Companies Bankruptcy Prediction by Using Altman Models and Comparing Them

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Abstract

Bankruptcy prediction of economic institutions is considered a necessary matter at the present time in order to avoid the risks that may drive such institutions out of business. Given such fact, the current study was made to highlight the intellectual aspects of the subject of bankruptcy prediction and means of measuring it. There are five main types of models for predicting companies bankruptcy: *one-way analysis of variance*, *multiple discriminant analysis*, *logarithmic analysis, recurrent algorithm analysis*, and finally *neural networks analysis*, which is the most recent bankruptcy prediction method. These methods do not produce similar results. Most bankruptcy prediction studies used multiple discriminant analysis (MDA) and statistical methods for models development. These studies covered both large and small companies as well as private and public companies. MDA is the essence of this research paper which deals with Altman Model in detail and describes the changes that the original Z-Score equation has gone through. The study problem lies in arranging Altman Models for bankruptcy prediction of commercial companies in Iraq in accordance with the importance of each model.

First: Study methodology

1. Problem of the study

Man has always been obsessed with knowing the future and the happy or sad events it holds for him. To attain such knowledge, man invented many ways, some relied on irrational bases such as fortune telling, and others were derived from sound bases, such as induction of past events and trying to generalize their results to the future. The more the issue was related to man's existence and life, the more importance it assumed. In fact, researchers who have studied companies affairs benefited from the idea of exploring the future of humans and tried to contrive sound scientific bases that would enable them to predict companies affairs in future times. That led to the emergence of a slew of prediction means, the most significant of them were the ones related to companies "life", as companies "demised" when they went bankrupt. Therefore, researchers came up with many models for predicting companies' failure or bankruptcy, most notably Altman Model, the original and the modified. The problem of the present study can be best phrased in the following question: "What is the degree of selected Iraqi companies' proximity to the risk of bankruptcy in accordance with Altman Models?"

2. Aim of study

The study aims at presenting Altman Models for predicting bankruptcy of industrial companies listed at the Iraq Stock Exchange. It also aims at:

1. Clarifying Altman models, in both forms, the original and the modified.
2. Identifying the degree of proximity of the selected companies to falling into bankruptcy.
3. Presenting the requirements necessary for helping companies to overcome the risk of bankruptcy.

3. Significance of the study

Expansion in conducting studies about bankruptcy and its devastating effects on the economies of various countries has a huge significance. Many countries pay great deal of attention to the continuity of their companies business to prevent the occurrence of any defects in certain economic aspects that may affect in the future the overall economic activities of the country. Furthermore, early bankruptcy prediction provides companies with the possibility of implementing urgent measures to limit the scope of such danger and eliminate it while its threat is not yet full-fledged.

4. Hypothesis of the study

The study is based on the following hypothesis: "Using Altman models for predicting financial failure contributes to helping companies in predicting financial failure and then devising the procedures needed to limit such failure or eliminate it completely".

5. Study population and sample

The study population consists of the industrial companies listed at the Iraq Stock Exchange. These companies represent the industrial sector in the market. Their number is 29 industrial company. 7 companies were chosen deliberately to be the study sample. These companies were chosen for the following reasons:

a. All of them have been carrying out their activities since a date preceding 2004. Thus, a time sequence of 10 years is available: 2004-2013.
b. In relation to these companies, all the data needed for analysis are available at the market bulletins.

The sample constituted 24% of the study population. From a statistical point of view, this ratio is accepted as representative of the study population.

6. Data collection methods

a. Foreign studies, research and books were relied upon to build the theoretical aspect of the study.

b. for the practical analysis, statements and financial accounts of the companies chosen to represent the sample of the study were used.

