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Identify financial risks of pharmaceutical – medical firms listed on the Vietnam stock exchange

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ABSTRACT: The study applies the Z-score model (Altman, 1968), S-score model (Springate, 1978), and X-score model (Zmijewski, 1984) along with analyzing data from 2016 to 2020 to identify risks of 21 phamaceutical – medical firms listed on the Vietnam stock market. The findings show that: (1) there is a significant difference between the Z-score model (Altman, 1968), S-score model (Springate, 1978), and X-score model (Zmijewski, 1984) in recognizing financial risks of phamaceutical – medical firms listed on the Vietnam stock exchange. Different variables in each study model cause the models' financial risk identification results to differ; (2) Among the three models, the X-score model is the most accurate forecasting model in predicting financial risks of pharmaceutical-medical enterprises listed on Vietnam stock market, with an accuracy rate of 81.90% and an error rate of 18.10%; (3) The VMD index Z-score, S-score, and X-score of Vimedimex Pharmaceutical Joint Stock Company (HOSE: VMD) are all below the financial safety level.

Keywords: financial risks, Z-score model (Altman, 1968), S-score model (Springate, 1978), X-score model (Zmijewski, 1984), phamaceutical – medical firms, Vietnam stock market.

I. INTRODUCTION

Financial risk is a type of issue that frequently arises in the course of running a business. Internal or external factors can contribute to this type of risk. It might have a direct impact on the business's profitability. As a result, financial risk analysis is critical. If it cannot be remedied, the company will almost certainly go bankrupt.

Financial risk refers to the probability of loss linked with financial activity, and it typically emerges from the execution of transactions directly related to financial activities, such as: buying, selling, investing, borrowing and some other business activities; but it can also be indirect consequence of changes in government policies, domestic and international political events, or can be caused by natural disasters. Financial risk is defined in this study as the risk of not being able to pay due debts due to firms' usage of financial leverage - borrowing cash for production and commercial activities.

Enterprise financial risks are linked to profitability and have two effects on production and business activities: positive impacts and negative ones. If enterprises aggressively prevent and restrict financial risks, and even incorporate financial risks into production and business prospects, they will reap numerous benefits, including saving cost; increasing profits and business value; enhancing market competitiveness. Financial risks, on the other hand, will become a financial burden for organizations if they are not proactively prevented or limited, resulting in increased production and business costs, insolvency, reduced earnings, capacity, and competitiveness. If the financial risks are too big to overcome, the company may experience a downturn, be unable to pay its debts, and eventually go bankrupt.

By December 31, 2020 there had been a total of 21 listed phamaceutical – medical firms on the Vietnam stock market, representing for around 0.6 percent of all phamaceutical – medical enterprises. The number of phamaceutical – medical enterprises listed on the stock market is limited, primarily large-scale businesses, but when compared to unlisted medical businesses, this number is insufficient, resulting in notably low market competition. When it comes to production and commercial activities in the context of worldwide integration and competition listed phamaceutical – medical organizations encounter variables affecting financial risks such as debt structure, solvency, profitability, operating efficiency, credit interest rates, and business size.

The average short-term (CR) audit system of listed phamaceutical – medical firms is 2.67 times between 2016 and 2020; the lowest CR is 0.89 times (PPP, 2017); MKV's CR in 2017 (0.89 times) and 2018 (0.94 times) is 1.0 times lower. The lowest return on assets (ROA) is negative 0.12 times (JVC, 2020), whereas the average ROA is 0.09 times. Some publicly traded phamaceutical – medical firms, such as JVC, SPM, MKV, LDP, and DBT, have negative ROAs that are lower than the industry average. The greatest total asset turnover (TAT) (DHT, 2019) is 16.0 times more than the lowest TAT (AMV, 2017), the average TAT is 1.06 times, while listed phamaceutical – medical firms such as JVC, VDP, AMV, DCL, and SPM have lower TAT than the industry average. The greatest debt-to-assets ratio (DAR) is 0.97 times (VMD, 2016), the average DAR is 0.38 times, and several businesses, such as DBT, DHT, DNM, LDP, and MKV, have DAR higher than the industry average.

In this study, the Z-score model (Altman, 1968), S-score model (Springate, 1978), and X-score model (Zmijewski, 1984) are employed along with secondary databases acquired from stock exchanges with all types of businesses and business lines to assess financial risks of firms in various nations throughout the world such as: Greece **(Lagkas & Papadopoulos, 2014)**, India **(Singh & Mishra, 2016; Verlekar & Kamat, 2019)**, Kuwait **(Musaed et al., 2018)**, Indonesia **(Sinarti & Sembiring, 2015; Andriani & Sihombing, 2021; Fauzi et al., 2021),** Portugal **(Ashraf et al., 2019),** Turkey **(Turk & Kurklu, 2017).** The Z-score model, S-score model, and X-score model are still being examined in Vietnam as part of the study to determine: (1) There is a significant difference between the Z-score model, S-score model and X-score model in identifying financial risks of phamaceutical – medical companies listed on Vietnam stock exchange; (2) The X-score model is the most reliable forecasting model for identifying financial risks of phamaceutical – medical enterprises listed on the Vietnamese stock exchange.

