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Research paper

Attempt to Create A New Model to Predict The Financial Failure of Business Companies

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Abstract

This research paper has two main objectives. The primary objective was to gain a deeper understanding of the relationship between financial ratios and financial failure, to develop an early warning system for detecting financial distress. The second purpose is to develop a new model, CHENNOUF's Model, for predicting financial failure.
This study examined 18 companies between 2012 and 2024 to test this model. Data were collected over 12 years, and we studied and analyzed the relationship between 75 financial ratios and financial failure in order to build a model to predict the failure of companies before it occurred.
This study is based on an analytical method and inferential statistical analysis of the independent variables that define the ratios used in calculating the predicted failure or financial success. We have been working on this model for eight years; we have worked on developing a new model to predict financial failure. We faced several difficulties; however, we incorporated artificial intelligence tools at some points in this research, such as relative weights and correlations. In addition, we used Excel to calculate the bankruptcy index.
After examining the problem of this study, we obtained a number of results. Despite the generality and some limitations in the new model, it must be developed by future research.
The present paper represents, in our view, one of the most important attempts to address and explain the relationship between financial failure and financial ratios. After examining and analyzing the relationship between financial ratios and financial failure, we obtain the following new model:
FS=0.146C+0.103H+0.187E+0.192N1+0.013N2+0.125O+0.138U+0.10F.

Keywords: *Financial Analysis; Financial Statements; Companies; Predicting Financial Failure or Success FS.*

1. Introduction

The interpretation of financial statements relies on the analyst's skill and expertise in forecasting financial failure or success. However, a comparative study of the techniques might be confronted with several challenges: there is no standard ratio for a clear evaluation and prediction. Comparing the incorporated financial indicators and ratios often offers contradictory conclusions. The interpretation of financial ratios can be inconsistent with one another, for example, a high profit rate and a low liquidity ratio. Therefore, a relative analysis may not provide a fair representation of the firm's financial position. The use of complex ratios in most models requires a mathematical approach to identify potential financial distress through a correlation relationship, which involves a set of intricate financial ratios and indices.
Analysis through complex ratios in most models also depends on the mathematical method used to derive the probability of financial failure, which involves a correlation relationship based on a set of complex financial ratios and indicators. However, the weights given to these financial ratios differ from one model to another, depending on the economic conditions of each company. Therefore, each model can be useful for a specific monetary circumstance. The financial analyst can use these models to adjust their variables to suit the company's specific circumstances. However, he needs high scientific and professional ability and competence to propose the appropriate model, and the model must also be tested before applying it so that the outputs are not inaccurate and affect decision making, which may result in the wrong prescription and medication being given, thus harming the company (Chennouf Chaaib, 2018)

1.1. Research questions

Therefore, when analyzing financial statements, we rely on the use of quantitative models consisting of financial ratios to predict financial failure, taking into account the suitability of imposing continuity for the company as a basis for preparing financial reports. However, the practical question is what is the research gap in current forecasting models? Are these models applicable to all companies, banks, and similar financial institutions? Why have there been contradictory and divergent results when trying to apply more than one model to the

same company in the same period. Is it the weakness in the model or the one in the financial reports of Algerian companies that these financial statements may not accurately reflect the true financial situation? What is the nature of the relationship between financial ratios and bankruptcy? Is it a relationship of influence of one variable on another variable, or a relationship of mutual influence? Is predicting financial failure or success linked to the strengths and weaknesses of business companies, and analyzing the external environment to identify opportunities and threats facing companies, can be done through the SWOT matrix[i], which tool considered the most effective tool for this purpose? Is it possible to create a new model that enables us to anticipate the near future in the Algerian environment? On the other hand, should Algerian financial companies' reporting be readapted to comply with IFRS?

The purpose of this research paper

This research paper has two main objectives. The first was to develop a clearer understanding of the relationship between financial ratios and financial failure, with an early warning system for detecting financial failure. The second purpose is to develop a new model for predicting financial failure. This previously mentioned research gap encourages exploring a new model for predicting failure or financial success. We attempt to create a model to predict the financial failure of business companies.

1.2. Research hypotheses

Previous studies on the relationship between financial ratios and financial failure also reveal divergent and inconclusive findings. In light of these results, our hypothesis states that as follows:

- H1: There is a significant relationship between financial ratios and financial failure
- H2: There is a relative agreement of more than 50 percent between the new model and other models for predicting financial failure.

