An Application of X-score Model to Analyse Factors Affecting Financial Risk of Medical Companies Listed on Vietnam Stock Market

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Abstract: This article analyses the factors affecting the company's financial risk measured by X-score model (Zmijewski, 1984), using data during 2016 and 2020 from 21 medical enterprises listed on the stock market of Vietnam. The study focuses on designing research hypotheses, using descriptive statistics analysis and applying regression models between the company's financial risk and the independent variables. After determining the appropriate model to examine the determinants of company's financial risk, the necessary tests to detect Multicollinearity, Autocorrelation, and Heteroskedasticity problems are performed. The analysis results show that listed medical companies has a negative relationship with company's profitability, asset's structure, efficiency and company's age. From the research findings, the study provides recommendations for medical companies listed on Vietnam stock market to efficiently manage the company's financial risk.

JEL Classification: G32, G33.
Keywords: Financial risk, Debt structure, Liquidity, Operation efficiency, Profitability, Financial structure.

1. INTRODUCTION

In Vietnam, the role of medical industry in the economy has been increasing significantly. In 2006, the number of companies in the industry listed on the stock market was only 3. Currently, there are 21 medical companies with stocks trading on Vietnam stock market, 9 of them are listed on Hanoi Stock Exchange (HNX) while the remaining 12 companies are listed on Hochiminh Stock Exchange (HOSE). Although the number of listed companies only accounts for 0.6% of the total number of the enterprises in the industry, most of listed medical companies are in big size and have high market share.

Financial risk is the main concern of medical companies in Vietnam because they are operating in the fiercely competitive domestic market and the volatile international environment. Medical companies import 90% of raw materials for drug production because the Vietnamese chemical and petrochemical industry is underdeveloped. The dependence on imported raw material reduces the company's income margin because of the difficulty in costs control. This problem can be observed at Hau Giang Company (DHG), Binh Dinh Company (DBD), Cuu Long (DCL, Domesco Company (DMC). Other listed medical companies even suffered losses such as Viet Nhat Company (JVC) in 2016 and 2020, Lam Dong Company (LDP) in 2018 and 2020, Cai Lay Company (MKV) in 2018. Moreover, listed medical companies have not concentrated on research and development of new products, so that selling costs put a lot of pressure on businesses.

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Company's financial risk is the possibility of having financial losses, that may bring company into financial distress or even bankruptcy. Therefore, it is necessary for a company to effectively control the financial risk to eliminate the losses caused from the financial risk. Determinants of financial risk can be company's debt structure, solvency, profitability, operating efficiency, company's age and size and the other factors such as interest rates and exchange rates.

Reviews of existing literature on financial risk worldwide shows that financial risk can be viewed in different points. Financial institutions often use the "expert" method to analyse the factors affecting the financial risk of enterprises. However, empirical researchers tend to apply widely the quantitative methods such as Z-score model (Altman, 1968, 1983, 1993), S-score model (Springate, 1978), O-score model (Ohlson, 1980), B-score model (Bathory, 1984), H-score model (Fulmer et al., 1984), and X-score model (Zmijewski, 1984) to examine the financial risk and its predictors. Although these models have been tested and used widely for analysing financial risk factors, appropriate adjustments may be required when they are applied for companies in Vietnam.

This article analyses the factors affecting financial risk of 21 medical companies listed on Vietnam stock market by applying the X-score model suggested by Zmijewski (1984) with data collected from 2016 to 2020. The LS (Least Squares) regression method is conducted on 105 observations in the period to determine the factors affecting the company's financial risk in the sample. From the result's findings, several recommendations that help companies to control the financial risk are provided.

2. LITERATURE REVIEW

Financial risk is the possibility of loss associated with the transactions directly related to financial activities such as issuing debt, investment, and other business activities. It can be viewed as an indirect consequence of changes in government policies, domestic and international political events, or other non-current events such as natural disasters. In this research, financial risk is defined as the risk of inability to pay due debts from using financial leverage – issuing debt to finance business activities.

Beaver (1966) used univariate regression analysis model and selected six indicators to forecast the financial risk of an enterprises including: Net cash flow to total liabilities (NCF/TL), Net income to total assets (NI/TA), Total liabilities to total assets (TL/TA), Working capital to total assets (WC/TA), Current ratio (CR) and Non-credit interval – NCR. Beaver (1966) concluded that: (i) the larger the enterprise size, the smaller the financial risk; (ii) the larger the net cash flow (NCF), the smaller the financial risk exposure; (iii) the larger the debt, the higher the financial risk; (iv) the more cash flow spent on operating expenses, the higher the financial risk of the business.