II. LITERATURE REVIEW

2.1. Z-score model (Altman, 1968)

In 1968, Altman created the Multiple Discriminant Analysis (MDA) model to estimate financial risks for manufacturing companies trading on the stock market. Altman (1968) chose 05 financial indicators with the best predictive value out of 25 to propose a Z-score model with an accuracy of up to 95%, including: WC/TA, RE/TA, EBIT/TA, MVE/TL, S/TA. Z-score model (**Altman, 1968**) has the form as follows:

Z-score = 1.2WC/TA+ 1.4RE/TA+ 3.33EBIT/TA + 0.6MVE/TL + 0.999S/TA (1)

Where: (1.1) WC/TA = Working Capital/Total Assets;	(1.3) EBIT/TA = Earnings Before Interest and Taxes/Total Assets;
(1.2) RE/TA = Retained Earnings/Total Assets;	
(1.4) MVE/TL = Market Value of Equity/Total Liabilities;	(1.5) S/TA = Sales/Total Assets.

Altman (1968) supposed that: Z-score ≥ 2.99, the corporation is in good financial shape and posed no financial risk; $1.81 \leq$ Z-score < 2.99, the corporation may be exposed to financial risks; Z-score < 1.81, the corporation is in financial difficulty, there is a possibility of financial risks.

2.2. S-score model (Springate, 1978)

Springate (1978) employed the MDA (Multiple Discriminant Analysis) method and picked some financial indicators connected to the company's insolvency to create a financial risk detection model. Springate (1978) utilized the MDA technique to select four financial indicators out of 19 typical financial indicators to distinguish between a group of firms with financial difficulties and a danger of bankruptcy and a group of enterprises with a good financial position and no risk of bankruptcy. The S-score model of Springate (1978) is as follows:

S-score = 1.3WC/TA + 3.07EBIT/TA + 0.66EBT/CL + 0.4S/TA (2)

Where: (2.1) WC/TA = Working Capital/Total Assets;	(2.3) EBT/CL = Earnings Before Taxes/Current Liabilities;
(2.2) EBIT/TA = Earnings Before Interest and Taxes/Total Assets;	(2.4) S/TA = Sales/Total Assets.

The S-score model (Springate, 1978) divides a company's financial risks into two categories: S-score ≥ 0.862, the firm is in good financial shape and poses no financial danger; S-score < 0.862, the firm is with financial difficulties and has a danger of bankruptcy. S-score (Springate, 1978), a financial risk forecasting model based on Altman's (1968) Z-score model, which constructed using data from 40 businesses, shows a 92.5 percent accuracy rate. Following studies find that the model is 83.3 percent accurate (Sands et al., 1983) and 88.0 percent accurate (Botheras, 2000).

2.3. X-score Model (Zmijewski, 1984)

The X-score model (Zmijewski, 1984) a popular model used by many researchers **(Grice & Dugan, 2003; Lagkas & Papadopoulos, 2014; Sinarti & Sembiring, 2015; Musaed et al., 2018; Verlekar & Kamat, 2019; Tanjung, 2020; Fauzi & et al., 2021; Muzanni & Yuliana, 2021)**, uses the probit approach to anticipate financial risk and financial indicators to quantify profitability, financial leverage, and business solvency. The X-score model uses the data of 40 bankrupt industrial enterprises and 800 non-bankrupt industrial enterprises

during the period 1972-1978. The following is the probit function, which is created using variables and coefficients determined from Zmijewski's (1984) research findings:

X-score = - 4.336 - 4.513NI/TA + 5.679TL/TA + 0.004CA/CL   (3)

Where: (3.1) NI/TA = Net Income /Total Assets;	
(3.2) TL/TA= Total Liabilities /Total Assets;	(3.3) CA/CL= Current Assets/Current Liabilities.

Based on the X-score, Djamaluddin et al (2017) classified the Zmijewski (1984) model into two groups: The X-score is negative (X-score 0), indicating that the company is in good financial shape and poses no financial risk; If the X-score is positive (X-score 0), the company is experiencing financial difficulties and is at risk of going bankrupt.

III.   METHODOLOGY AND HYPOTHESES

3.1. Methodology

To investigate financial risk identification of phamaceutical – medical companies listed on the Vietnam stock exchange, the authors compile data from 21 phamaceutical – medical companies in Table 1 from audited consolidated financial statements covering the years 2016 to 2020, including: Consolidated balance sheet, Consolidated income statement, Consolidated cash flow statement, Notes to the consolidated financial statements which are collected at https://www.hsx.vn/; and https://hnx.vn/vi-vn/hnx.html. Phamaceutical – medical companies listed on the Vietnam stock exchange have 21 stock codes respectively, including: AMV, DHT, DNM, DP3, DBT, DBD, DBD, DCL, DHG, DMC, IMP, JVC, LDP, MKV, OPC, PMC…