7. Means of measurement

Altman models for companies bankruptcy prediction were used. These models are:

a. Z-Score Model: According to this model, bankruptcy was calculated by the following formula (Shim, 2009: 191) and (Anjum, 2012: 214):

Z-score = 1.21(x1) + 1.41 (x2) + 3.3 (x3) + 0.6 (x4) + 0.999 (x5)

Where:
X1 = working capital / total assets
X2 = retained earnings/ total assets
X3 = profit before interest and tax / total assets
X4 = market value of equity / debt book value
X5 = sales / total assets

b. Zeta Model: According to this model, bankruptcy was calculated by the following formula (Anjum, 2012: 214); (Pitrova, 2011: 67); (Karas et al, 2013: 2014)

Zeta: 0.717 (x1) + 0.84 (x2) + 3.107 (x3) + 0.42 (x4) + 0.999 (x5)
Whereas:
X1 = working capital / total assets
X2 = retained earnings / total assets
X3 = Profit before interest and tax / total assets
X4 = market value of equity / liabilities book value
X5 = sales / total assets

c. Z3 Modified Model: According to this model, bankruptcy was calculated by the following formula (Edwards, 2004: 142); (Caouette, 1998: 121) and (Anjum, 2012: 215)

Z3 = 6.56 (x1) + 3.26 (x2) + 6.72 (x3) + 1.05 (x4)
Whereas:
X1 = working capital / total assets
X2 = retained earnings / total assets
X3 = Profit before interest and tax / total assets
X4 = market value of equity / liabilities book value

Second: Theoretical background

1. The concept of bankruptcy

Ventura, 2004: 5 defines bankruptcy as a constitutional right to protect from reference condition of credit. It allows consumers and companies to start over when they owe more money than they make and became unable to pay their debts. Depending on the kind of bankruptcy filed, most debts due to be paid by consumers or companies are to be written off; debts may also be reorganized to enable consumers and companies to pay their creditor, in return for a new financial start. Yet, the consumer or the company may be forced to give some of his/it assets to creditors. Santos et al, 2006: 350) defines bankruptcy as a state in which a company's commercial businesses are incapable of meeting its debt obligations even when required to do so by a court order, and debts can only be paid through reorganizing the company's debts or liquidating its assets.

Distenfield & Distenfield (2005: 9) adds that bankruptcy means that the financial affairs of the company has gone out of control entering a state in which the company became stuck and unable of planning for the future because it owe large amounts of money and bankruptcy became a means for erasing some of the debts preventing the company from moving forward. Ranter et al, 2009: 3-4) states that bankruptcy is a group of corrective steps for stumbling companies used as an alternative solution for solvency. This is done through addressing operational problems, replacing administration incapable of facing problems, and making the tough choices needed for solving problems. Therefore, creditors stipulate that the company keeps an external consultant as a condition for its continuation and that t receives loans to make a shift towards successful operation outside the scope of bankruptcy. Sometimes the problem of bankruptcy can be solved through some techniques:

a. Selling part of the company,
b. overtake strategy by another company,
c. investment in new shares,
d. capitalizing works,
e. temporary endurance on part of creditors,
f. prioritization: debts for debts, debts for equity, and debts for debts and equity.

Herman & Bodiford (2003: 2-3) says that although bankruptcy involves financial losses, it would be a liberating experience from being suffocated by debts and creditors interference, and a chance for erasing some debts, devising a reasonable payment plan, and avoiding a company shutdown.

According to (Brow et al, 199: 1), the bankruptcy system is based on the theory that the debtor would disclose all of his assets and liabilities so that the final action would be taken in accordance with the requirements of law.

Both (Fulerson, 2001: 305) and (White, 2001: 18) have stated that bankruptcy involves terminating the allocation of companies owners' future profits for debt payment so that the companies may start new commercial businesses without the need to pay higher taxes to pay its pre-bankruptcy debts. It also involves that companies owners should hand out the current assets which are above the exemption level set by the state which their companies operate. Nonexempt assets are used to pay debts because exemptions vary from one country to another. Grammatikos (1984: 437) points out that bankruptcy prediction models are valuable tools for assessing a company's financial health for creditors, shareholders, analysts and directors. Investors are interested in the first place in assessing the value of their present and future investments, and consequently have a strong motive for assessing the company's abilities.