2. Literature Review

2.1. An analytical view and comprehensive vision of previous studies of models for predicting financial failure or success

Table 1: The relationship between the bankruptcy index and the financial ratios

Prediction Models	The field of foresight in predicting financial failure or success	Ratios and financial indicators that make up the model	Correlation equation
Altman (El Khoury, Rim and Al Beaïno,2014,pp:11-18)	-Bankrupt companies: If the Z value < 1.23, then the company is included in the Bankrupt category. -Non-bankrupt companies: If the Z value > 2.9, the company is in a healthy condition or not bankrupt -Grey Area: If the value is 1.23 < Z < 2.9then the company is in a gray area. This means that the company has financial difficulties, but the possibility of being saved and bankrupt is just as great, depending on the company's policy decisions.	X1 Working capital/Total Assets; x2 Retained earnings/ Total Assets; x3 EBIT/ Total Assets; x4 Book value of equity/Total liabilities; X5 Net sales/ Total Assets.	Z = 0.717X1 + 0.847X2 + 3.107X3 + 0.420X4 + 0.998X5
Altman, Hartzell, Peck (Palash Saha and Sujana Ahmed,2024)3365-3342	Non-Bankrupt companies >2.6 The company is in good health Bankrupt companies <1.1 The company is in a state of Distress Grey Area 1.10 < Z" < 2.60. The company is in a vulnerable area	X1 = working capital/ Total Assets X2 = Retained earnings/ Total Assets X3 = EBIT/ Total Assets X4 = Book value of equity/Total liabilities.	Z = 6.56X1 + 3.26X2 + 6.72X3 + 1.05X4
Gordan Springate (Deimena Kiyak and Daiva Labanauskaite,2012,pp:895-905)	The higher the value of the index indicates the sounder the company's financial position If it is less than 0.862, the company is classified as threatened with bankruptcy	X1 = working capital/total physical assets; X2 = EBIT/Total tangible fixed assets; X3 = Earnings before taxes/current liabilities; X4 = Net sales/ Total tangible fixed assets.	Z = 1.03X1 + 3.07X2 + 0.66X3 + 0.4X4
Zmijewski (Palash Saha and Sujana Ahmed,2024)3365-3342		X1 = Net profit/Total Assets; X2 = Total liabilities/ Total Assets; X3 = Current assets /Current liabilities.	Z= – 8.7117 – 6.5279X1 + 9.8054X2 – 0.1814X3
Kida (Deena Saleh Merza Radhi and Adel Sarea,) ,pp:1-15 2019	If the result is positive, then the company will be safe from financial failure, and If the results are negative, then the company faces the risk of financial failure, including bankruptcy	X1: Net profit/Total Assets; X2: Equity/Total liabilities; X3: Cash/current liabilities; X4: Sales/Total Assets; X5: Cash/total assets.	Z = 1.042X1 + 0.42X2 - 0.461X3 - 0.463X4 + 0.271X5
Sherrod (Wisam Sami Jabbar Zinal,2023,,pp:172-180)	The low risk of failure Z between 20-25 The risk of failure is difficult to predict, Z between 5-20 The company is at risk of failure Z ≥ 5≥- 5 The company is exposed to a significant risk of failure, Z <- 5	X1: working capital/Total assets; X2: Cash/Total assets; X3: Total Equity/Total Assets; X4: Ratio: Earnings before taxes/Total assets; X5: Ratio: total assets/Total liabilities; X6: Ratio: Total Equity/ Total tangible fixed assets	Z = 17X1 + 9X2 + 3.5X3 20X4 + 1.2X5 + 0.10X6

2.2. In terms of application

Applying many models is difficult because some financial statement elements are not quoted on the stock exchange. Sometimes, financial statements do not present an honest and reliable picture of the company's financial position.
When applying several models to the company, we found variation in the results, which raises many questions: Is the model not applicable to those companies? On the other hand, do the financial reports of those companies not reflect the correct financial position of the company because they are based on historical cost without the obligation to re-evaluate the elements of the financial statements according to the fair value model...Previous studies on the relationship between financial ratios and financial failure reveal divergent findings. (Chennouf, 2018, pp 245-270)

2.3. The most important financial ratios and indicators used in financial analysis

Table 2: Study and analyze the most important financial ratios and indicators used in financial analysis

Financial Statement Types of ratios	Number of Ratios	Balance sheet or Financial position	Income statement or profit or loss	Statement of changes in equity
Liquidity ratios	4 Ratios	x	x	x
Profitability ratios	5 Ratios	x	x	x
Activity ratios	8 Ratios	x		
Debt ratios	4 Ratios	x		
Stock ratios, Dividend distribution, and measurement of market values	5 Ratios	x	x	x
Market value ratios	4 Ratios	x	x	x
Solvency ratios	8 Ratios	x	x	x
Leverage ratios	3 Ratios	x	x	
Efficiency Ratios	4 Ratios	x	x	
Indicators of financial balance	6 Ratios	x	x	
Other financial indicators and ratios	4 Ratios	x	x	x

Source: Chennouf Chaaib (2022), Chennouf Chaaib (2018).