Table 1. List of listed companies on Vietnam stock exchange

STT	Names of listed medical companies	Stock code
01	Viet My pharmaceutical products and medical equipment manufacturing and trading JSC	AMV
02	Ha Tay Pharmaceutical JSC	DHT
03	DANAMECO medical JSC	DNM
04	Central Pharmaceutical JSC n.3	DP3
05	Ben Tre Pharmaceutical JSC	DBT
06	Binh Dinh Pharmaceutical - Medical Equipment JSC	DBD
07	Cuu Long Pharmaceutical JSC	DCL
08	Hau Giang Pharmaceutical JSC	DHG
09	DOMESCO Medical Import-Export JSC	DMC
10	Imexpharm Pharmaceutical JSC	IMP
11	Japan Vietnam Medical Instrument JSC	JVC
12	Lam Dong Pharmaceutical JSC - Ladophar	LDP
13	Cai Lay Veterinary Pharmaceutical JSC	MKV
14	OPC Pharmaceutical JSC	OPC
15	Pharmedic Pharmaceutical Medicinal JSC	PMC
16	Phong Phu Pharmaceutical JSC	PPP
17	Pymepharco JSC	PME
18	SPM JSC	SPM
19	Traphaco JSC	TRA
20	Vidipha Central Pharmaceutical JSC	VDP
21	Vimedimex Medi – Pharma JSC	VMD

Source: Processed by Authors (www.hsx.vn/; www.hnx.vn/vi-vn/hnx.html)

The financial data of 21 phamaceutical – medical firms listed on the Vietnamese stock exchange is aggregated on Excel software by year (5 years, 2016-2020) and financial components of each enterprise (Total assets - TA, Net income - NI, Total liabilities - TL, Current assets - CA, Current liabilities - CL, Profit before tax - EBT, Interest expense - I, Net revenue - S, Retained earnings - RE, Market value of equity – MVE). On this premise, financial indicators such as WC/TA, EBIT/TA, EBT/CL, S/TA, NI/TA (ROA), TL/TA (DAR), CA/CL (CR), RE/TA, MVE/TL, Z-score, S-score, and X-score are generated on Excel software to identify financial risks of phamaceutical – medical enterprises listed on Vietnam stock exchange.

This research uses Excel tools to conduct data analysis, such as: descriptive statistical analysis method, comparative method, Anova test technique (Single Factor) to detect financial risks of 21 medical firms listed on the Vietnam stock exchange, and determine: If there is a significant difference between the Z-score model, S-score model and X-score model in identifying financial risks of phamaceutical – medical companies listed on Vietnam stock exchange; (2) the most reliable forecasting model for identifying financial risks of phamaceutical – medical enterprises listed on the Vietnamese stock exchange.

3.2. **Hypotheses**

Huda et al. (2019) claim that the three models Z-score Altman (1993), S-score (Springate, 1978), and X-score (Springate, 1978) produce different findings of financial risk forecasting in firms listed on the Indonesian Stock Exchange (Zmijewski, 1984). Muzanni & Yuliana (2021) discover a substantial difference between the Z-score model Altman (1993), the S-score model (Springate, 1978), and the X-score model (Zmijewski, 1984) in risk forecasting financial hazards for listed businesses in Indonesia and Singapore.

H$_1$: There is a difference in the results of financial risk identification of pharmaceutical - medical enterprises listed on Vietnam's stock market between the Z-score (Altman, 1968), S-score (Springate, 1978) models.) and X-score (Zmijewksi, 1984).

According to Zmijewski (1984), the X-score model can predict financial risk with a 94.9 percent accuracy. The X-score model, according to Nilasari & Haryanto (2018), is the most accurate model for predicting financial risk of companies listed on the Indonesian Stock Exchange, with a rate of 97.9%. Similarly, Muzanni & Yuliana (2021) believe that the X-score model, with an accuracy rate of 87 percent, is the most accurate predictor of financial risk of listed firms in Indonesia; with an accuracy rate of 86 percent, the Z-score model is the most reliable model for predicting financial risk of listed businesses in Singapore.

H$_2$: The X-score model (Zmijewski, 1984) is the most reliable model for assessing financial risks of pharmaceutical and medical firms listed on the Vietnam stock exchange.

IV.   RESEARCH RESULTS

4.1. Descriptive statistical analysis

Statistical results describing the variables of the financial risk identification models of pharmaceutical and medical enterprises listed on the Vietnamese stock market including Z-score model, S-score model and X-score model along with the independent variables (WC/TA, CA/CL, RE/TA...) shown in Table 2 indicate that there are differences in factors affecting financial risk of listed pharmaceutical - medical enterprises. The Z-score has a minimum of -0.32 times (JVC, 2020) and a maximum of 8.05 times (AMV, 2019), with a mean of 3.43 times and a standard deviation of 1.63 times. The S-score has a minimum of -0.12 times (JVC, 2020) and a maximum of 5.21 times (AMV, 2019), with a mean of 1.59 times and a standard deviation of 0.9 times. The X-score has a minimum of -5.12 times (AMV, 2018), a maximum of 1.13 times (VMD, 2018), a mean of -2.56 times, and a standard deviation of 1.43 times.