Shim (2000: 203-204) adds that bankruptcy is a final statement saying that a company is no longer capable of maintaining its businesses because of current debts. Most companies need loans for business, and that increases its obligations during production operations for the purposes of expansion, improvement or even staying alive. When debts surpass assets, the company becomes close to bankruptcy. Ibid mentions a number of advantages resulting from bankruptcy:

a. Using it in analyzing mergers: It helps in identifying the likely problems related to a potential merging partner.
b. Managing transformation: to develop work plans and emergency strategies to correct the deteriorated situation rapidly.

c. Subscribing in insurance to assess potential credit risks by companies or banks offering the credit, including risk sharing and self-insurance retentions

d. Corporate governance: Analyzing the review and accounts committee in terms of its effect on minimizing the company's ability, reviewing companies risks, and analyzing merging and overtaking scenarios.

e. Analysis of investment: The model may help the investor in choosing the company shares which are likely to stumble for capitalists, investment banks, and business assessment experts. I t also assesses potential investment decisions.

f. Analysis of auditing: Reviewing external CPA accounts to assess whether the company was continuing its business, to review the qualifying opinion and disclose financial statements.

g. Legal analysis: The investments or credit awards given to your company against which claims costing the company financial losses may be filed. The model may help in defending your company against such claims.

h. Loan credit analysis: Bankers and lenders may use it to determine whether a loan should be given or not, as it enables bankers to decide whether the company is facing the risk of failure even before such failure takes place. Accordingly, corrective measures may be taken to enable bankers to: first, decrease the company's acceptability as a customer; second, encouraging the company to identify problems and take the necessary procedures to solve them; third, encouraging the company's directors to put more money in commercial businesses; fourth, encouraging the company to find another source of funding, which can be done by obtaining funds from other creditors, like sellers, to determine whether the credit will be extended.

Hargreares (2010: 5) believes that many companies in the United States use bankruptcy as a tool to stay alive, even in a different form, specifically if bankruptcy is necessary to begin measuring a new range for quickly-generated cash (possibility of generating cash in short term) and determining the time remaining to provide cash after bankruptcy. Therefore, it is imperative for the company's consultants to move quickly and efficiently through benefiting efficiently from such decision and using the available tools in restructuring, which depends on whether the company has or has not entered the legal procedures of bankruptcy. Shumway (2001: 101-102) adds that bankruptcy prediction models are important for identifying the characteristics of each company, monitoring each company and collecting available information to determine the bankruptcy risk for each company, and doing so at the right time.

Buchbinder (2009: 24) states that bankruptcy works towards solving the financial problems of the debtor as all to-be-liquidated assets and liabilities are disclosed and divided amongst creditors in accordance with specified priorities law of the non-exempt assets, as most debts are used to clear the debtor's liability, which is the main reason underlying the bankruptcy case.

2. The importance of bankruptcy prediction

Aziz & Dar (2004: 2-3) indicates that bankruptcy prediction received the attention of many investors, creditors, borrowing companies, and governments, so as to determine the time when companies fail. This is a main focus of Basel II. It uses prediction to reduce the credit risk. Global economies are becoming more wary of the risks of participating in the liabilities of companies, especially after the demise of the corporate giants. So it became necessary to develop new means and models to predict companies bankruptcy, and to rely on many of the statistical analyses, so as to increase the accuracy of prediction. Santos et al (2006: 350) indicated that financial disasters represented by excessive debt and lack of capital adequacy, economic disasters represented by weakness of industry, as well as neglect and fraud, all of that led the investors to reduce credit risk and avoid unprofitable investments. So it became necessary to predict corporate bankruptcy. Beaver (1966) introduced a model predictive of companies' behavior, using one variable; whereas Altman (1968) suggested the application of linear discriminant analysis. Since then, several contributions have been made to improve the results of Altman and to predict companies' bankruptcy. Mukhopadhyay (2013: 910) added that bankruptcy prediction started in 1930s when ratio analysis was used to predict future bankruptcy. It aims at the correct assessment of the financial position of the company in the future, because the poor performance of the company will make the company's shareholders bear direct and indirect costs. It also aims at the equitable distribution of the properties of the indebted and troubled company among all creditors. He referred to several methods predictive of corporate bankruptcy. Anjum & Muhammad (2012: 213) referred to abstracts and models of senior scholars,

chronologically arranged by year, predictive of bankruptcy or business failure. The following table lists important studies only. It doesn't list all of the studies in this field.

