be difficult for large enterprises to effectively manage the organizational structure because of bureaucratic issues in the management structure; disagreements between shareholders and managers, these conflicts might lead to a lack of control. On the other hand, the results showed that small and medium-sized enterprises have gradually improved internal forces, operated more effectively, thus reducing the risk of bankruptcy (Harhoff, Stahl, & Woywode, 1998; Salman & Yazdanfar, 2012).

The analysis results showed that businesses operating in the manufacturing sector were at a higher level of bankruptcy risk than those operating in the remaining sectors. In the data set of this study, enterprises operating in the manufacturing sector were mainly processing and aquaculture enterprises. This sector resulted higher profits but also accompanied by higher risks because of large investment in machinery, production lines, as the standards of food safety on the world market are required strictly.

When enterprises were classified by type of establishment, private enterprises were less risky than the others. In contrast, joint-stock companies were at higher risk. Joint-stock companies often have many members, and complex management arrangements require a strict management mechanism. It is also possible that due to disagreements between shareholders and managers, these conflicts will lead to ineffective control (Pi & Timme, 1993). Besides non-financial factors that belong to the characteristics of the enterprises and the operators, financial factors also had direct impacts on bankruptcy risk.

For the financial factor group, the results of the regression analysis confirmed the previous studies. If the earnings before tax was low, the enterprise may have used the profits to pay off debt and interest or the business was inefficient leading to an increased risk to the business. Net profit/equity ratio (ROE) of enterprises had the same impact with the performance of enterprises. The research showed that enterprises with higher ROE had better performance and a lower level of bankruptcy risk. In addition, the higher earnings before interest and tax/total assets ratio (EBIT/TA), the better the profitability of assets of the business or the lower the risk of bankruptcy. The higher ratio of equity/total debt proved the ability to raise capital by debt of the business as reflected by a lower level of risk.

CONCLUSION AND RECOMMENDATIONS

The study used Altman's *Z*-score as a tool to assess the bankruptcy risk of enterprises and the binary logistics model to measure the impact of financial and non-financial factors to bankruptcy risk of the business. Basically, these factors affected the bankruptcy risk and were confirmed by many previous empirical studies. However, in this research, two factors, including the age of the enterprise and the gender of the executor, did not have significant influence.

It is useful for managers, investors, and stakeholders to measure and predict the bankruptcy risk, which helps to identify business with potential risks in order to timely formulate the management policies. In

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addition, for commercial banks, when granting credit to businesses, it is also beneficial to refer to the impact of factors in the research to consider and decide to loan sizes.

From the perspective of corporate governance, the use of the *Z*-score and the evaluation of impact factors regularly to promptly detect and prevent the negative financial status of the business. Administrators need to decide to improve the management apparatus, business strategies to help businesses have a good direction, increase the financial stability.

In this research, the concept of bankruptcy was viewed as the financial status of an enterprise rather than an event (bankruptcy). This implied that the correct perception of bankruptcy risk will help businesses to have appropriate management solutions to improve and change their financial status in a more positive way. Limitations of this study: the lack of data available to track and verify the improvement and the probability of an event if the expected improvements were not implemented. Besides, the data set used in this study was only collected from the financial statements of enterprises in one region. Although Soc Trang province was located at average rank in the 2018 PCI of the country (VCCI and USAD, 2018), argues on differences by localities may be raised, which require the data of additional provinces to better reflect the situation of SMEs in Vietnam.

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