Altman (1968, 1983, 1993) suggested four groups of financial risk determinants of an enterprises of solvency, profitability, financial structure and operating performance. The solvency of a business is measured by working capital to total asset (WC/TA). The profitability of an enterprise is determined by two indicators: Retained earnings to total asset (RE/TA) and Earnings before interest and taxes to total assets (EBIT/TA). The financial structure is the ratio between the market value/book value of equity to total liabilities (MVE/TL or OC/TL). The operation efficiency is measured by total asset turnover (S/TA). Altman (1968, 1983, 1993) stated that the higher the value of WC/TA, RE/TA, EBIT/TA, MVE/TL (or OC/TL), S/TA, the smaller the financial risk of the enterprise is.

Springate (1978) identified three main groups of factors affecting the financial risk of an enterprise, including: solvency (WC/TA), profitability (EBIT/TA, EBT/CL), and operating efficiency (S/TA). Springate (1978) concluded that the higher the value of WC/TA, EBIT/TA, EBT/CL, S/TA, the lower the financial risk of the enterprise. Ohlson (1980) also studied financial risk by collecting data for the period 1970-1976 of 105 bankrupt and 2,058 non-bankrupt companies. Ohlson (1980) revealed that the determinants of the company's financial risk are: (i) company's size (TA/GNI); financial structure (TL/TA); (iii) profitability (NI/TA, FU/TL); (iv) and company's solvency (WC/TA, CA/CL). According to Fulmer et al. (1984), five factors affecting the financial risks of enterprises included: (i) profitability (RE/TA, EBT/OC); (ii) operational efficiency (S/TA); (iii) solvency (NCF/TL, WC/TL, Ln EBIT/I); (iv) financial structure (TL/TA, CL/TA); and (v) firm's size (LnTA). Fulmer et al. (1984) suggested that the higher the value of RE/TA, EBT/OC, S/TA, NCF/TL, WC/TL, Ln (EBIT/I), Ln (TA), the smaller the financial risk of the company. The higher TL/TA and CL/TA, the higher the financial risk of the business. Similarly, Zmijewski (1984) mentioned three groups of factors affecting the financial risk of enterprises, including profitability (NI/TA), financial structure (TL/TA), and solvency (CA/CL). Zmijewski (1984) concluded that the higher the value of NI/TA, CA/CL, the lower the financial risk of the enterprise. The higher the TL/TA, the higher the financial risk of the business.

Among models designed for company's financial risk prediction, X-score model with Probit approach (Zmijewski, 1984) is widely applied by many researchers (Grice & Dugan, 2003). Using data of 40 bankrupt and 800 non-bankrupt enterprises from 1972 to 1978, Zmijewski (1984) suggested that the accuracy prediction level of X-score model can reach 94.9%. The X-score model estimated from the research of Zmijewski (1984) is presented as follows:

X-score = - 4.336 - 4.513NI/TA + 5.679TL/TA + 0.004CA/CL

Where, NI/TA = Net Income/Total Assets;	
TL/TA= Total Liabilities/Total Assets;	CA/CL= Current Assets/Current Liabilities.

Djamaluddin *et al.* (2017) classified firms into two groups based on the scores calculated from the X-score model (Zmijewski, 1984). If the X-score is negative (X-score < 0), the firm belongs to the group labelled no financial risk. In contrast, having positive X-score (X-score ≥ 0), the firm is then classified into the group with high possibility of financial difficulties. The X-score model (Zmijewski, 1984) has been frequently used to forecast company's financial risks in many countries such as in the US (Sayari & Mugan, 2017; Lagkas & Papadopoulos, 2014), India (Singh & Mishra, 2016), Kuwait (Musaed *et al.*, 2018), Pakistan (Ashraf et al., 2019), Indonesia and Singapore (Nilasari & Haryanto, 2018; Tanjung, 2020; Andriani & Sihombing, 2021; Muzanni & Yuliana, 2021).

Lagkas & Papadopoulos (2014) emphasised that during more than a decade of liberalization of the Greek telecommunications market and in the adversed conditions caused by the economic crisis, only a small number of enterprises could survive and maintained a relatively stable position in the market. The study analysed the financial sustainability of the company by combining four financial risk models including Z- score (Altman, 1968), S-score (Springate, 1978), O-score (Ohlson, 1980) and X-score (Zmijewski, 1984). The research especially highlighted reliability and applicability of these models in financial risk investigation.

Singh & Mishra (2016) developed a model to estimate the financial risk for Indian manufacturing enterprises with a total sample of 208 observations, using Z-score (Altman, 1968), O-score (Ohlson, 1980) and X-score (Zmijewski, 1984) models. Especially, they re-estimated the coefficients of the original models with data collected from different time periods. Singh & Mishra (2016) argued that a model that forecast the industry-specific financial risk should be developed with a combination of financial ratios in firm level in a particular country. The study also showed that the coefficients of the model changed when periods that the studies taken changed. Therefore, to produce higher level of prediction accuracy, the researchers should not apply the original models without recalculating the model's coefficients.