Table 3: Ratios and indicators extracted from treasury cash flows to analyze the liquidity table

Financial Statement Types of ratios	Number of Ratios	Statement of cash flows	Financial position	Income statement/ profit or loss
Liquidity assessment indicators	4 Ratios	x		x
Earnings quality analysis indicators	4 Ratios	x		
Indicators for evaluating financing policies	4 Ratios	x	x	
Other financial indicators and ratios	4 Ratios	x	x	

Sources: El said Ahmed Abdel Nasser Shehdeh, 2008; Chennouf, 2018, pp 192-206; Moayad Radi Khanfar, Ghassan Falah Al-Matarna, 2009.

3. Method, Tools, and Processing Methodology: Materials and Methods

This study is based on the analytical method, inferential statistical analysis for the independent variables(C, H, E, N1, N2, O, U, and F), which define the ratios used in the calculation of the predicted failure or financial success (FS), and the dependent variable (FS).
The previously mentioned research gap encourages exploring a new model for predicting failure or financial success. Accordingly, we tried to build a model to predict the financial failure of business companies. We relied on the approaches adopted in accounting theory, and the scientific method used, which consists of linking premises to results, identifying the problem and addressing it, then arriving at results through the accuracy or otherwise forecasting model compared to previous models.
We used the mathematical approach, in which ideas of accounting theory were formulated in the form of mathematical models, used to solve the problem of correlation between financial ratios and the bankruptcy index, and estimate weights. This is accomplished in several steps by applying it to a significant number of companies. At each step, a difference in the values obtained was observed due to variations in financial ratios among different institutions. This created difficulties for us in determining the weights, so several equations were formulated at each stage until we reached the equation that may be the final one in building the model.
To formulate the new model, 75 standard financial ratios were selected that affect profitability, assess the quality of profits, measure performance, liquidity, indebtedness, economic balance, and analyze financing policy. Through this, 30 ratios were identified, which we consider the most significant. We analyzed the correlation equation for these ratios with the Bankruptcy index. To convert the absolute values of the correlations into initial weights, so that the stronger the correlation between bankruptcy and the financial ratio, the greater the weighting. From it, the weights for each financial ratio, measured and estimated based on artificial intelligence because the weights are calculated using techniques such as logistic regression or linear discriminant analysis based on the available data, so that if we rely on the news estimate, we use the experimental method based on the importance of the variables. To propose a new bankruptcy prediction model using financial ratios, it is essential to select the most suitable method for determining the weighted scores for each ratio. Two common approaches are using the correlation coefficient between the financial ratios and bankruptcy.
If we have historical data, we use linear regression or principal components analysis. To achieve a more accurate and objective analysis, we utilize IA to derive weights from the correlation equation. However, relative weight analysis is a procedure for estimating the relative importance of associations; however, researchers using relative weight analysis are unable to make judgments about the statistical significance of relative weights.

Table 4: Correlation, Linear Regression, and Weighted Coefficients Relative Weight

	Weighted coefficients, Relative Weight	Linear regression for bankruptcy prediction	Correlation
Total liabilities/Total Assets	0.146	-996.58	0.72-
Total liabilities/ Total Equity	0.103	5864.05	0.51-
Profit/ Total Assets	0.187	-1961.79	0.92-
Profit before interest and tax/Sales	0.192	-67.48	0.95-
Cash and cash equivalents/ Current liabilities	0.013	-52.29	0.07-

Non-current liabilities /working capital	0.125	115.17	0.62-
Capital expenditure/Cash inflows from long-term loans and equity issues	0.137	-0.17	0.68
Interest/ Profit-loss	0.10	0.07	0.49-

Source: Prepared by the researchers based on Sonatrach Financial statements, Inputs, and IA outputs.

Therefore, many tools and programs might be used to estimate the weighted weights that we researched, such as PyTorch and Tensor-Flow, Weights & Biases (W&B), RIM Weighting, QuestionPro, SPSS, Python, SmartPLS4, GPT-5; however, we ultimately chose AI estimates.

Therefore, we have a fundamental issue with the indexation tools when studying the relationship between financial standard ratios and the bankruptcy index. Is the relationship between the study variables relational in the sense that a correlation coefficient should be calculated, or is it an influence relationship from which a regression should be calculated, or reckoning them both...The correlation coefficient shows the strength of the relationship between the ratios and the most significant financial indicators with the bankruptcy index. While the regression analysis reveals the extent and strength of the effect of one indicator on another, such as the impact of a financial ratio on the bankruptcy index, which helps predict financial failure, including bankruptcy.