Table 2. Descriptive statistics of the variables of Z-score, S-score and X-score models

STT	Ratio	Count	Minimum	Maximum	Mean	Standard Deviation
01	WC/TA	105	-0.0506	0.8516	0.3275	0.2140
02	CA/CL	105	0.8866	13.3278	2.6717	1.7946
03	RE/TA	105	-1.7393	0.4314	0.0360	0.3740
04	EBIT/TA	105	-0.1185	0.4318	0.1195	0.0892
05	EBT/CL	105	-0.4831	6.0870	0.5624	0.7937
06	NI/TA	105	-0.1222	0.3368	0.0894	0.0795
07	S/TA	105	0.1730	2.7664	1.0648	0.4910
08	MVE/TL	105	0.0362	9.8474	2.5421	2.0048
09	TL/TA	105	0.0922	0.9651	0.3819	0.2134
10	Z-score	105	-0.3195	8.0545	3.4269	1.6301
11	S-score	105	-0.1224	5.2110	1.5898	0.8984
12	X-score	105	-5.1238	1.1343	-2.5598	1.4257

Source: Processed by Authors (www.hsx.vn/; www.hnx.vn/vi-vn/hnx.html)

4.2. Financial risk identification results for listed pharmaceutical - medical companies

4.2.1. The Z-score model (Altman, 1968)

Table 3 shows the findings of a study that used the Z-score model to detect financial risks based on the number of pharmaceutical and medical firms listed on the Vietnam stock exchange from 2016 to 2020. In which the quantity of firms exposed to financial risks has been decreasing, from 5/21 enterprises in 2016 to 3/21 enterprises in 2020. However, the number of firms that may be exposed to financial hazards has been increasing with being 4/21 enterprises in 2016, 6/21 enterprises in 2020 and 11/21 enterprises in 2019. In 2016, 4/21 listed pharmaceutical - medical enterprises may be subject to financial risks, including: DBD, SPM, LDP, PPP; in 2017 there were 5/21 enterprises: DBD, DCL, OPC, DBT, LDP; in 2018 there were 5/21 enterprises: DCL, OPC, DBT, DNM, PPP; in 2019 there were 11/21 enterprises: DBD, DCL, OPC, VDP, JVC, VMD, DBT, DNM, LDP, MKV, PPP; in 2020 there were 6/12 enterprises: DCL, OPC, VDP, VMD, DNM, MKV. In 2016, there were 5/21 listed pharmaceutical - medical enterprises with financial risk: JVC, VMD, AMV, DBT, MKV; in 2017 there were 04/21 enterprises: JVC, VMD, MKV, PPP; in 2018 there were 04/21 enterprises: JVC, VMD, LDP, MKV; in 2020 there were 3/21 enterprises: JVC, DBT, LDP.

Table 3. Results of the study applying the Z-score model to identify financial risks based on the number of listed pharmaceutical and medical enterprises

Z-score model	2016	2017	2018	2019	2020
Z-score < 1.81: Area with financial risk	5	4	4	0	3
1.81 ≤ Z-score < 2.99: Uncertain area	4	5	5	11	6
Z-score ≥ 2.99: Safe area	12	12	12	10	12
Total	21	21	21	21	21

Source: Processed by Authors (www.hsx.vn/; www.hnx.vn/vi-vn/hnx.html)

The results of the study applying the Z-score model (Altman, 1968) to identify financial risks by structure of pharmaceutical and medical enterprises listed on the Vietnam stock market are shown in Figure 1. In which the proportion of listed pharmaceutical - medical firms with financial risks saw a decrease, from 23.81 percent of total enterprises in 2016 to 14.29 percent in 2020. The proportion of listed pharmaceutical-medical firms that may be exposed to financial risks grew by 9.52 percent from 19.05 percent in 2016 to 28.57 percent in 2020. The number of listed pharmaceutical-medical companies in good financial status with no financial risks is reasonably consistent, accounting for 47-57 percent of the total number of companies. (DHG, DMC, IMP, PME, TRA…).

Figure1. Results of the study applying the Z-score model to identify financial risks by structure of listed pharmaceutical - medical enterprises
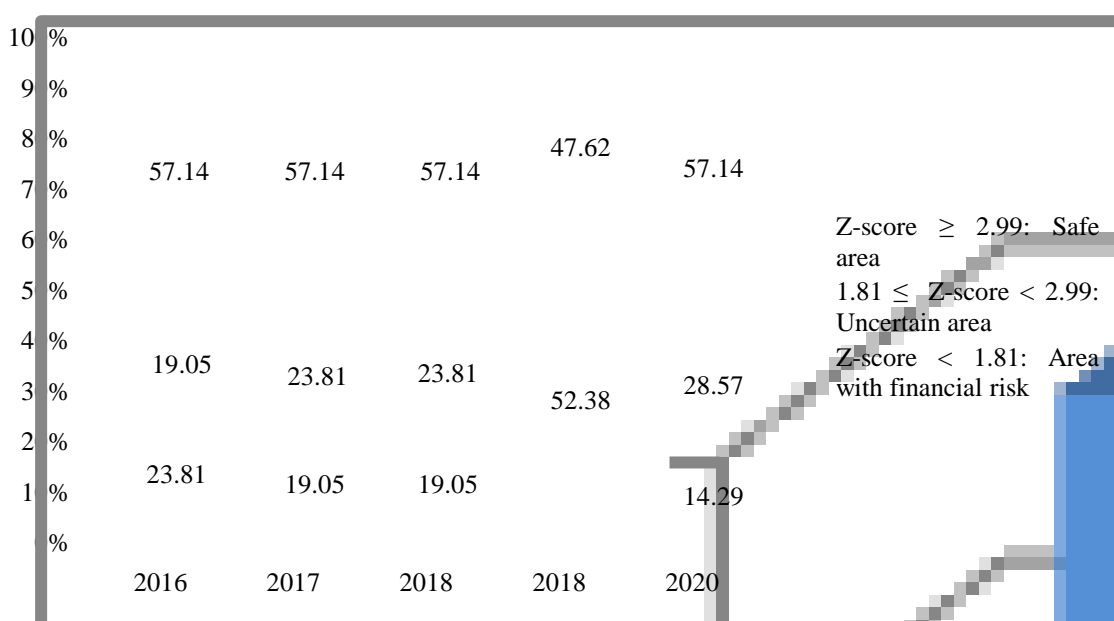
Source: Processed by Authors (www.hsx.vn/; www.hnx.vn/vi-vn/hnx.html)

