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# Study the Altman model for predicting the financial failure of companies by applying to ASE listed companies

# Une étude du modèle Altman pour prédire la défaillance financière des entreprises en les appliquant aux sociétés anonymes cotées à la bourse d'Amman

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**Abstract:**

This study aimed to measure the effectiveness of the credit model ((z-score) for predicting financial failure on the companies listed on the Amman Stock Exchange, and this model has been applied to 15 failed companies that were referred to liquidation or suspended companies and 15 continuous companies not referred to liquidation (sound). The study concluded that the Altman model was inclined to predict financial failure, and that it can be relied upon to judge the financial position of companies, but not by a large percentage.

**Keywords:** financial failure, financial failure prediction, financial ratios, Altman Model.

**(JEL) Classification :** G33 ،C25.

**Résumé:**

Cette étude visait à mesurer l'efficacité du modèle de crédit ((z-score) pour prédire la défaillance financière des sociétés cotées à la bourse d'Amman, et ce modèle a été appliqué à 15 sociétés en faillite qui ont été renvoyées à des sociétés en liquidation ou suspendues et 15 sociétés continues non référées à la liquidation (saine). L'étude a conclu que le modèle Altman était enclin à prédire la défaillance financière et qu'il pouvait être utilisé pour juger de la situation financière des entreprises, mais pas dans une large mesure.

**Mots-clés:** défaillance financière, prévision de défaillance financière, ratios financiers, modèle Altman.

**(JEL) Classification :** G33 ،C25.

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## INTRODUCTION:

The issue of financial failure of economic institutions is one of the important topics that have occupied many international bodies and organizations, because it has negative effects on the level of the institution and its surroundings of dealers, partners and interested, and the process of forecasting financial failure helps in taking decisions in the institution in order to mitigate these effects and enable them From achieving the continuity assumption, and the financial ratios are the main pillar of this process by finding the ratios that contribute to the interpretation of financial failure, and the formation or suggestion of models through which they reveal in advance the possibility of its occurrence, and many researchers have studied the problem of predicting financial failure, some of whom have studied the financial ratios separately, such as Beaver (1966), and some have mixed a set of financial ratios to build a discriminatory model such as Altman1968, and many others who have used methods Other modern ones may be used according to the needs of the study variables, such as neural network analysis, logistical analysis...

In this research, we will use one of the methods of predicting financial failure by using financial ratios by applying the z-score model to a sample of companies listed on the Amman Stock Exchange, because of the ease and great ability of this model to predict financial failure before it occurs, that is why he was chosen in this research to apply it and measure its effectiveness in order to recommend its application to companies listed on the Amman Stock Exchange, So the study's problem is to apply the z-score to reveal the possibility of companies failing, therefore, the following main question is asked: **Can the Altman Model be used to forecast financial failure on the Amman Stock Exchange?**

This question is divided into the following questions:

- What is the ability of the (z-score) model to distinguish between failed and non-failed companies listed on the Amman Stock Exchange?
- Is it possible to rely on the Altman model ((z-score) to predict the failure of companies listed on the Amman Stock Exchange?

**Hypotheses of the study**

Based on the study problem, the following hypotheses were formulated:

- The credit score (z-score) can distinguish between failed companies listed on the Amman Stock Exchange and non-failed ones.

- we can rely on the model Altman (z-score) in predicting the failure of the companies listed on the Amman Stock Exchange and Ansh high precision.

**the importance of studying**

The importance of the study is that predicting financial failure is one of the important topics that affects companies and has not been adequately studied by researchers, as previous studies did not address the use of the (z-score) to predict financial failure in companies listed on the Amman Stock Exchange, also to take advantage of the results of the study in order to predict the possibility of companies failing before they happen to take appropriate corrective measures, and then reduce the risks that result from this failure, whether for the shareholders or for other groups who have interests in those companies.

**Objectives of the study**

This study aims to establish a theoretical framework in which financial failure is identified, and the Altman model (z-score) is defined, and also indicate the degree of validity of it and if the Altman model (z-score) is appropriate for the application of the companies listed on the Amman Stock Exchange.