Sayari & Mugan (2017) constructed a financial risk forecasting model for companies in different industries in the US,

Table 1. Description of Independent Variables and Control Variables.

Variables		Explanation	Source
Independent Variables			
Debt structure	DS	Debt Structure	Cao & Zen (2005); Bhunia & Mukhuti (2012); Gang & Dan (2012);
Liquidity	QR	Quick Ratio	Bhunia & Mukhuti (2012); Gang & Dan (2012); Simantinee & Phanikumar (2015)
	ALR	Asset to Liability Ratio	Bhunia & Mukhuti (2012); Gang & Dan (2012)
	CFL	Cash Flow to Liabilities	Beaver (1966); Fulmer et al. (1984)
	WCL	Working Capital to Liabilities	Fulmer & et al. (1984)
Profitability	ROS	Return On Sales	Bhunia & Mukhuti (2012); Gang & Dan (2012)
	ROE	Return On Equity	Haydarshina (2008)
	REE	Retained Earnings to Equity	Porporato & Sandin (2007)
Efficiency	IT	Inventory Turnover	Bhunia & Mukhuti (2012); Gang & Dan (2012); Simantinee & Phanikumar (2015)
	FAT	Fixed Asset Turnover	Bhunia & Mukhuti (2012); Gang & Dan (2012); Simantinee & Phanikumar (2015)
	TAT	Total Asset Turnover	Altman (1968, 1983, 1993); Springate (1978); Fulmer et al. (1984); Bhunia & Mukhuti (2012); Gang & Dan (2012); Simantinee & Phanikumar (2015)
	ART	Accounts Receivable Turnover	Bhunia & Mukhuti (2012); Gang & Dan (2012)
Asset's structure	NAR	Net Asset Ratio	Altman (1968, 1983, 1993); Bhunia & Mukhuti (2012); Gang & Dan (2012)
	FAR	Fixed Assets Ratio	Bhunia & Mukhuti (2012); Gang & Dan (2012);
Control Variables			
Interest rates	IRS	Short-term interest rate (%)	Cao & Zen (2005), Kasim (2019).
Company's age	AGE	Number of years in business	Liao (2006)
Company's size	SIZE	Log (TA)	Ohlson (1980); Fulmer et al. (1984);
Place of listing	PLA	HOSE: PLA = 1; HNX: PLA = 0.	Author's choice

Source: Author's review.

consisting of consumer and healthcare, energy and utilities, industry and basic materials, telecommunications services, and information technology. Using factor analysis and logistic regression analysis, Sayari & Mugan (2017) revealed that a financial risk prediction model should take into consideration the industry's characteristics. Musaed et al. (2018) examined the financial soundness of companies listed in the oil and gas sector on the Kuwait stock exchange in the period 2010-2017, using the X-score model (Zmijewski, 1984). The research results show that delisted company as required by Kuwait Stock Exchange were the ones experienced a decrease in X-score.

Nilasari & Haryanto (2018) applied Z-score model (Altman, 1968), S-score model (Springate, 1978) and X-score model (Zmijewski, 1984) on companies in the retail industry in Indonesia from 2012 to 2016. They found that X-score model produced the highest level of prediction accuracy (97.9%). Similar conclusion can be seen in the study of Ashraf et al. (2019), Tanjung (2020), Andriani & Sihombing (2021) and Muzanni & Yuliana (2021).

In Vietnam, financial risk is associated with the risk of bankruptcy or insolvency of an enterprise. Previous studies mainly related to the application of Altman's Z-score model (Nguyen, 2016) or B-score model (Vu, 2017; Dang et al., 2020) to analyze the factors affecting financial risk, and estimate the bankruptcy possibility of enterprises. Nguyen (2016) focused on the financial risk of companies in pharmaceutical industry while Vu (2017) analysed the determinants of financial risks of firms in Real estate industry and Dang et al. (2020) predicted the financial risk of firms listed on Vietnam stock exchanges.

Although financial risk examination and management have become the main concern of researchers in corporate finance worldwide, the number of relevant researches taken in Vietnam is limited. Therefore, the company's financial risk has not been well examined to support financial managers especially managers in medical industry in Vietnam. This study is conducted to fill in the research gap in Vietnam by performing X-score model (Zmijewski, 1984) to analyse the factors affecting financial risk of companies in medical industry listed on Vietnam stock exchanges.