To arrive at an accurate model that enables us to predict bankruptcy, we can use the correlation coefficient as a first step to understand the nature of the relationship between ratios and financial indicators and the bankruptcy index. Including identifying the most significant financial ratios and indicators that have a strong relationship with bankruptcy. Then, using them in a logistic or linear regression model to determine the statistical effect and predict financial failure or success.

The study sample consisted of 18 companies, with published data from various financial periods, which were used to build the model with its current equation. Based on the above, the model was formulated to rely on a combination of indicators, including profitability, liquidity, and indebtedness indicators. We also believe that it has a strong relationship with financial distress, inability to pay, and measuring financial independence, which may lead to bankruptcy. Through this, we calculate the bankruptcy index using this model and compare it with other models to determine its accuracy, whether it is over several different periods or for various companies.

In this research paper, we have chosen to present only the results of the Algerian company Sonatrach and the Qatari company Baladna for the following reasons: Sonatrach is the largest Algerian company. Baladna is the largest new investor in the agricultural sector. The Qatari company Baladna has invested in the dairy and food industries in Algeria since 2023. The results of the other companies require a separate research paper.

Table 5: Details on sample selection -full list of 18 Companies

Details on sample selection -full list of 18 companies	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
SONATRACH-DZ	x	x	x	x	x	x	x	x					
GCB-DZ									x	x	x	x	x
ENOR-DZ											x	x	
SAIDAL-DZ								x	x				
EL-AURASSI-DZ					x	x				x	x		
ENAC-DZ						x	x	x					
-DZCEVITAL			-	-	-	-	-	-					
EPE INFRATELE-DZ						-	-	-					
SEAAL-DZ								x	x	x			
SNVI VIR-DZ								x	x				
ENAGEO-DZ											x	x	
ANABIB-DZ			-	-	-	-	-	-					
GICA-DZ			-	-	-								
KANAGAZ-DZ						x	x	x					
BP-UK							x	x	x	x	x		
BALADNA-QATAR												x	x
CEPSA SPAIN											x	x	
ARAMCO- Saudi Arabian												x	x

3.1. Variables and model choice: trying to create a new model

3.1.1. Questions and constants

How can we make an early prediction of the financial future of business firms? How can we choose the financial ratios that form a model for predicting a company's financial failure? What is the impact of each financial ratio on the probability of bankruptcy? How are weights determined to reduce skewness and increase the accuracy of the prediction model? What are the ratios and indicators related to financial failure? What is the correlation between the ratios and financial indicators used in the model and bankruptcy? What is the effect of this deviation on predicting financial failure? How is the scope of forecasting financial failure or success determined?

3.1.2. Determine the ratios associated with the model and the correlation coefficient

Where: The bankruptcy index. Total liabilities/Total assets, Total Equity / Total liabilities; Result/Assets, Result before interest and taxes/Assets

Cash and cash equivalents/ Current Liabilities Working capital/Non-Current Liabilities

Capital expenditure/cash flows collected from long-term loans and equity issues, Profit-Loss. / Interest.

3.1.3. Formulate the model without weights

The bankruptcy index, according to this model, is based on the eight financial variables mentioned, which cover different aspects of financial structure, liquidity, profitability, and ability to cover liabilities.

The better the ratios of profitability, financial structure, and liquidity, the lower the risk of bankruptcy, and the better the company's financial position. In other situations, any imbalance in high debt ratios, low profits, and weak liquidity would lead to increased financial risks, including bankruptcy.

- Determine the coefficients of the ratios that make up the model and the correlation and regression coefficients: To estimate the ratio coefficients in the bankruptcy index equation: Test the model and improve it when needed continuously on several companies at different stages and in different periods, calculate the coefficients in the equation:

$$FS = C+H +E+N_1+N_2+O+U+F$$

Where (FS) is an indicator of financial failure or success, we must follow analytical steps that depend on the nature of the data and the methodology used. This process usually uses statistical techniques or mathematical models, such as logistic regression or linear discriminant analysis, by following the methodology to calculate weights. Data collection: We collected a data set containing the actual values of the variables C, H, E, N1, N2, O, U, and F for Sonatrach. At each step, we chose the value of the bankruptcy index based on other comparative models.

- Choosing the appropriate model: Since (FS) represents the bankruptcy index, which is often a binary variable, and use linear regression to calculate the coefficients. Ratio coefficients are also estimated using optimization algorithms such as downward gradient or maximum likelihood
- Testing and adjustment of the model: After the coefficients have been calculated, the performance of the model should be checked using measures such as prediction accuracy. So that if the model test results are inaccurate, new variables can be added, and some variables excluded.