**Study Approach**

The researcher relied on the use of the experimental and descriptive analytical method in conducting the study because it is one of the most used approaches in social and human studies, with the aim of studying the ability to predict the failure of companies using the z-score model on companies listed on the Amman Stock Exchange, and to collect the study data, the researcher relied on the annual financial reports of the companies published on the Amman Stock Exchange website for the period from 2011 to 2018.

## I. Theoretical framework

### 1. Previous studies

We will present some of the previous foreign studies related to financial failure, namely:

**a) Zmjewsk (1984): "Methodological Issues Related to the Estimation of Financial Distress Prediction Models"**

The study aimed to predict the financial failure of companies two years before it occurred through the construction of a standard model, where it was conducted on several different industries in which the researcher selected a sample consisting of 40 bankrupt companies, and 800 non-bankrupt companies in the period between 1972-1978, and applied a number of The financial ratios that he analyzed from previous studies and based on his study on the analysis of Probit Analysis in the financial statements.

The study concluded that the formulation of the model consists of three financial ratios that can be used to predict the failure of companies.

The study also came up with a new idea: relying on three ratios proved in previous studies that have the ability to predict financial failure, and also distinguished the researcher using a new method is the method of Probet, but the researcher relied on a heterogeneous sample in terms of the number of companies, the researcher neglected a group of ratios That can have good predictability.( Zmijewski, 1984, p-p :59-82)

**b) Zavgren (1985): "Assessing the Vulnerability to Failure of American Industrial Firms: A Logistic Analysis"**

The study aimed to build a model to predict failure, where the researcher conducted this study in the United States during the period from 1972-1978 on a sample consisting of 45 failed companies and 45 successful companies, and these companies are equal in size and in total assets, the researcher used logistic regression method Regression In analyzing the financial statements extracted from the financial statements of these companies, seven financial ratios were used for this purpose.

The accuracy of the model in predicting the failure of the companies reached by this study was 99%, however, it is not possible to generalize the accuracy of this model to the rest of the American companies or others because the researcher in choosing the sample of the study on a group of companies of equal size and total assets.( Zavgren, 1985, p-p :19-25)

**c) Rashid et Abbas(2011) :"Predicting Bankruptcy in Pakistan"**

This study aims to determine the most important financial ratios in bankruptcy forecasting for the non-financial sector in Pakistan based on a sample of companies consisting of 52 companies half of which are failing and the other half

are unsuccessful during the time period 1996-2006, and to achieve this a multivariate discriminatory analysis method was used, and was done Calculating 24 financial ratios that express four different aspects of the company from profitability, liquidity, financial leverage and activity. In this study, the two researchers found a model consisting of three financial ratios.

The model achieved a prediction accuracy of 76.9% when applied to bankruptcy forecasts on the core sample. What can be observed on this study is that it adopted the same approach as previous studies in building a model for predicting failure, with a difference in the study period and sample size.( Rachid et Abbas, 2011, p-p :103-128)

**d) Lakshan and Wijekoon (2013) : "The use of financial ratios in predicting corporate failure in Sri Lanka"**

The purpose of this study is to develop a model using financial ratios to forecast corporate failure in listed companies in Sri Lanka. This study used publicly available data from the annual reports of a sample of 70 failed companies and a sample of 70 non-failed companies listed on the stock market in Colombo for a period covering the fiscal years 2002 to 2008 using logistic regression analysis. A total of 15 financial ratios were used as predictive variables for corporate failure . In this study, the two researchers reached the final model that includes three financial ratios.

Analysis of the results of statistical tests indicated that the accuracy of the model's prediction consists of financial ratios of 77.86% a year before failure, moreover, the predictive accuracy of the model in all three years prior to failure exceeds 72%, and therefore the model is strong in obtaining accurate results for a period of Up to three years before failure, from which the model developed in this study can help investors, managers, shareholders, financial institutions, auditors and regulatory agents in Sri Lanka to predict companies 'failure in listed companies. (Lakshan and Wijekoon, 2013, p-p :37-43).