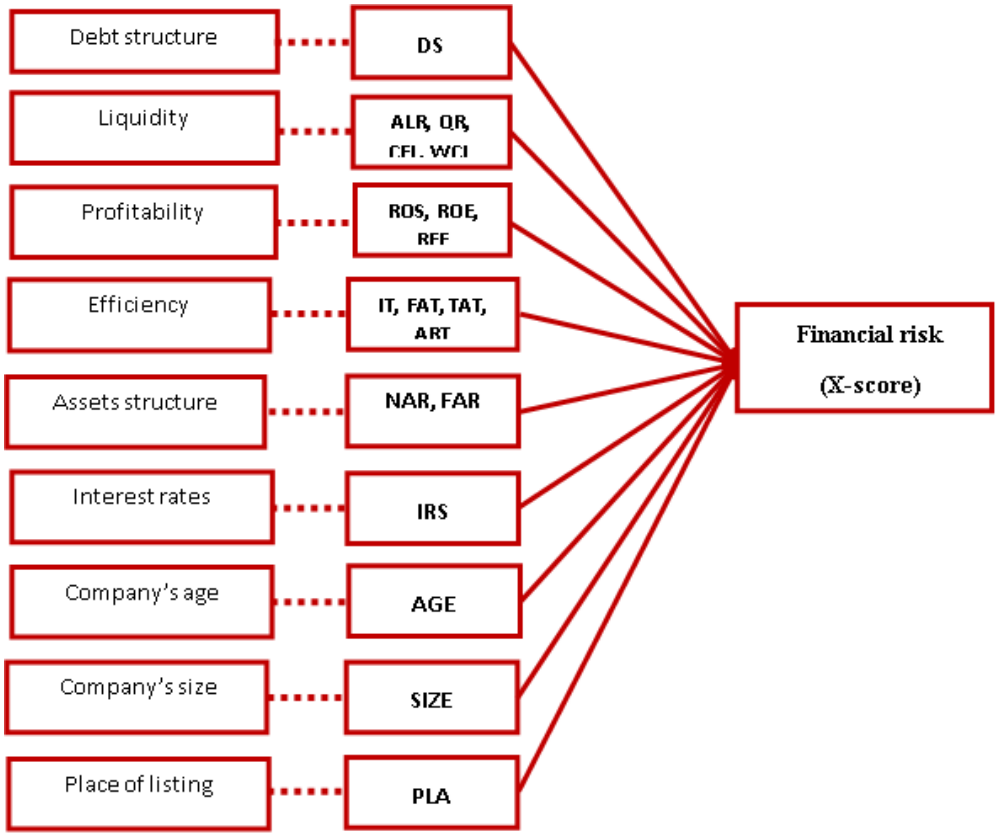

Fig. (1). Conceptual framework.

Source: Zmijewski (1984) and Author's review.

3. METHODOLOGY

3.1. Definition of Variables

Dependent variable: is company's financial risk of listed medical enterprises calculated by X-score model provided by Zmijewski (1984). Independent variables and control variables: Independent variables are divided into 6 groups: Debt structure (DS), Liquidity (ALR, QR, CFL, WCL), Profitability (ROS, ROE, REE), Operating efficiency (IT, FAT, TAT, ART), Asset's structure (NAR, FAR), Interest rates (IRS). The control variables include age of the business (AGE), size of the business (SIZE) and listing location (PLA).

Fig. (**1**) presents the relationship between independent variables and control variables and financial risk of listed medical companies in Vietnam.

3.2. Research Hypothesis

The study tested 9 hypotheses from H_1 to H_9:

H_1: *The company's financial risk has a positive relationship with debt structure*

H_2: *The company's financial risk has a negative relationship with liquidity.*

H_3: *The company's financial risk has a negative relationship with profitability.*

H_4: *The company's financial risk has a negative relationship with operation efficiency.*

H_5: *The company's financial risk* has a negative relationship with the assets structure.

H_6: *The company's financial risk* has a positive relationship with loan interest rate. In this research, the authors used the average short-term lending rate in VND to illustrate the fluctuation of credit interest rates in the market.

H_7: *The company's financial risk* has a negative relationship with the age of the enterprise (AGE).

H_8: *The company's financial risk* has a negative relationship with the size of the enterprise (SIZE). The larger the business size, the easier it is to improve profits, profitability and help businesses reduce financial risks. Frank & Goyal (2003) argued that the larger the enterprise size, the better the financial resources, the more diversified in business lines. The size of listed medical firms is measured through the log of total assets (Fulmer et al., 1984).

H_9: Place of stock listing (PLA) affects t*he company's financial risk*. PLA is the new control variable that is added into the model to investigate the factors affecting company's financial risk. This variable takes 1 for stocks listed on Hochiminh Stock Exchange (HOSE) and receives 0 for companies listed on Hanoi stock Exchange (HNX).

4. RESEARCH RESULTS

4.1. Descriptive Statistics Presentation

The analysis results produced by Eviews show that there are differences in financial risk (X-score) and factors such as

debt structure, liquidity, profitability, company's efficiency, asset structure, interest rate, listing location, company's size, and age among 21 medical enterprises listed on the Vietnam stock market. The minimum and maximum values of X-score are -5.12 and 1.13 respectively. However, the number of listed medical companies with and without high probability of financial risk remain quite stable in the period 2016 – 2020. The maximum value of Debt structure (DS) is 1.0 which is 2.71 time higher than the minimum value. The average value of WCL and QR are over 1.4. The lowest ROS is -0.19 while the highest ROS is 0.54, showing that some listed medical companies have negative profit after tax.