We had tested the model on numerous industrial companies for 12 years in order to reset the correlation coefficients between the financial ratios and the bankruptcy index, and re-estimate the ratio coefficients.
We had to re-adjust to refine the model the variables N_1 and F to refine the model as follows:
N_1 = Profit before taxes and interest/turnover, and F = Interest/profit
Adjusted weights: There is some difference between the first and second analyses in the correlation of the bankruptcy index and some financial ratios. This is due to the data being different from one company to another. Therefore, at each stage, the correlation equation and weights must be readjusted and adjusted.
Therefore, the model equation will be as follows:

$$F/S = 0.146\ C+0.103\ H +0.187\ E+0.192\ N+0.013\ N+0.125\ O+0.138\ U+0.10\ F$$

Limits and scope of forecasting financial success or failure: CHENNOUF's model shows companies that have a

- Non-Bankrupt companies: (FS) >0.74 the company is in good health; Bankrupt companies: (FS) <0.18 the company is in a state of Distress; Grey Area: (FS) 0.18 < (FS) < 0.74 the company is in a vulnerable area.

If the bankruptcy index is high, this means that the company is in a good financial position and has sufficient liquidity, positive profitability, and a balanced debt structure. If the probability of bankruptcy is very low, a low bankruptcy index indicates potential financial weakness. The company may suffer from high debt, poor liquidity, or low profitability. The likelihood of financial difficulties and possibly bankruptcy increases.

Table 6: Enhance Methodology Transparency: Provide Precise Definitions for All Variables

Variables	Ratios	Definitions for all variables (C, H, E, N1, N2, O, U, F)
C	Total liabilities/Total Assets	This ratio indicates the percentage of a company's assets that are financed by debt, so that the higher the liabilities compared to the assets, the greater the risk of bankruptcy, but it is not the most influential factor.
H	Total liabilities/ Total Equity	This ratio shows how much debt a company uses to finance its assets compared to the value of shareholders' equity. A higher ratio indicates greater financial leverage and risk, as the company is relying more on debt, while a lower ratio suggests more conservative financing with a stronger equity base, such that increased liabilities compared to equity increase the risk of bankruptcy.
E	Profit/ Total Assets	Indicates how efficiently a company uses its assets to generate profit. A strong inverse correlation such that the higher the net profits compared to the assets, the significantly lower the risk of bankruptcy, indicating the importance of making good profits
N1	Profit before interest and tax/Sales	This ratio indicates a company's profitability from its core business operations before accounting for interest expenses and income taxes. A higher ratio means the company is more efficient at generating profit from its sales, as a larger percentage of revenue remains after covering the costs of goods sold and operating expenses. Inverse correlation such that EBIT has an inverse effect on bankruptcy risk, but not as strongly as net profits
N2	Cash and cash equivalents/ Current liabilities	The ratio of cash and cash equivalents to current liabilities is a measure of a company's immediate liquidity, indicating its ability to pay off short-term debts with its liquid assets. A high ratio suggests a company can comfortably cover its short-term obligations, while a low ratio may signal potential liquidity issues and a reliance on other assets or financing to meet debts. Inverse correlation: Increased cash compared to short-term liabilities reduces the risk of bankruptcy.
O	Non-current liabilities /working capital	The ratio indicates how a company's long-term debt compares to its short-term operating liquidity. A higher ratio suggests long-term debt is substantial relative to a company's ability to cover its short-term obligations, while a lower ratio indicates more of the company's short-term liquidity is available to manage immediate needs. This metric is useful for assessing risk, but must be considered alongside other financial ratios for a complete picture. This correlation increased long-term liabilities compared to working capital, increasing the risk of bankruptcy, reflecting the need to manage long-term debt effectively.
U	Capital expenditure/Cash inflows from long-term loans and equity issues	This ratio indicates how a company is financing its fixed assets. By investing in fixed assets, such as building factories or upgrading technology, companies aim to enhance their operations, ensuring sustained growth and competitive advantage Capital expenditures are the funds companies allocate to acquire, upgrade, and maintain essential physical assets like property, technology, or equipment. A strong inverse correlation, such that the higher the capital expenditure compared to the loans, the lower the risk of bankruptcy, indicating that good investment in assets improves financial stability
F	Interest/ Profit-loss	The ratio of profit interest indicates interest compensates for the use of capital and the risk associated with lending, while profit represents the owner's reward for taking on risk and the success of the business venture. They are distinct concepts: interest is received by a lender, whereas profit is earned by the owner of an asset or business.