4.2.2. The S-score model (Springate, 1978)

The findings of the research using the S-score model to identify financial risks by number of pharmaceutical and medical firms listed on the Vietnamese stock exchange from 2016 to 2020 are shown in table 4. In which, the proportion of listed pharmaceutical - medical firms with financial risk witnessed a decrease from 6/21 enterprises in 2016 to 3/21 enterprises in 2020. In contrast, the number of listed pharmaceutical-medical firms with a strong financial position and minimal financial risks rose from 15/21 firms (DHG, DMC, PME, TRA, PMC…) in 2016 to 18/21firms (DHG, DMC, TRA, DP3, PMC…) in 2020. In 2016, there were 6/21 listed pharmaceutical - medical enterprises with financial risk: DBT (S-score is of 0.753 times), JVC (0.239 times), MKV (0.510 times), PPP (0.766 times), SPM (0.536 times), VMD (0.764 times); in 2017 there were 4/21 enterprises: JVC (0.726 times), MKV (0.435 times), PPP (0.607 times), VMD (0.685 times); in 2018 there were 5/21 enterprises: JVC (0.790 times), LDP (0.420 times), MKV (0.511 times), PPP (0.805 times), VMD (0.675 times); in 2019 there were 5/21 enterprises: DBT (0.824 times), JVC (0.842 times), LDP (0.785 times), MKV (0.672 times), VMD (0.854 times); in 2020 there were 3/21 enterprises: JVC (-0.122 times), DBT (0.637 times), LDP (0.222 times).

Table 4. Results of the study applying the S-score model to identify financial risks by the number of listed pharmaceutical - medical enterprises

S-score model	2016	2017	2018	2019	2020
S-score < 0.862: Area with financial risk	6	4	5	5	3

S-score ≥ 0.862: Safe area	15	17	16	16	18
Total	21	21	21	21	21

Source: Processed by Authors (www.hsx.vn/; www.hnx.vn/vi-vn/hnx.html)

The findings of the research using the S-score model **(Springate, 1978)** to identify financial risks by proportion of pharmaceutical and medical firms listed on the Vietnam stock exchange from 2016 to 2020 are shown in figure 2. In which, the structure of listed pharmaceutical - medical enterprises exposed to financial risks saw a decrease by 14.28% from 28.57% in 2016 to 14.29% in 2020. In contrast, the structure of listed pharmaceutical-medical enterprises with a sound financial position and no financial risk grew by 16.08% from 71.43% in 2016, to 87.51% in 2020.

Figure2. Results of the study applying the Z-score model to identify financial risks by proportion of listed pharmaceutical - medical enterprises
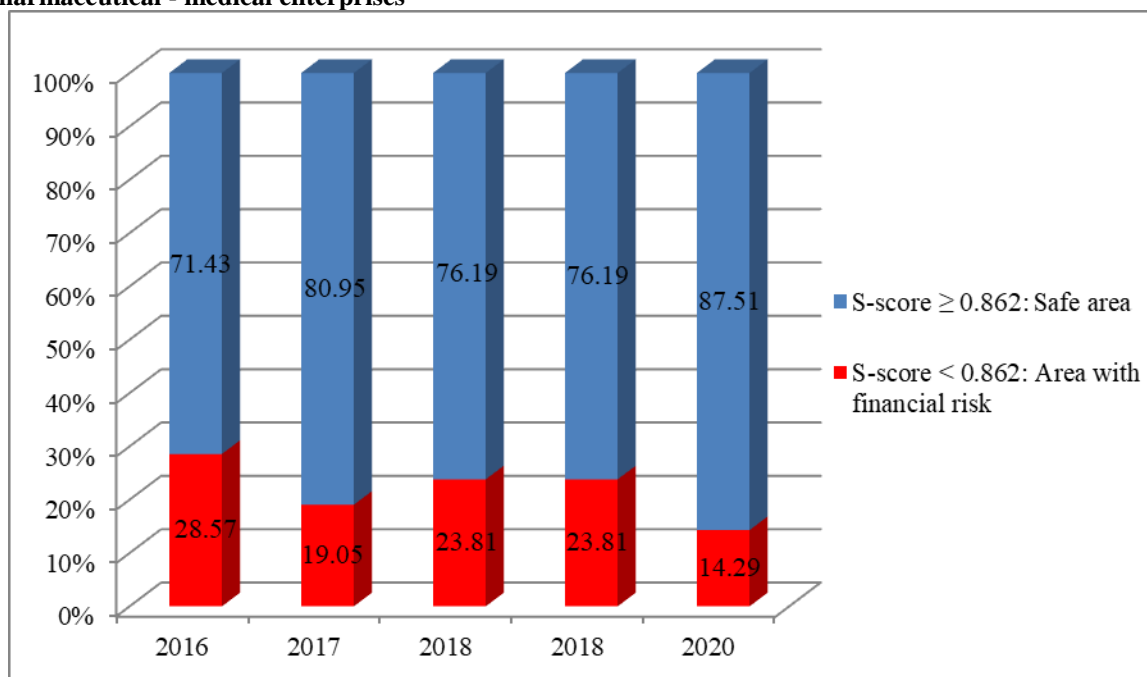
Source: Processed by Authors (www.hsx.vn/; www.hnx.vn/vi-vn/hnx.html)