Table 2. Descriptive Analysis of Variables

Variable	Number of observations	Min	Max	Mean	Std. Dev
X-score	105	-5.1238	1.1343	-2.5598	1.4257
DS	105	0.3690	1.0000	0.8876	0.1529
ALR	105	1.0362	10.8474	3.5421	2.0048
QR	105	0.3631	12.7933	1.8859	1.6819
CFL	105	-13.1561	1.3626	-0.1178	1.3180
WCL	105	-0.0824	7.3582	1.4192	1.4047
ROS	105	-0.1864	0.5448	0.0990	0.1079
ROE	105	-0.2352	0.4427	0.1374	0.1084
REE	105	-2.4012	0.5547	0.0713	0.4980
IT	105	1.0399	26.2133	4.0318	3.6865
FAT	105	1.1426	262.6357	14.0216	38.7834
TAT	105	0.1730	2.7664	1.0648	0.4910
ART	105	0.1962	18.5139	5.4776	3.5363
NAR	105	0.0349	0.9078	0.6181	0.2134
FAR	105	0.0059	0.6623	0.2425	0.1629
IRS	105	0.0839	0.0924	0.0888	0.0030
AGE	105	13.0	58.0	32.0476	11.3573
SIZE	105	4.3101	6.9889	5.8838	0.4913
PLA	105	0.0	1.0	0.5714	0.4972

Source: Eviews analysis's results

Dependent variable (X-score): The lowest value of X-score is -5.12 times (AMV, 2018), the highest value is 1.13 times (VMD, 2016), the average value is -2.56 times, degree standard deviation is 1.43 times.

Debt structure (DS): The largest value of DS is 1.0 times (in 2016: SPM, PMC; 2017: VDP, DNM, PMC; 2018: VDP, PMC; 2019: VDP, DP3, PMC; 2020: SPM, VDP, DP3, PMC), which is 2.71 times higher than the minimum value (DCL, 2018), the mean is 0.89 times, the standard deviation is 0.15 times. Descriptive statistics show that the debt structure (DS) of listed medical companies is mainly short-term debt. This leads to pressure to pay short-term debts and financial risks of medical companies listed on Vietnam's stock market.

Liquidity (ALR, QR, CFL, WCL): The maximum value of ALR is 10.85 times (AMV, 2019), which is 10.47 times higher than the minimum value (VMD, 2016), the average value is 3.54 times. times, the standard deviation is 2.00 times. The maximum value of QR is 12.79 times (AMV, 2017), which is 35.23 times higher than the minimum value (LDP, 2018), the mean value is 1.89 times, the standard deviation is 1.68 times. The maximum value of CFL is 1.36 times (PMC, 2018), the lowest value is -13.16 times (PPP, 2020), the mean value is -0.12 times, the standard deviation is 1.32 times. The lowest value of WCL is -0.08 times (PPP, 2017), the highest value is 7.36 times (DMC, 2020), the mean value is 1.42 times, the standard deviation is 1.40 times.

Profitability (ROS, ROE, REE): The lowest value of ROS is -0.19 times (JVC, 2020), the highest value is 0.54 times (AMV, 2017), the average value is 0.10 times, the degree of profitability is 0, standard deviation is 0.11 times. The lowest value of ROE is -0.24 times (LDP, 2018), the highest value is 0.44 times (DP3, 2018), the mean is 0.14 times, the standard deviation is 0.11 times. The lowest value of REE is -2.40 times (JVC, 2020), the highest value is 0.55 times (SPM, 2020), the mean value is 0.07 times, the standard deviation is 0.50 times.

Operational efficiency (IT, FAT, TAT, ART): The maximum value of IT is 26.21 times (AMV, 2018), which is 25.21 times higher than the minimum value (OPC, 2019), the average value reaches 4.03 times, the standard deviation is 3.69 times. The maximum value of FAT is 262.64 times (VMD, 2017), 229.86 times higher than the minimum value (JVC, 2016), the mean is 14.02 times, the standard deviation is 38.78 times. The maximum value of TAT is 2.77 times (DHT, 2019), 15.99 times higher than the minimum value (AMV, 2020), the mean value is 1.06 times, the standard deviation is 0.49 times. The maximum value of ART is 18.51 times (DP3, 2019), 94.36 times higher than the minimum value (AMV, 2017), the mean value is 5.48 times, the standard deviation is 3.54 times.