		A strong correlation: the higher the returns on interest, the lower the risk of bankruptcy, but if interest/returns are calculated, it is a positive relationship, meaning that the higher this ratio, the greater the probability of bankruptcy.
FS	Financial failure or financial success index	F: Financial failure S: Financial success
Model	CHENNOUF	FS =0.146C+0.103H+0.187E+0.192N1+0.013N2+0.125O+0.138U+0.10F
CHENNOUF's model	Limits and scope of forecasting financial success or failure	CHENNOUF's model shows that companies have a Z-score of > 0.74 are considered a good sign for being successful, non-bankrupt companies Compared to those that have a Z-score of < 0.18, which had potential serious problems and may not be able to continue, Bankrupt companies However, for a company whose Z-score falls between 0.74 and 0.18, it is difficult to determine its status, Grey Area

4. Results: Results of Testing and Refining The Model

Table 7: Calculation of the c to f ratio on the Chennouf model for Sonatrach

FS=0.146C+0.103H+0.187E+0.192N_1+0.013N_2+0.125O+0.138U+0.10F	2012	2013	2014	2015	2016	2017	2018	2019
Total liabilities	2926	3001	3195	4032	4042	4328	4724	5078
Total Assets	8064	8555	9089	9448	10088	10570	11301	11932
C	0,36	0,35	0,35	0,43	0,40	0,41	0,42	0,43
0,146	0,05	0,05	0,05	0,06	0,06	0,06	0,06	0,06
Total liabilities	2926	3001	3195	4032	4042	4328	4724	5078
Total Equity	5138	5554	5894	5830	6046	6242	6577	6854
H	0,57	0,54	0,54	0,69	0,67	0,69	0,72	0,74
0,103	0,06	0,06	0,06	0,07	0,07	0,07	0,07	0,08
Result	578	411	334	9	207	326	414	338
Total Assets	8064	8555	9089	9448	10088	10570	11301	11932
E	0,07	0,05	0,04	0,00	0,02	0,03	0,04	0,03
0,187	0,01	0,01	0,01	0,00	0,00	0,01	0,00	0,01
Result before interest and tax	1449	1181	1081	522	545	783	1075	958
Sales	5831	5324	4991	3648	3398	4031	4881	4303
N_1	0,25	0,22	0,22	0,14	0,16	0,19	0,22	0,22
0,192	0,05	0,04	0,04	0,03	0,03	0,04	0,04	0,04
Cash and cash equivalents	618	557	823	542	485	665	1256	222
Current liabilities	2801	2858	2945	3420	3834	3979	4353	4642
N_2	0,22	0,19	0,28	0,16	0,13	0,17	0,29	0,05
0,013	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Non-current liabilities	2926	3001	3195	4032	4042	4328	4724	5078
working capital	585	884	1279	-35	-123	195	581	279
O	5,00	3,39	2,50	-115,20	-32,86	22,19	8,13	18,20
0,125	0,63	0,42	0,31	-14,40	-4,11	2,77	1,02	2,28
Capital expenditure	847	650	52	1929	1358	1560	1549	3144
Cash inflows from long-term loans and equity	566	497	534	262	20	177	143	272
U	1,50	1,31	0,10	7,36	67,90	8,81	10,83	11,56
0,138	0,21	0,18	0,01	1,02	9,37	1,22	1,49	1,60
Interest	749	667	750	594	393	495	664	530
Profit-Loss	578	411	334	9	207	326	414	338
F	1,30	1,62	2,25	66,00	1,90	1,52	1,60	1,57
0,1	0,13	0,16	0,22	6,60	39,30	49,50	66,40	53,00
FS:SONATRACH / F <: Risk; 0.18 , 0.18 ≤ S ≤ 0.74: Unstable Area; S > 0.74: Good sign for being successful	1,14	0,93	0,71	-6,62	44,73	53,67	69,09	57,06

Source: Prepared by the researchers based on Sonatrach Financial statements, Inputs, and Excel outputs
Financial Reports of SONATRACH For the periods 2012-2023, Available online at: https://sonatrach.com/raports

Table 8: Calculation of the C to F ratio on the CHENNOUF model for BALADNA Company

FS =0.146C+0.103H+0.187E+0.192N_1+0.013N_2+0.125O+0.138U+0.10F	2023	2024
Total liabilities	248540232	252642414
Total Assets	484352641	49334657
C	0,51	5,12
0,146	0,07	0,75
Total liabilities	248540232	252642414
Total Equity	235812409	240704156
H	1,05	1,05
0,103	0,11	0,11
Result	10962857	18501216
Total Assets	484352641	49334657
E	0,02	0,38
0,187	0,00	0,07
Result before interest and tax	109995564	186193594
Sales	10567597	114522718
N_1	10,41	1,63
0,192	2,00	0,31
Cash and cash equivalents	5971128	2762373
Current liabilities	63663467	69711895
N_2	0,09	0,04
0,013	0,00	0,00
Non-current liabilities	1848767645	1829305192
working capital	313977191	222347038