Table 1: Bankruptcy prediction models and authors

Type of Model	Author	Date
Univariate	Fitzpatrick	1932
	Merwin	1942
	Walter	1957
	Beaver	1966
Multiple Discriminant Analysis	Altman	1968
	Edmister	1972
	Deakin	1972
	Blum	1974
	Moyer	1977
	Altman, Halderman, & Naarayanan	1977
	Altman	1983
	Booth	1983
	Rose & Giroux	1984
	Casey & Bartczak	1985
	Lawrence & Bear	1986
	Altman	1993
	Poston, Harmon, & Gramlich	1994
	Grice & Ingram	2001

Source: Anjum, Sanobar & Muhammad, Prince "**Business bankruptcy prediction models: A significant study of the Altman's Z-score model**" Asian Journal of Management Research, Vol. 3, No.1, p:213, 2012.

Bernhardsen (2001: 1) indicated that the importance of bankruptcy prediction is not limited to looking for explanatory factors which we need only when identifying factors affecting inadequacy of company's performance, but it includes unfailing companies where questions arise as to the reason why such companies were not liquidated, merged, or restructured debt-wise in a timely manner when certain indications of bankruptcy were noticed. Dakovic et al (2007: 3) added that, given its importance in determining a company's position, bankruptcy prediction attracted the attention of many academics and business practitioners. It determines a company's position via the treatment of relevant information (i.e., the application of linear and nonlinear models to assess a company's performance and to project its financial future.) Given their importance, models of bankruptcy prediction evolved over time, becoming more precise in their predictions, and for longer periods of time. Caouette (1998: 115) indicated that the importance of bankruptcy prediction lies as well in the determination of bankrupt companies versus financially stable ones, enabling banks to lend money to the latter.

3. Altman's models of bankruptcy prediction

Three models of corporate bankruptcy prediction are developed by Altman over time periods. Adjustments were made to those models as will be shown later.

A.   Z-Score Model Analysis.

This model is developed by Edward Altman, utilizing multiple discriminant analysis, to relatively predict whether the company will face bankruptcy within the next five years.

Shim (2009: 191) and Anjum (2012: 214) demonstrated that a bankruptcy model (Z-Score) is developed via the application of a combination of traditional financial ratios and multiple discriminant analysis by Altman. Altman indicated that this model represents a reliable tool predictive of bankruptcy in a diverse mix of commercial companies (industrial, service) as the following equation demonstrates:

$$Z = 1.21(X_1) + 1.41 (X_2) + 3.3 (X_3) + 0.6 (X_4) + 0.999 (X_5)$$

Where:

X_1 = working capital / total assets

X_2 = retained earnings / total assets

X_3 = Profit before interest and tax / total assets

X_4 = market value of equity / debt book value (or net value of private company)

X_5 = sales / total assets

   As for the coefficients (i.e., 1.21, 1.41, 3.3, 0.6, 0.999), they represent weights of function's variables. They express the relative importance of each variable based on what the companies in question use. Z represents the equation's value, and is compared with principles developed by Altman (Lewis & Pendrill, 2000: 406). The said principles are:

a)   Companies where $Z \leq 1.8$ are failures due to their low performance.
b)   Companies where $2.99 \geq Z > 1.8$ are of "middle" performance whose fate is difficult to predict.
c)   Companies where $Z \geq 3.0$ are successes in the short run due to their high performance.

   It is established that Z-score index is about 90% accurate in predicting business failure for one year in the future, and about 80% accurate in predicting for two years in the future. It is used in the late years of the 1960s, along with other important variables, as the reports show. Therefore, Z-score model is somewhat outside the period of the 1980s.