Financial structure (NAR, FAR): The maximum value of NAR is 0.91 times (AMV, 2019), 26.01 times higher than the minimum value (VMD, 2016), the average value is 0.62 times, the deviation is different. standard is 0.21 times. The maximum value of FAR is 0.66 times (PPP, 2017), 112.25 times higher than the minimum value (VMD, 2017), the mean value is 0.24 times, the standard deviation is 0.16 times.

Control variables (IRS, AGE, SIZE, PLA): The maximum value of IRS is 9.24% (2019), which is 1.10 times higher than the minimum value (8.39%, 2016), the mean value is 8.88% , the standard deviation is 0.003 times. The maximum value of AGE is 58.0 years (DP3, 2020), which is 4.46 times higher than the minimum value (VDP, 2016), the mean value is 32.05 years, the standard deviation is 11.36 times. The maximum value of SIZE is 6.99 times (VMD, 2018), which is 1.62 times higher than the minimum value (AMV, 2016), the mean value is 5.88 times, the standard deviation is 0.49 times. PLA value is 1.0 (12 medical enterprises listed on

Table 3. Results of Correlation Analysis between X-score and Independent and Control Variables.

Variables	DS	ALR	QR	CFL	WCL	ROS	ROE	REE	IT
Correlation	0.0127	-0.8376	-0.5871	0.0463	-0.7372	-0.6474	-0.3908	-0.0366	-0.1189
Probability	0.8978	0.0000	0.0000	0.6391	0.0000	0.0000	0.0000	0.7110	0.2270
Variables	TAT	FAT	ART	NAR	FAR	AGE	IRS	SIZE	PLA
Correlation	0.4265	0.5621	-0.0345	-0.9766	-0.0429	-0.1456	-0.0315	0.0305	-0.1645
Probability	0.0000	0.0000	0.7265	0.0000	0.6639	0.1385	0.7496	0.7573	0.0935

Source: Eviews analysis's results

Table 4. The Regression Analysis Results.

Dependent Variable: X-score				
Method: Least Squares				
Date: 11/17/21 Time: 20:26				
Sample: 1 105				
Included observations: 105				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.717384	0.079402	21.62893	0.0000
ROS	-2.051924	0.205641	-9.978183	0.0000
ART	-0.034551	0.005434	-6.357877	0.0000
NAR	-5.968689	0.104041	-57.36884	0.0000
AGE	-0.006108	0.001696	-3.602118	0.0005
R-squared	0.983138	Mean dependent var		-2.559811
Adjusted R-squared	**0**.982463	S.D. dependent var		1.425686
S.E. of regression	0.188798	Akaike info criterion		-0.449835
Sum squared resid	3.564453	Schwarz criterion		-0.323456
Log likelihood	28.61632	Hannan-Quinn criter.		-0.398623
F-statistic	1457.615	Durbin-Watson stat		2.233208
Prob(F-statistic)	0.000000			

Source: Eviews analysis's results.

HOSE) and PLA is 0.0 (9 medical enterprises listed on HNX).

4.2. Correlation and Regression Analysis Results

Table **3** shows the correlation analysis results between X-score with independent and control variables. According to this table, X-score has a statistically significant positive relationship (P-value < 0.05) with FAT, TAT while it has a statistically significant negative relationship (P-value < 0.05) with ALR, QR, WCL, ROS, ROE, NAR. There is no statistically significant correlation between X-score with DS, CFL, REE, IT, ART, FAR, AGE, IRS, SIZE and PLA.

Using X-score as the dependent variable representing financial risk and 18 independent and control variables, the regression model has been run on Eviews. Initially, the regression results were not satisfactory as the model included the insignificant variables (Table **3**). Therefore, DS, ALR, CFL, QR, WCL, ROE, REE, IT, FAT, TAT, FAR, IRS, SIZE, PLA have been removed. The analysis results of model after variable reduction are shown in table **4**.

Regression results using the LS model show that independent variables can explain 98.25% for the dependent variable. Model is significant according to F test result. There is no multicollinearity because all VIF values are smaller than 2 (Table **5**). ROS, ART, NAR, AGE have statistical significance, with all P-values are smaller than 0.05.

Table 5. Results of Multicollinearity Tests.