**e) Meeampol and al (2014): "Applying Emerging Market Z-Score Model to Predict Bankruptcy: A Case Study of Listed Companies in The Stock Exchange of Thailand (Set) ";**

This research aims to analyze the possibilities of predicting the failure of companies by applying the Z-score model and the EM Z-score model to the companies listed on the stock market in Thailand, and the extent to which they can be relied upon, and for this the researcher has selected a sample of 31 companies to be examined Using the two models during the period 2010-2011.

This study concluded that both models can fully predict the financial failure that may occur where the Z-score model when applied to the core sample achieved prediction accuracy of 89.66% in 2010 and 80.77% in 2011, while the EM Z-score was 75.86% And 46.15% during 2010 and 2011, respectively, thus the results of the two models fit the Thai stock market.( Meeampol and al ,2014, p-p :25-27)

**2. The concept of financial failure:**

Many financial and accounting researchers disagreed about the definition of financial failure, and became there are many concepts and terminology associated with this concept, which made the views of those interested in determining the stages and types of failure, some of them believe that financial failure means the failure of the institution to pay its obligations at maturity, and others believe that it means the institution to stop paying its debts due to insufficient Liquid assets to cover their financial obligations.

The concept of failure has been associated with the economic researcher Beaver, who is the first to use this term to indicate the beginning of the institution to reach bankruptcy, where it is defined as "the inability of a firm to pay its financial obligations as they mature. Operationally a firm is said to have failed when any of the folllM'ing events have occurred: bankruptcy, bond default, an overdrawn bank account or non-payment of a preferred stock dividend ".( Castagna, Matolcsy, 1981, p :31)

However The researcher Deakin sees the failed companies "only included those firms which experienced bankruptcy, insolvency, or which were otherwise liquidated for the benefit of creditors in his default analysis".( Weiying, 2008, p :06)

Altman also briefly defined corporate failure as "a company that is legally bankrupt and placed in liquidation". (Coelho, 2014, p :23)

Blum defines it as "events signifying an inability to pay debts as they come due, entrance into a bankruptcy proceeding, or an explicit agreement with creditors to reduce debts". (Blum, 1974, p :03)

Also it can be defined as "the condition of a firm when it is unable to meet its financial obligations to its creditors in full. it is deemed to be legally bankrupt and is usually forced into insolvency liquidate".( Berryman, 1983, p :49)

Based on previous definitions of financial failure, a comprehensive definition consistent with the requirements of the study can be formulated as follows: Financial failure is a financial situation that does not occur suddenly but is the result of a set of accumulations and complications that start from a certain situation, and a certain degree of liquidity shortage, which develops in the absence of attention from a bad situation to a worse situation, to the point where available financial resources are unable to meet obligations owed to creditors, and usually the institution is forced to liquidate.

## 3. Quantitative models used to predict financial failure

The issue of financial failure is of great importance to all parties involved in the company, and since financial failure takes a long way, as the company must pass before it reaches that state, in turbulent positions that set it apart from other successful companies in the market, and since the 1960s, researchers have conducted studies aimed at developing quantitative models to predict the probability of financial failure. The most prominent and most capable of predicting financial failures based on financial statements to assess the company's future financial position are: Altman 1968, Kida 1980, and Sherrod 1987.

### a. Altman Model (1968) :

Altman study is one of the important studies he conducted in the field of predicting the failure of companies in 1968, where it relied on many studies, and aimed at determining the predictability of financial failure of companies, and this through studying and analyzing of financial ratios and indicators for a group of companies under study, he Conducted a study on 33 non-bankrupt companies and 33 bankrupt companies during the period 1946-1965, and he used 22 financial ratios extracted from the financial statements of these companies and relied on a statistical model known as Multiple Discriminant Analysis (MDA) to analyze

these ratios and construct a Z-score model, which distinguishes this study from its predecessor which used a single-variable model. .

The researcher concluded that the following ratios are among the most important rates that can be predicted for bankruptcy of companies:

- retained earnings to total assets;
- working capital to total assets;
- Sales to total assets;
- EBITDA to total assets;
- Market value of shares to book value of total debt.