   Lim & Jessica (2012: 70) added that Altman had used MDA to develop a model consisting of five factors. It was named Z-score. The model predicts bankruptcy if the company's "parameter" becomes lower than a specific limit. Z-score model had a high predictive capability in the first year prior to failure with a precision rate of 95%. However, the predictive capability reduced to a precision rate of 72% two years prior to failure. It reduced again to a precision rate of 48% three years prior to failure, and then to 36% four or five years prior to failure, consecutively. The predictive capability of the model, when tested using a specific sample, was 79%.

   Anjum (2012: 214-215), Altman (1968: 594-596), Wahlen (2011: 283) and Shemetev (2012: 306-307) referred to the financial ratios used in the model as follows:

   X1: this ratio represents working capital to total assets. It is frequently found in the studies dealing with corporate problems. It measures corporate liquidated net assets close to total capitalization. Working capital is defined as the difference between current assets and current liabilities. Size and characteristics of liquidation are considered "disclosed", since a company suffering from operational losses will shrink its current assets relative to total assets "from the three existing liquidation ratios". This alone is most valuable. Listing this variable consists with Merwin's study which classifies this measurement as the best one.

   X2 = this ratio represents retained profit to total assets. It measures accumulative profitability over time. Company's life-time is implied in this ratio. Recently-incorporated companies may show a decrease in retained profits relative to total assets, since they wouldn't have enough time to build accumulative profitability. Consequently, recently-incorporated companies oppose such analysis. Their chance to be classified as bankrupt is relatively higher than older ones, other factors being the same.

   X3: this ratio represents profit (earnings) before interest and tax to total assets. It measures real productivity of corporate assets. It depends on earning power of corporate assets. Bankruptcy occurs when total liabilities exceed fair assessment of company's assets "with a value determined by earning power of corporate assets".

   X4: this ratio represents market value of equity to book value of total debt. Equity is measured via market value of all preferred and common stocks. Debt includes what is short term and long term. The measurement shows us how corporate assets may reduce value (measured by market value of equity in addition to debts). This

is before liabilities exceed assets and a company became bankrupt. This index is more effective in measuring bankruptcy. There are more common similar ratios; e.g., net value to total debt (book value).

X5: this ratio represents sales to total assets. It is turnover ratio. It demonstrates the ability to generate sales from corporate assets. It measures management's ability to deal with competitive conditions. It is a very important ratio since it accounts for the model's ability to differentiate/discriminate.

B.   Zeta Model Analysis.

Altman et al (1977: 34) and Altman (2000: 26-27) indicated that a model has been developed comprising of seven variables after a repetitive process to reduce variables' number from 28 to 7. This model has been dubbed as the most credible in investigating the validity of different procedures. This means we cannot improve our position via the addition of more variables. Other models with fewer variables can do that.

Altman et al (1977: 34-35) and Shim (2009: 191) referred to a model of the second generation known as Zeta analysis. It goes with these changes, primarily with capitalization of financial leases. Zeta model predicts bankruptcy up to five years in advance, since it is "one of the equity and precise weights". The model contains seven variables. This is what a recent study led to, explaining corporate failure and bankruptcy.

X1 = return / assets. Profit before interest and tax / total assets.

X2 = profit's stability. Measured by normalization of standard error of estimate about X1's direction for ten years.

X3 = debt's service. Profit before interest and tax / total interest payment.

X4 = accumulative profits. Retained earnings / total assets.

X5 = liquidity. Current assets / current liabilities.

X6 = capitalization. Equity / total capital. Equity is measured "at the rate of five years of total market value instead of book value". It also includes preferred stocks when liquidated, long-term debts and lease capitalization. It is used, in average, for five years, so that severe and temporary market fluctuations may be tempered and direction component may be added "side by side with X2".

X7 = size measured by corporate total assets. As with other variables, late changes will be tuned when preparing financial reports. Capitalization of leased buildings' equity has added to assets' averaged size of both, bankrupt and non-bankrupt groups. Variable of size has transferred, to help normalizing and distributing the variable. Logarithmic transfer is applied.