Variable	ROS	ART	NAR	AGE
R_i^2	0.2838	0.0444	0.2842	0.0485

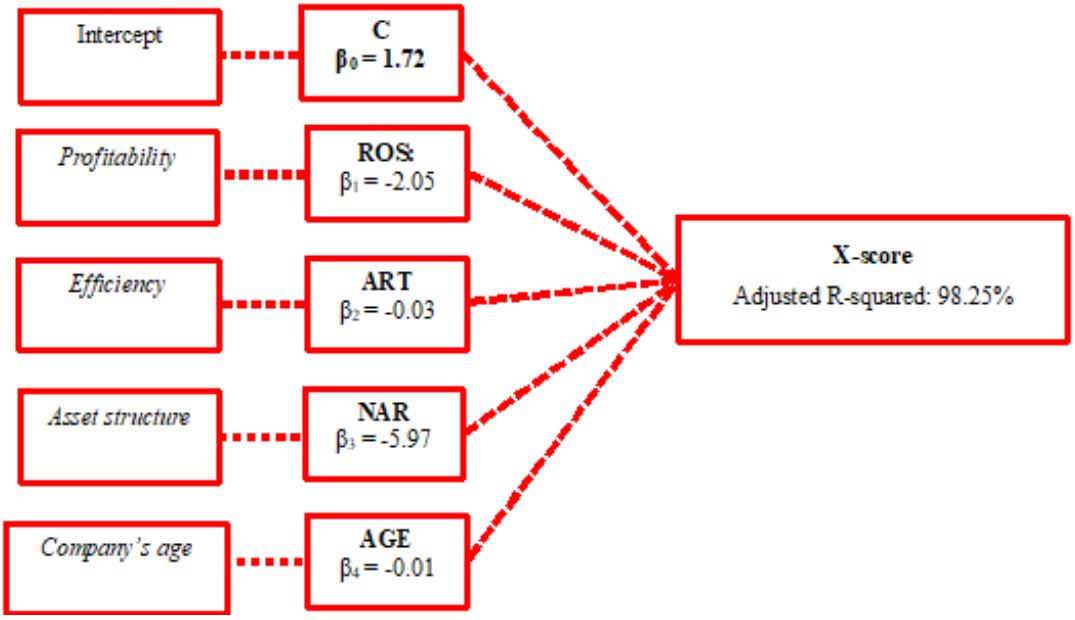

Fig. (2). The model analysis results.

Source: Eviews analysis's results

$VIF = \frac{1}{1-R_i^2}$	1.3962	1.0465	1.3970	1.0510

Source: Eviews analysis's results.

The autocorrelation problem in the model is recognised by performing Breusch-Godfrey test. Breusch-Godfrey test results shown in Table **6** show that P-value = 0.1864 > α. Therefore, H_0 is accepted or there is no autocorrelation in the model.

Table 6. Autocorrelation Test Results.

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.673588	Prob. F(1,99)	0.1988
Obs*R-squared	1.745509	Prob. Chi-Square(1)	0.1864

Source: Eviews analysis's results

White's test is run to detect Heteroskedasticity, in which the null hypothesis is: There is no Heteroskedasticity in the model. Initially, H_0 is rejected because P-value (0.0000) is smaller than 0.05. The problem is overcome by using a weighted regression method with a weight of 1abs_residf. As shown in table **7**, the P-value = 0.4935 which is bigger than 0 so that H_0 is accepted. In other words, there is no Heteroskedasticity detected in the model.

Table 7. Results of testing Heteroskedasticity.

Heteroskedasticity Test: White			
F-statistic	0.865788	Prob. F(5,99)	0.5070
Obs*R-squared	4.398949	Prob. Chi-Square(5)	0.4935
Scaled explained SS	6.587896	Prob. Chi-Square(5)	0.2531

Source: Eviews analysis's results.

5. CONCLUSION AND RECOMMENDATIONS

Fig. (**2**) demonstrates how the factors affecting the financial risk of listed medical companies in Vietnam stock market during 2016 and 2020. The adjusted R^2 calculated in the model concludes that ROS, ART, NAR and AGE have ability to explain 98.25% of the change in financial risk of companies. In which, ROS, ART, NAR, AGE have negative relationship with X-score: The higher the ROS, ART, NAR, AGE (lower), the lower the X-score (higher). Specifically, when ROS increases by 1.0%, the X-score decreases by 2.05%. As ART increases by 1.0%, X-score decreases by 0.03%. NAR increased by 1.0%, the X-score decreased by 5.97%. AGE increases by 1.0%, X-score decreases by 0.01%.

Based on the research results, the following conclusions and recommendations can be presented:

Firstly, financial risk of medical companies listed on Vietnam stock market has no relationship with debt structure (H_1 is rejected). This finding is also provided by Cao & Zen (2005), Fu & Liu (2012), Bhunia & Mukhuti (2012), Vu (2017). It can be explained by the fact that short-term debt accounts for extremely large proportion of total liabilities in medical companies. High levels of short-term debts reduce the pressure on company's payments. Therefore, short-term debt does not cause company's financial risk.

Second, financial risk of medical companies listed on Vietnam stock market has no relationship with liquidity (H_2 is rejected). This analysis result is different with what have been found by Altman (1968, 1983, 1993), Springate (1978), Ohlson (1980), Fulmer *et al.* (1984), Porporato & Sandin (2007), Cerovac & Ivicic (2009), Fu & Liu (2012), Bhunia & Mukhuti (2012), Vu (2017), Dang et al. (2020). The inconsistency may come from the limitation in sample collected in

this research. In addition, liquidity is not the main problem leading to financial risk of listed medical companies in the sample as the main debts are short-term. However, it is revealed that some companies have liquidity lower than the industry average such as VDM, DBT, DHT, LDP, MKV.