Finally, a multivariate model (Z-score) was developed:

$$Z = 0.012X1 + 0.014X2 + 0.033X3 + 0.006X4 + 0.999X5$$

Where:

**X1:** Working capital to total assets.
**X2:** Retained earnings to total assets.
**X3:** EBITDA to total assets.
**X4:** the market value of shares to total debt.
**X5:** Sales to total assets.
**Z:** represents the financial default index where:
Z>2.99: No bankruptcy is expected.
Z<1.88: Bankruptcy is expected.
1.88 <Z <2.99: The position of the company cannot be judged.

1. The model was able to predict the failure of companies before it happened and for five years accurately reached 95% in the first year before the failure, 72% in the second year, 48% in the third year, 29% in the fourth year, 36% in the fifth year before bankruptcy.( Altman, 1968, p-p: 589-609)

**b. Kida Model (1980):**

The study aimed to determine the predictability of financial failure of companies through the construction of a prediction model, based on the method of discriminatory analysis step-by-step based on 20 financial ratios and a sample of 40 institutions, half of which are distressed and the other half non-defaulted. A short period of time spanned from 1974 to 1975, while the results of this study coincided with the results of the Altman study in ratios that have the ability to predict financial failure.

The study reached the formulation of the model consists of five financial ratios with great predictability, reaching 90%:

**Z = -1.042X1-0.427X2-0.461X3-0.463X4 + 0.271X5**

Where:

**X1:** net profit to total assets.
**X2:** Equity to total debt.
**X3:** liquid assets to current liabilities.
**X4:** Sales to total assets.
**X5:** Cash to total assets.
**Z:** financial default index as the higher the index indicates the integrity of the financial position of the company and the lower it indicates the possibility of falling into the company.

The error rate in forecasting non-performing companies was 15%, which is greater than the non-performing non-performing companies' error rate of 9%. This means that the model has more effectiveness in predicting non-performing companies.( Kida, 1980, p-p : 506-523)

**c. Sherrod Model (1987):**

which is one of the most modern models in predicting financial failure, this model depends on the six independent financial indicators, in addition to the relative weights of the discrimination function coefficients given for these variables, according to the following formula: (Arkan, 2015,p-p :240-241)

**Z = 17X1 + 9X2 + 3.5X3 + 20X4 + 1.2X5 + 0.1X6**

where:

**X1:** net operation capital/total assets,
**X2:** current liquid assets/total assets,
**X3:** total equity/total assets,
**X4:** net income before income tax/total assets,
**X5:** total assets/total liabilities,
**X6:** total equity/total fixed assets.
**Z:** bankruptcy index (financial failure) where:

| Category | Risk degree | Z |
|---|---|---|
| First | Company is not exposed to the risk of | Z > 25 |

| | | |
|---|---|---|
| | bankruptcy | |
| Second | Little likelihood of exposure to the risk of bankruptcy | $25 \geq Z > 20$ |
| Thrid | Difficult to predict the risk of bankruptcy | $20 \geq Z > 5$ |
| Fourth | The Company is exposed significantly to the risk of bankruptcy | $5 \geq Z > -5$ |
| Fifth | The Company is exposed to the risk of bankruptcy | $Z \leq 5 -$ |

## 2. Applied side of the study

### 1. The study population

The study population consists of all the public shareholding companies listed on the ASE.The number of companies in the study community reached 195 companies according to the ASE website in 2018 (https://www.exchange.jo/en).

### 2. Sample study

The study sample was selected from the study population, where we divided the study sample into two groups, the first group was the failed companies and the second group was the non- failed companies, whose financial data are available during the study period (2011, 2018).Failure companies were selected from a total of ninety-five (195) companies present in the study population, this selection was in accordance with the criteria of failure in our study, which was represented in the companies that stopped practicing the activity, which were liquidated, and were taken according to the location of the Securities Depository Center.

While fifteen non- failed companies were selected to meet the number of failed companies, this choice was according to companies that have not stopped their activities and have not been liquidated, which have achieved profits during the last three years, and was taken at random while trying to diversify sectors excluding the financial sector.