Karas et al (2013: 204), Pitrova (2011: 67) and Anjum (2012: 214-215) indicated that, after Altman published his model in 1968, a discussion concerning how to use Z-score model, including how to use it with companies that don't own stocks in the stock exchange (i.e., are not listed in the stock exchange), was held. The original model was modified. The model and the equity's market value were totally reassessed in X4. It is replaced with equity's book value. In 1977, the final model, named Zeta, was published and applied to companies not listed in the stock exchange market. The equation was:

$$Z = 0.717(X1) + 0.84 (X2) + 3.107 (X3) + 0.42 (X4) + 0.998 (X5)$$

Classification of ranges for this model has been changed. If the result is higher than 2.9, the company is doing well. If it is less than 1.23, the company is bankrupt. If it is between 1.23 and 2.9, the company is in "the grey area". The latter happens when prediction is not clear. Grey area of this model is larger than that of Altman's original model. During subsequent years, the original model was investigated by the author and other economists.

X1 = working capital / total assets

X2 = retained earnings/ total assets

X3 = Profit before interest and tax / total assets

X4 = book value of equity / book value of liabilities

X5 = sales / total assets

Edwards et al (2009: 6) points out that in the year 1977, Altman et al came up with the Zeta model. This model was more powerful as it correctly classified (96.2%) of bankrupt companies and (89.7) of non-bankrupt companies one year before bankruptcy. Most importantly, the prediction power of Zeta model remained (70%) for bankrupt companies and (80%) for non-bankrupt companies for five years. These results revealed that Zeta model, which was based on assets returns, stability of profit, ability to serve debts, accumulative profitability, cash, value and size, was more powerful and efficient than (Altman, 1968) model when it came to predicting companies failure. According to (Guerard Jr. & Schwartz, 2007: 91), Zeta model succeeded in predicting bankruptcy for a sample of (32-33) industrial company with a (97%) percent a year before the bankruptcy actually took place. It also made accurate predictions, (94%) percent, for a sample of (31-33) industrial companies of the non-bankrupt companies a year before bankruptcy.

c. Analysis of Z3 modified model:

Each of (Anjum, 2012: 215-216), (Caouette, 1998: 121), (Edwards, 2004: 142) and (Chuvakin & Gertmenian, 2003: 4) states that Altman had noticed that his original Z-score model and Zeta model lacked methodology in weights, involved some ambiguity, depended on a unilateral methodology, and that some of the ratios were misleading. He had also felt that the fifth ratio: sales/total assets, did not represent a difference between failing and non-failing companies nor did it reflect any difference from one industry to another. (X5) was eliminated to decrease its impact on the industry. Altman made a modifies model that can accurately predict companies financial difficulties and recalculated the model after excluding the fifth variable:

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

X_1 = working capital / total assets

X_2 = retained earnings / total assets

X_3 = Profit before interest and tax / total assets

X_4 = market value of equity / liabilities book value

a. Companies with (1.10) or less are considered bankrupt.

b. companies with (1.10 – 2.60) are considered to be in the middle and their bankruptcy or non-bankruptcy cannot be predicted.

c. Companies with more than (2.6) are considered non-bankrupt companies.

The model's accuracy rate in predicting bankruptcy one year prior to the company's demise was (90.9%), while for non-bankrupt company it was 97%.

Graham (200: 122-123) points out that Z models are required to predict bankruptcy in all industries and various countries.

Anjum & Muhammad (2012: 216) refers to Altman models which shows the ratios related to bankruptcy, non-bankruptcy and the gray area for the models as shown in table (4):

Coefficients Variables	Original Model (1968)	Revised Model (ZETA) (1983)	Revised Three Model Z3 (1993)
X1	1.20	0.717	6.56
X2	1.40	0.840	3.26
X3	3.33	3.107	6.72
X4	0.60	0.420	1.05
X5	0.999	0.998	N/A
Bankrupt firms	<1.81	<1.23	<1.10
Non-bankrupt firms	>2.99	>2.90	>2.60
Gray area	1.81-2.99	1.23-2.90	1.10-2.60

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Classification results			
Actual Bankrupt	94%	90.9%	90.9%
False Bankrupt	6%	9.1%	9.1%
Actual Bankrupt	97%	97%	97%
False Bankrupt	3%	3%	3%