Third, financial risk of medical companies listed on Vietnam stock market has a negative relationship with profitability (ROS). This conclusion is consistent with research results of Altman (1968, 1983, 1993), Springate (1978), Ohson (1980), Fulmer et al. (1984), Cao & Zen (2005), Porporato & Sandin (2007), Cerovac & Ivicic (2009), Fu & Liu (2012), Bhunia & Mukhuti (2012), Dang et al., (2020). If the companies suffer losses for a long time, they will have to face pressure to pay their due debts, lose their reputation and find hard to raise capital. In contrast, a listed medical company with better profitability has a smaller probability to face financial risk. Listed medical companies can apply measures such as increasing revenue and controlling costs to increase ROS, especially necessary for listed medical enterprises with negative after-tax profits (JVC, LDP, MKV).

Fourth, financial risk of medical companies listed on Vietnam stock market has a negative relationship with performance (ART). This conclusion is consistent with research results of Altman (1968, 1983, 1993), Springate (1978), Ohlson (1980), Fulmer et al. (1984), Cao & Zen (2005), Porporato & Sandin (2007), Cerovac & Ivicic (2009), Fu Gang & Liu Dan (2012), Bhunia & Mukhuti (2012), and Dang et al. (2020). In fact, many listed medical enterprises have not operated in full capacity, with below industry average ART, such as Viet My Pharmaceutical and Medical Equipment Manufacturing and Trading JSC (AMV), SPM Joint Stock Company (SPM), Domesco Medical Import-Export Joint Stock Company (DMC)… Therefore, to improve operational efficiency, listed medical companies need to improve the efficiency of receivables management to increase revenue. Companies should maximize the capacity of existing assets and liquidate those that are no longer in operation, contributing to effective control of financial risks.

Fifth, financial risk of medical companies listed on Vietnam stock market has a negative relationship with financial structure (NAR). The same conclusion can be seen in the works of Altman (1968, 1983, 1993), Ohlson (1980), Fulmer et al. (1984), Porporato & Sandin (2007), Cerovac & Ivicic (2009), Fu & Liu (2012), Bhunia & Mukhuti (2012), Vu (2017), Dang et al. (2020). Theoretically, a low Net assets ratio (NAR) or a high debt ratio (DR), will put a pressure on the companies. The average NAR of the listed medical enterprises is 0.62, lower than the average NAR of the group with healthy financial performance in the studies of Altman (1968), Ohlson (1980), Porporato & Sandin (2007), Cerovac & Ivicic (2009). Therefore, listed medical companies need to maintain a reasonable asset structure and restructure their capital structure to prevent financial risks (Ben Tre Pharmaceutical JSC- DBT, Ha Tay Pharmaceutical JSC - DHT, Vimedimex Medicine and Pharmaceutical JSC - VMD).

Sixth, financial risk of medical companies listed on Vietnam stock market has negative relationship with enterprise's age (AGE). The older the listed medical companies are, the longer they have been operating in the market, the more experience they have in managing production and business activities as well as obtaining better branding and business strategies. They can generate large accumulated profits and have optimal capital structure. Thus, the financial risks can be eliminated.

Seventh, financial risk of medical companies listed on Vietnam stock market has no relationship with interest rate, size of business and listing location. There are not enough grounds to conclude the impact of credit interest rates and firm size on financial risks of listed medical companies due to the data limitation. The same conclusion is also stated by Cao & Zen (2005), Dang et al. (2020).

Eighth, the sign and value of the beta coefficient corresponding to the variables show the degree of impact of the factors on the financial risks of the medical enterprises listed on the Vietnam stock market. Accordingly, asset structure has the strongest impact on company's financial risks as the highest beta coefficient of -5.97 belongs to NAR. The impacts of profitability, efficiency and age on company's financial risks are smaller. Therefore, financial managers of listed medical companies need to focus on controlling financial risks at an acceptable level by choosing a reasonable capital structure as well as improving company's profitability and performance efficiency. This finding also raises the alarm about having below the industry averages in Net assets ratio (NARs), return on sales (ROS) and receivables turnover (ART) such as JVC, AMV, LDP, MKV, VMD, DBT, DHT.

ACKNOWLEDGEMENT

This is a part of a university level project funded by the Thai Nguyen University of Economics and Business Administration in 2021. Project code: ĐH2021- TN08- 02. Project name: Analysing factors affecting financial risk of listed medical companies on Vietnam stock exchange.

CONFLICT OF INTEREST

The authors reported no potential conflict of interest.

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Received: Jan 06, 2022 Revised: Jan 20, 2022 Accepted: Jun 07, 2022

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