O	5,89	8,23
0,125	0,74	1,03
Capital expenditure	163923159,3	230191061
Cash inflows from long-term loans and equity	199829055	15360533
U	0,82	14,99
0,138	0,11	2,07
Interest	71453524	60111646
Profit	10962857	18501216
F	6,52	3,25
0,1	0,65	0,32
FS –BALADNA/ F <: Risk; 0.18 , 0.18 ≤ S ≤ 0.74: Unstable Area; S > 0.74: Good sign for being successful	3,69	4,66

Source: Prepared by the researchers based on BALADNA Financial statements, Inputs, and Excel outputs.
Financial Reports of BALADNA Q.P.S.C. for the periods 2020-2024, Available online at: baladna.com/en/reports.

5. Conclusion: Discussions and Data Analysis, and Results

Table 9: Results of the bankruptcy index for Sonatrach according to the CHENNOUF model and some other models

	2012	2013	2014	2015	2016	2017	2018	2019
CHENNOUF -SONATRACH	1.14	0,93	0.71	-6.62	44.73	53.67	69.09	57.06
KIDA -SONATRACH	0,40	0,47	0,45	0,37	0,45	0,40	0,32	0,41
ALTMAN -SONATRACH	2,12	1,92	1,79	1,26	1,15	1,23	1,35	1,23
SPRINGATE -SONATRACH	0,60	1,67	1,46	1,11	0,53	0,52	0,75	0,92
ZMIJEWSKI -SONATRACH	-5,40	-5,35	-5,24	-4,35	-4,74	-4,71	-4,65	-4,53
SHERROD -SONATRACH	9,39	9,52	9,91	5,67	5,95	6,76	7,81	6,40

By analyzing the results of testing the new model by applying it to Sonatrach during the study period 2012-2019. To confirm its accuracy or not, we compared this to several other models, and the results were as follows:
Looking at the results of the values collected during the study period, the bankruptcy index exceeded the standard values and ranged between 7.85 for the year 2020 and high values of 44.73, 53.67, 69.09, and 57.06, respectively, for the years 2016, 2017, 2018, and 2019, which are indicators that suggest that there is no risk of bankruptcy for Sonatrach.
While values of 1.14, 0.93, and 0.71 for 2012, 2013, and 2014, respectively, indicate that the company may face the risk of failure, given that the values are close to 0.74
The worst percentage was for 2015, given that the bankruptcy index was negative at -6.62. This also indicates that the company suffers from a financial imbalance, as the permanent working capital had a negative value of 123 billion. The Altman model confirmed this; the value of the index was 1.15 for the year 2016, which is less than the standard value.
According to the Kida model, all bankruptcy value indices during the study period were positive, ranging between 0.32 and 0.47. Although they were above zero, the values were average. The company may be safe from the risk of bankruptcy, but it was close to the gray area during the study period.
As for the Altman model, the values indicate that the company may have faced the risk of bankruptcy in the year 2016, as the value of the index was 1.15, and the same applies in the year 2020, as the value was 0.87, which are all values less than the standard value for this model.
The same applies to the years 2017 and 2019, where the values were 1.23, with a slight increase in 2018 to 1.35. These values indicate that the company was experiencing financial difficulties, which is consistent with our analysis of the financial balance indicators, where the permanent working capital was 195, 581, and 279 billion. For the years 2017, 2018, and 2019, respectively. Although the company, in terms of numbers, enjoyed a margin of safety. However, we point out that positive working capital with large values expresses missed investment opportunities.
While the values ranged between 2.12, 1.92, and 1.79 for the years 2012, 2013, and 2014, respectively, this indicates that the company is in the gray zone.
The results of the SPRINGATE model showed that the company does not face the risk of bankruptcy, so the values during the period 2013-2015 were greater than the standard value, which is 0.862
While the bankruptcy index values were 0.60, 0.53, 0.52, 0.75, 0.91, and 0.72 for the years 2012, 2016, 2017, 2018, 2019, and 2020, respectively, this indicates that the company was facing the risk of bankruptcy, given that the values during this period were all less than the standard value.0.862
As for the ZMIJEWSKI model, all values indicated that the company does not face financial difficulties and the risk of bankruptcy, given that all values were negative during the study period. The SHERROD model confirms this, as the values indicate the presence of moderate risks, given that all values were limited to between 5 and 20

Table 10: Results of the bankruptcy index for Baladna Company according to the CHENNOUF model and other models

Results of the bankruptcy index for the Baladna company	2024	2023
CHENNOUF –BALADNA	3,69	4,66
Zmijewski –BALADNA	51,89	9,97
KIDA -BALADNA	0,28	0,32
Springate-BALADNA	0,39	0,49
Altman - BALADNA	18,91	4,90