### 3. Apply the Altman form to the joint stock companies listed on the Amman Stock Exchange

The main variables of the study are the financial ratios of the Altman model (independent variables), while financial failure is the dependent variable, and the

following is a presentation of the results of applying this model to the study sample:

- **Failed Companies**

**Table (01): Altman model results for failed companies**

| the number | The Company's name | Z values | | |
|---|---|---|---|---|
| | | Third year before liquidation | Second year before liquidation | first year before liquidation |
| 01 | JOWL | 0.31 | 0.22 | 0.09 |
| | | Failed | Failed | Failed |
| 02 | AJFM | 0.34 | 0.25 | 0.18 |
| | | Failed | Failed | Failed |
| 03 | JOTN | 0.10 | 0.00 | 0.01 |
| | | Failed | Failed | Failed |
| 04 | ICER | 0.40 | 0.40 | 0.41 |
| | | Failed | Failed | Failed |
| 05 | AREN | 0.08 | 0.02 | 0.00 |
| | | Failed | Failed | Failed |
| 06 | UNIC | 1.06 | 0.72 | 0.45 |
| | | Failed | Failed | Failed |
| 07 | GLCI | 0.18 | 0.09 | 0.01- |

| | | | | |
|---|---|---|---|---|
| | | Failed | Failed | Failed |
| 08 | FNVO | 0.64 | 0.16 | 0.00 |
| | | Failed | Failed | Failed |
| 09 | AMAN | 0.01 | 0.00 | 0.06 |
| | | Failed | Failed | Failed |
| 10 | IENG | 0.13 | 0.03 | 0.05 |
| | | Failed | Failed | Failed |
| 11 | JOCF | 0.04 | 0.05- | 0.03- |
| | | Failed | Failed | Failed |
| 12 | PRED | 10.03 | 2.47 | 5.24 |
| | | Non-Failed | cannot judge | Non-Failed |
| 13 | UNIF | 0.40- | 1.29- | 1.35- |
| | | Failed | Failed | Failed |
| 14 | DKHS | 0.73 | 0.62 | 0.42 |
| | | Failed | Failed | Failed |
| 15 | AMDI | 0.19 | 0.20 | 0.17 |
| | | Failed | Failed | Failed |

**Source:** Prepared by the researchers based on the financial statements of the study sample within three years

The above table shows the results of applying the Z-score to failing companies, and what can be observed is that all companies are in continuous decline from year to year during the three years preceding the liquidation event, and according to the values of Z obtained, UNIF company was the most deteriorating, where the results show the failure of this company over the three years preceding the liquidation event, followed by JOCF company and GLCI company

The results of the previous table also show that the model was able to predict the failure of all companies over the three years preceding the liquidation event, with the exception of PRED company, which predicted the difficulty of determining its status in the second year before the liquidation event, and that it is non-failed and not subject to bankruptcy and liquidation in the first and third year before the liquidation.

We can clarify the percentage of predictive power of companies failure of the Altman model for each of the three years preceding the liquidation event as follows:

**Table (02): The aggregate results of the Altman model in terms of predictive power of companies failure**

| **Statement** | **Repetition** | **The ratio%** |
|---|---|---|
| The predictive power of companies failing for the third year before the liquidation event | 14 | 93.33 |
| Predictive ability of companies to fail for the second year before the liquidation event | 14 | 93.33 |
| Predictive ability for companies to fail for the first year before the liquidation event | 14 | 93.33 |

**Source:** Prepared by the researchers based on the results of applying the Altman model

We notice from the previous table that the predictive power of the Altman model is constant, as the ratio of the number of times that Z indicates the company's failure in relation to the total number of companies in the three years before the liquidation incident, respectively was 93.33%, and therefore we can say that this model was able to predict the failure of sample companies studying at a

rate of 93.33% for each of the three previous years of liquidation and failure respectively.