Third: Practical aspect

In this chapter, the bankruptcy of the companies representing the sample is calculated from the data obtained from these companies financial statements and accounts using the three Altman models: (Z-score, Zeta, and Z3). The calculations covers a period of ten years: 2004-2013. analysis shall depend on comparing the results obtained from each of the above samples for the following companies:

1. Baghdad Soft Drinks Company
2. Iraqi for Tufted Carpets
3. Packaging and Wrapping Company MISHIN
4. Iraqi Engineering Works
5. Modern Paints Industries
6. Metallic Industries and Bicycles
7. Electronic Industries

Analysis:

1. Baghdad Soft Drinks Company

Table (1) presents the analysis of Altman models for Baghdad Soft Drinks Company from 2004-2013. The following can be noticed from the analysis:

a. Z-score model: This model shows that the company was vulnerable to bankruptcy in the years (2005, 2006, 2007); was in the grey area in the years (2008, 2009, 2010, 2011, and 2012); and was not vulnerable to bankruptcy in the years (2004, 2013).

b. Zeta model: This model shows that the company was vulnerable to bankruptcy in the years (2005, 2006, 2007); was in the grey area in the years (2004, 2008, 2009, 2010, 2011, 2012, 2013); and was not vulnerable to bankruptcy in any year.

c. Z3 model: This model shows that the company was vulnerable to bankruptcy in the years (2006, 2007); was in the grey area in the years (2005); and was not vulnerable to bankruptcy in the years (2004, 2008, 2009, 2010, 2011, 2012, 2013).

The above analysis shows that the three models agree that the company had a high bankruptcy probability in the years (2006 and 2007). Z-score model and Zeta model agreed that the company was in the stability (grey) area for the years (2008-2012). Z-score agrees with the modified Z3 model that the company was not close to go bankrupt in the years 2004 and 2013.

Year	z-score	Top gray	Bottom gray	Zeta	Top gray	bottom gray	Z3	Top gray	Bottom gray
2004	5.43	2.99	1.81	1.41	2.9	1.23	4.65	2.60	1.10
2005	1.57	2.99	1.81	0.95	2.9	1.23	2.27	2.60	1.10
2006	1.19	2.99	1.81	1.17	2.9	1.23	0.58	2.60	1.10
2007	0.66	2.99	1.81	0.64	2.9	1.23	-0.46	2.60	1.10
2008	1.87	2.99	1.81	1.47	2.9	1.23	3.30	2.60	1.10
2009	1.91	2.99	1.81	1.55	2.9	1.23	2.76	2.60	1.10
2010	2.33	2.99	1.81	1.98	2.9	1.23	3.89	2.60	1.10
2011	2.57	2.99	1.81	2.17	2.9	1.23	4.30	2.60	1.10
2012	2.75	2.99	1.81	2.19	2.9	1.23	4.53	2.60	1.10
2013	3.27	2.99	1.81	2.10	2.9	1.23	4.62	2.60	1.10

Table (1) Baghdad Soft Drinks Company

2. Iraqi for Tufted Carpets

Table (2) presents the analysis of Altman models for Iraqi for Tufted Carpets for the period 2004-2013. The following can be noticed from the analysis:

a. Z-score model: This model shows that the company was vulnerable to bankruptcy in the years (2005-2013); was in the grey area only in the year 2004, and was never safe from the risk of bankruptcy.

b. Zeta model: This model shows that the company was vulnerable to bankruptcy in the years (2005, 2006, 2007, 2010, 2011, 2013); was in the stability area in the years (2004, 2008, 2009, 2010, 2011, 2012, 2013). The model did not indicate that the company was invulnerable to bankruptcy in any year.

c. Z3 model: This model shows that the company was invulnerable to bankruptcy throughout the whole period: 2004-2014, and was never in the gray area or close to bankruptcy.

The above analysis shows that the three models do not agree to one case. The Z-score model agree with Zeta model that the company faced the danger of bankruptcy in years 2005 and 2013 and that it was in the gray area in the year 2004.