4.2.3. The X-score model (Zmijewski, 1984)

The findings of a study using the X-score model to detect financial risks by number of pharmaceutical and medical firms listed on the Vietnam stock exchange from 2016 to 2020 are shown in Table 5. In which, the scale of listed pharmaceutical-medical firms with financial risks and enterprises with a healthy financial status and no financial difficulties stayed stable over the period 2016-2020. In which 1/21 business faced financial danger (VMD), while 20/21 businesses were in good financial shape and had no financial risk (DBD, DCL, DHG, DMC, IMP…). As a result, VMD is the sole company with a financial risk, with an X-score of 1,134 in 2016, 1,128 in 2017, 1,133 in 2018, 1,117 in 2019, and 1,078 in 2020.

Table 5. Results of the study applying the X-score model to identify financial risks by the number of listed pharmaceutical - medical enterprises

X-score model	2016	2017	2018	2019	2020
X-score > 0: Area with financial risk	1	1	1	1	1
X-score < 0: Safe area	20	20	20	20	20
Total	21	21	21	21	21

Source: Processed by Authors (www.hsx.vn/; www.hnx.vn/vi-vn/hnx.html)

The results of the study applying the X-score model to identify financial risks by the proportion of listed pharmaceutical-medical enterprises on Vietnam stock exchange are shown in figure 3. In which, between 2016 and 2020, the proportion of firms with financial risks and enterprises with solid financial positions and no financial hazards stayed quite stable. The percentage of businesses with financial risk is 4.76 percent, while the percentage of businesses with a sound financial position and no financial risk is 95.24 percent of the total number of businesses.

Figure 3. Results of the study applying the X-score model to identify financial risks by the proportion of listed pharmaceutical-medical enterprises
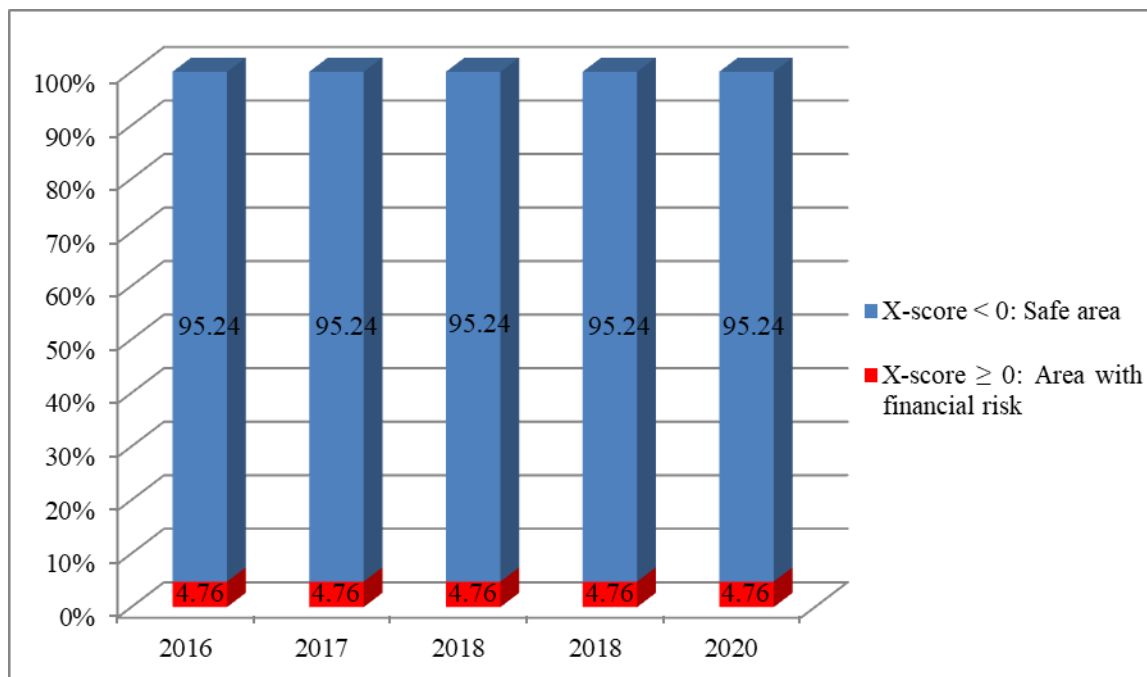
Source: Processed by Authors (www.hsx.vn/; www.hnx.vn/vi-vn/hnx.html)

4.3. Research hypothesis test results

The Anova test method (Single Factor) is used to study the difference in financial risk identification results between the Z-score (Altman, 1968), S-score (Springate, 1978) and X-score (Zmijewski, 1984) models. The significance value of the P-value test in the Anova test results shown in Table 6 is 0.000 0.05, indicating that there is a difference in the results of financial risk identification in pharmaceutical and medical enterprises listed on the Vietnam stock exchange between the Z-score model (Altman, 1968), S-score model (Springate, 1978), and X-score model (Zmijewski, 1984). In other words, hypothesis H1 has been confirmed.