- **Non-failed companies**

**Table (03): Results of the Altman model for non-failed companies**

| the number | The Company's name | Z values | | |
|---|---|---|---|---|
| | | Third year before liquidation | Second year before liquidation | first year before liquidation |
| 01 | GENI | 0.37 | 0.36 | 0.40 |
| | | Failed | Failed | Failed |
| 02 | JODA | 1.20 | 1.17 | 1.04 |
| | | Failed | Failed | Failed |
| 03 | RMCC | 0.69 | 0.68 | 0.51 |
| | | Failed | Failed | Failed |
| 04 | APOT | 86.20 | 65.55 | 16.36 |
| | | Non-Failed | Non-Failed | Non-Failed |
| 05 | ICAG | 0.54 | 0.61 | 0.70 |
| | | Failed | Failed | Failed |
| 06 | UMIC | 1.52 | 1.22 | 1.12 |
| | | Failed | Failed | Failed |
| 07 | AIFF | 0.78 | 0.57 | 0.43 |

| | | | | |
|---|---|---|---|---|
| | | Failed | Failed | Failed |
| 08 | | 0.59 | 0.58 | 0.58 |
| | NATA | Failed | Failed | Failed |
| 09 | | 1.09 | 2.21 | 3.22 |
| | NAST | Failed | cannot judge | Non-Failed |
| 10 | | 0.25 | 0.22 | 0.17 |
| | JOWM | Failed | Failed | Failed |
| 11 | | 2.13 | 2.07 | 2.13 |
| | MANE | cannot judge | cannot judge | cannot judge |
| 12 | | 0.56 | 0.52 | 0.57 |
| | JTEL | Failed | Failed | Failed |
| 13 | | 0.12 | 0.12 | 0.12 |
| | TAJM | Failed | Failed | Failed |
| 14 | | 0.70 | 0.66 | 0.63 |
| | JOHT | Failed | Failed | Failed |
| 15 | | 1.06 | 0.96 | 0.81 |
| | JOEP | Failed | Failed | Failed |

**Source:** Prepared by the researchers based on the financial statements of the study sample within three years

It is clear from the previous table that the Altman model predicted failure in all study years except for APOT company, which the model considered non-failed throughout the study years, and also NAST company, which predicts its safety in the first year before liquidation only, it also appears difficult to determine the position of the company in the second year before the liquidation of NAST company, and throughout the years of study for MANE company, and through these results we conclude that there are two things:

- There are signs of financial failure in non-failed companies that are not subject to liquidation and do not disclose them;
- The model does not achieve the required results when the company is healthy and is not threatened by financial failure.

**Results and recommendations**

In this research, we have tried to identify the effectiveness of the Altman model for public shareholding companies listed on the Amman Stock Exchange in predicting the failure of a sample of these companies on this stock exchange, in addition to specifying the ability of the model to give an early warning of companies failure to make the necessary corrections to avoid the risk of bankruptcy and failure.

After applying the model to the study sample, we reached the following results:

- Financial failure is a negative phenomenon that the company can be exposed to during its life span;
- The study showed the ability of the (z-score) model to predict the failure of public joint-stock companies listed on the Amman Stock Exchange during the years that preceded the reality of liquidation at high rates: 93.33%, 93.33%, 93.33% for the third, second and first years, respectively, this result is consistent with many Arab and Western studies.
- The study concluded that the Altman model is able to predict the failure of companies and during the three years preceding the reality of bankruptcy and liquidation, where the average predictive capacity of it reached 93.33%.

- The success of the model in predicting the financial failure of failed companies, As for the non-failed companies, the model was not able to predict them well, and it can be said that the Altman model (z-score) can be used as a good way to know the extent of the public shareholding companies listed on the Amman Stock Exchange to continue practicing its activity but Not very reliable.

Through the findings, We recommend the following:

- Motivating the public shareholding companies listed on the Amman Stock Exchange to use and apply forecasting models because they have a high ability to predict failure and for a sufficient period before the liquidation event ;
- Establishing specialized institutions to predict the bankruptcy and failure of companies in order to assist those requesting this service in the early detection of the risk of bankruptcy and try to avoid it by various procedures and means ;
- Attention to the topic of forecasting financial failure and carrying out the necessary research on this subject in order to protect companies that are subject to financial failure annually and the specter of bankruptcy and liquidation;
- Preparing new studies that include other independent variables that have proven effective in predicting failure in environments similar to the Jordanian business environment.

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