By analyzing the results of testing the new model on BALADNA Company and confirming its accuracy, we compared this to several other models, and the results were as follows:
The results of the new model indicated that BALADNA Company was financially stable during the study period, which included good standard values of 4.66 and 3.69 for the years 2023 and 2024, respectively. Considering that these values were greater than 1.74, BALADNA Company is not at risk of bankruptcy. These results were confirmed by the Kida model, where the values were positive 0.32 and 0.28 for the years 2023 and 2024, respectively, and some results were confirmed by the standard values of the Altman model, where the results were 4.90 and 18.91 for the years 2023 and 2024, respectively, which are values greater than 2.9. There was also an agreement with the results of the Zmijewski model, as the standard values of this model indicated that the company does not face a risk of bankrupt-

cy. The values for the years 2023 and 2024 were 9.97 and 51.89, respectively. As for the Springate model, the values that were 0.49 and 0.39 for the years 2023 and 2024, respectively, indicated that the company might face the risk of bankruptcy, given that the results are less than the standard values (0.862).

6. Conclusion for Comparative Analysis

The results of other companies differed between the new model and some other models. Testing the latest model on other companies, excluding the Algerian company SONATRACH and the Qatari company BALADNA.
Testing study hypotheses: The results support the study hypotheses, so that:
Proving the validity of the first hypothesis through the results, we found there is an important relationship between financial ratios and financial failure.
Proving the validity of the second hypothesis, as the comparison proved that there is a relative agreement of more than 50 percent between the new model and other models for predicting financial failure.
Through our analysis of the results of testing the proposed model on 18 companies and comparing it with other models, the percentage of compatibility of this model with the KIDA model was 90 percent, and the compatibility rate of this model with the ALTMAN model was 80 percent. The compatibility rate of this model with the SHERROD model is 90 percent.
The compatibility rate of this model with the SPRINGATE model was 60 percent. However, the compatibility rate of this model with the ZMIJEWSKI model was 90 percent.
From it, the accuracy and effectiveness rate, or the average compatibility rate, can be obtained, approximately 82 percent, compared to the compatibility rates for each model applied to Sonatrach.

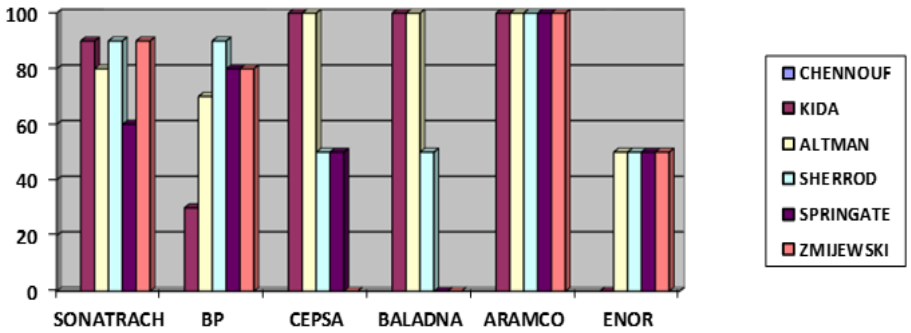

Fig. 1: Graphic of the Degree of Compatibility between Models.

However, we believed that the ratios and indicators that it had chosen to create the model were the closest to anticipating the future of business companies, and therefore these variables must be subject to analysis, although the process of predicting financial failure or success focuses on evaluating all variables using financial analysis tools for also identifying opportunities. In addition, threats in the environment of business companies that operate in a system open to the outside world, which results in identifying the strengths and weaknesses of business companies, and identifying the environmental opportunities and threats. Optimal for her to anticipate the near future. The SWOT matrix is one of the tools that can be used in the field of financial failure prediction

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Appendix

"The SWOT analysis is a method that uses a matrix with four windows: Strengths ،Weaknesses ،Opportunities and Threats. The purpose of the method is to identify strategic axes to achieve the objectives sought by the development project.
Strength: An internal characteristic that contributes to the achievement of the organization's mission. A strength is an existing internal asset (management, sector, staff motivation, knowledge, resources, links with other universities, etc.) that will help exploit opportunities and reduce the threats
Weakness: An internal characteristic that negatively influences the functioning of the organization. Weaknesses are internal conditions that erode the university's position, hinder the cooperation with others or hinder the exploitation of opportunities.
Opportunity: An external fact that, if taken advantage of, can be used to make a contribution to the organization's mission
Threat: An external event that has or may have a negative effect on the organization's performance. Threats are challenges posed by adverse trends or developments in the context that, in the absence of corrective action, could erode the position of the organization".