Table 6. Anova - Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Z-score	105	359.822	3.427	2.657
S-score	105	166.933	1.590	0.807
X-score	105	-268.780	-2.560	2.033

ANOVA

Source of Variation	Sum of Squares	df	Mean Square	F	P-value	F crit
Between Groups	1975.215	2	987.608	539.0035	0.000	3.025
Within Groups	571.673	312	1.832			
Total	2546.888	314				

Source: Processed by Authors (www.hsx.vn/; www.hnx.vn/vi-vn/hnx.html)

Fauzi et al. (2021) compare the accuracy of the financial risk identification model to binary terms (DAR - Debt to Asset Ratio): if DAR > 50%, the enterprise is facing financial difficulties, and is exposed to financial risks; DAR ≤ 50%, the enterprise is in good financial shape and poses no financial danger. The results of comparing the accuracy of financial risk identification models with DAR shown in Table 7 reveal that the X-score model (Zmijewski, 1984) is the most accurate model for identifying financial risk of pharmaceutical and medical enterprises listed on the Vietnam stock market with an accuracy rate of 81.90% and an error rate of 18.10%. As a result, hypothesis H2 has been approved.

Table 7. The results of comparing the accuracy of financial risk identification models

STT	Model	Level of Accuracy	Type Error
1	Z-score (Altman, 1968)	68.57%	31.43%
2	S-score (Springate, 1978)	79.05%	20.95%
3	X-score (Zmijewski, 1984)	81.90%	18.10%

Source: Processed by Authors (www.hsx.vn/; www.hnx.vn/vi-vn/hnx.html)

V. CONCLUSIONS AND RECOMMENDATIONS

Based on the research findings of using Z-score, S-score, and X-score models to identify financial risks of pharmaceutical and medical firms listed on Vietnam stock exchange, the authors draw the following conclusions and recommendations:

First, the financial risk identification results of pharmaceutical - medical enterprises listed on the Vietnam stock market differ between the Z-score model (Altman, 1968), S-score model (Springate, 1978), and X-score model (Zmijewksi, 1984). Hypothesis H1 is accepted. According to the results of hypothesis testing by Anova test (Single Factor), the identification results have a value of P-value = 0.000 < 0.05, which means that there is a difference in the results of financial risk identification between Z-score model, S-score model, and X-score model of pharmaceutical and medical enterprises listed on the Vietnam stock market.

The difference in financial risk identification results of the models is due to different variables in each study model. According to Nurcahyanti (2015), differences in prediction outcomes are caused by differences in the variables used by each model and the coefficients in the calculation method for each forecasting model, resulting in different forecast results. According to Permana et al. (2017), each forecasting model's forecast outcomes vary since each model has various components or variables. Tanjung (2020) claims that each forecasting model differs because the measurements used in each model are different. According to Winaya et al. (2020), each model's forecast results differ because the indicators used as analytical variables in forecasting models differ.

Second, the research results show that the X-score model (Zmijewski, 1984) is the most accurate model to identify financial risks of pharmaceutical - medical enterprises listed on the Vietnam stock market. Theory H2 is accepted. The X-score is the best accurate model for identifying financial risks of pharmaceutical - medical companies listed on the Vietnamese stock market, according to the binary comparison (DAR) results, with an accuracy ratio of 81.90 percent and an error rate of 18.10 percent. The key reason is that the X-score model, out of all the research models, can forecast the most samples of enterprises in good financial shape and without financial risk. The findings of this study corroborate those of Nilasari & Haryanto (2018), Munawarah et al (2019), Huda et al (2019), and Fauzi et al (2019). (2021).

Third, as shown in Table 8, research results using VMD's Z-score, S-score, and X-score models to identify financial risks over the 2016-2020 period reveal that VMD's Z-score, S-score, and X-score are all below the financial safety threshold. According to the Z-score model, VMD's financial risk is decreasing, but it has not yet surpassed the financial safety level. Between 2016 and 2020, the average Z-score value was 1.88 times which increased by 0.46 times, from 1.80 times in 2016 to 2.26 times in 2020. VMD was rated as a financially troubled company in 2019 and 2020, with a potential for financial risk. VMD's financial risk tended to decrease according to the S-score model; in 2016, the S-score was 0.764 times; in 2020, it was 0.921 times, 0.157 times higher than the former. However, from 2016 to 2020, the average S-score was only 0.78, 0.082 times lower than the financial safety level.

Table 8. Results of the study applying the Z-score model, S-score model and X-score model to identify financial risks of VMD

Unit: times

Model	Ratio	2016	2017	2018	2019	2020	Mean 2016 - 2020
Z-score	WC/TA	0.025	0.023	0.016	0.013	0.017	0.019
	RE/TA	0.006	0.005	0.004	0.003	0.004	0.004
	EBIT/TA	0.017	0.012	0.009	0.007	0.007	0.010
	MVE/TL	0.036	0.037	0.036	0.039	0.046	0.039
	S/TA	1.690	1.540	1.557	2.026	2.184	1.799
	Z-score	**1.804**	**1.634**	**1.632**	**2.092**	**2.259**	**1.884**
S-score	WC/TA	0.025	0.023	0.016	0.013	0.017	0.019
	EBIT/TA	0.017	0.012	0.009	0.007	0.007	0.010
	EBT/CL	0.006	0.005	0.005	0.006	**0.006**	0.006
	S/TA	1.690	1.540	1.557	2.026	2.184	1.799
	S-score	**0.764**	**0.685**	**0.675**	**0.854**	**0.921**	**0.780**
X-score	Constant	-4.336	-4.336	-4.336	-4.336	-4.336	-4.336
	NI/TA	0.003	0.003	0.003	0.004	0.004	0.003
	TL/TA	0.965	0.964	0.965	0.962	0.956	0.962
	CA/CL	1.026	1.023	1.016	1.013	1.017	1.019
	X-score	**1.134**	**1.128**	**1.133**	**1.117**	**1.078**	**1.118**

Source: Processed by Authors (www.hsx.vn/; www.hnx.vn/vi-vn/hnx.html)

Table 8 shows the results of using the X-score model to determine VMD's financial risks from 2016 to 2020. The financial risks of VMD tended to reduce, but they tended to increase when compared to other firms in the

industry. The average ROA (NI/TA) of VMD was 0.003 times, which was 29.8 times lower than the average ROA of listed pharmaceutical - medical companies. This demonstrates that VMD's profitability was significantly lower than those of its competitors. According to the research findings of Altman (1968), Ohlson (1980), Porporato & Sandin (2007), Cerovac & Ivicic (2009), the financial structure of VMD reflected in DAR index (TL/TA) is very high, with an average level of 0.96 times in the 2016-2020 period, 0.58 times higher than the industry average DAR, 0.61 times higher than the group of businesses with healthy financial positions. Short-term solvency - CR (CA/CL) tended to decrease. In the period 2016-2020, the average CR was 1.02 times, which was 1.65 times lower than the industry average.

Some objective sources of VDM's financial risks, as well as pharmaceutical and medical firms listed on Vietnam stock market in recent years, have been related to systematic risk variables such as GDP growth rate, inflation, interest rates, and currency rates, which affect every aspect of the economy. Due to the Covid-19 epidemic, Vietnam's economic growth decreased to 2.91 percent in 2020. Vietnam's overall pharmaceutical income in 2020 (including production and imports) increased by roughly 3% compared to 2019, which was much lower than the average annual growth rate of 11.8 percent from 2015 to 2019. The influence of the time of social alienation and regulations to closely regulated people coming to hospitals has slowed the expansion of the pharmaceutical sector. Therefore, people with non-urgent health problems have been less likely to visit the doctor, resulting in lower prescription and medicine sales. The social distancing period has minimized the need to acquire medicine for the OTC market channel (selling over-the-counter drugs, primarily at drugstores and pharmacies). Instead of buying medicine for stock, consumers have switched to goods like hand sanitizer and face masks (which are not the main products of most pharmaceutical-medical businesses) lowering the revenue of the industry.

Furthermore, because of the impact of the Covid-19 epidemic, a lack of crucial pharmaceutical raw materials (APIs) from China and India has raised production prices. APIs sourced from China and India account for roughly 70% of all APIs used in Vietnamese medication manufacture. Meanwhile, in many epidemic-affected nations, demand for critical APIs for drug lines such as antibiotics, respiratory support, and antipyretics has risen dramatically, resulting in a major increase in production costs for the entire sector. Because of the scarcity, the average price of most APIs imported into Vietnam increased by 5-8 percent in 2020, while the gross profit margin of domestic pharmaceutical and medical businesses fell by 1-3 percent. The country's supply of new pharmaceuticals was also affected since new pharmaceutical plants were running behind schedule. According to Ministry of Health data, domestically produced medications grew at a comparatively high compound annual growth rate of 13% from 2015 to 2019 thanks to government programs and a large number of newly invested factories.…

In order to avoid and limit financial risks in the future, VMD must: periodically check production and business activities, control and reconcile customer debts, and control recurrent expenses to ensure financial work is considered as a tool to strictly manage revenue and expenses in order to collect and spend properly and fully in accordance with VMD's regulations; regularly conduct acceptance tests, compare customer receivables to provide a foundation for analyzing debt age, and swiftly make provisions for bad debts in accordance with current rules; enhance the head office's and member units' financial capacity in a variety of ways: equity capital, asset quality, and profitability fully setting aside risk provisions in order to clarify financial position and assets at risk; improve the Accounting Department's responsibility and authority to examine the reasonableness and validity of the corresponding revenues and expenses in order to achieve the most efficient revenue and expenditure management; monitor the accuracy of financial statements and information disclosures, with the goal of implementing IFRS-compliant financial statements (international accounting standards); Continue to assess the internal audit, internal control, and risk management systems to ensure that they are in conformity with current laws…

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