Year	z-score	Top gray	Bottom gray	Zeta	Top gray	bottom gray	Z3	Top gray	Bottom gray
2004	2.89	2.99	1.81	1.45	2.9	1.23	6.27	2.60	1.10
2005	1.71	2.99	1.81	1.08	2.9	1.23	5.30	2.60	1.10
2006	1.57	2.99	1.81	1.10	2.9	1.23	4.36	2.60	1.10
2007	1.43	2.99	1.81	1.05	2.9	1.23	4.09	2.60	1.10
2008	1.76	2.99	1.81	1.29	2.9	1.23	5.08	2.60	1.10
2009	1.73	2.99	1.81	1.25	2.9	1.23	5.21	2.60	1.10
2010	1.52	2.99	1.81	0.99	2.9	1.23	4.65	2.60	1.10
2011	1.64	2.99	1.81	1.10	2.9	1.23	4.89	2.60	1.10
2012	1.79	2.99	1.81	1.26	2.9	1.23	5.41	2.60	1.10
2013	1.46	2.99	1.81	1.10	2.9	1.23	4.87	2.60	1.10

Table (2) Iraqi for Tufted Carpets

3. Packaging and Wrapping Company

Table (3) presents the analysis of Altman models for Packaging and Wrapping Company for the period 2004-2013. The following can be noticed from the table:

a. Z-score model: This model shows that the company was vulnerable to bankruptcy in the years (2004, 2006, 2007, 2008); was in the gray area only in the year 2013, and was safe from the risk of bankruptcy in the years (2005, 2009, 2010, 2011, 2012).

b. Zeta model: This model shows that the company was vulnerable to bankruptcy in the years (2006-2013); was in the gray area in the year 2013; and was safe from bankruptcy in the years (2005, 2009, 2010, 2012).

c. Z3 model: This model shows that the company was vulnerable to bankruptcy in the years (2006, 2007, 2008, 2009, 2010); was invulnerable to bankruptcy in the years (2004, 2005, 2011, 2012, 2013); and was never in the stability (gray) area.

The results of this analysis show that all models agree that the company was close to bankruptcy in the year 2006. Z-score model agrees with Z-3 modified model that the Company was close to bankruptcy in the years 2007 and 2008 and was safe from bankruptcy in the years 2005, 2011 and 2012.

Year	z-score	Top gray	Bottom gray	Zeta	Top gray	bottom gray	Z3	Top gray	Bottom gray
2004	1.71	2.99	1.81	1.94	2.9	1.23	5.97	2.60	1.10
2005	3.06	2.99	1.81	1.39	2.9	1.23	6.89	2.60	1.10
2006	1.25	2.99	1.81	0.62	2.9	1.23	-2.69	2.60	1.10
2007	1.28	2.99	1.81	0.19	2.9	1.23	-4,42	2.60	1.10
2008	1.80	2.99	1.81	0.34	2.9	1.23	-3.37	2.60	1.10
2009	5.57	2.99	1.81	0.16	2.9	1.23	-3.63	2.60	1.10
2010	3.63	2.99	1.81	0.27	2.9	1.23	-3.19	2.60	1.10
2011	4.82	2.99	1.81	1.02	2.9	1.23	4.48	2.60	1.10
2012	3.24	2.99	1.81	1.00	2.9	1.23	3.67	2.60	1.10
2013	2.46	2.99	1.81	1.01	2.9	1.23	4.93	2.60	1.10

Table (3) Packaging and Wrapping Company

4. Iraqi Engineering Works

Table (4) presents the analysis of Altman models for Iraqi Engineering Works for the period 2004-2013. The following can be noticed from the table:

a. Z-score model: This model shows that the company was vulnerable to bankruptcy in the years (2004, 2005, 2011, 2012, 2013); was in the stability (gray) area only in the year 2009, and was safe from the risk of bankruptcy in the years (2006, 2007, 2008, 2010).

b. Zeta model: This model shows that the company was vulnerable to bankruptcy in the years (2004, 2005, 2011, 2012, 2013); was in the stability (gray) area in the years (2006, 2008, 2009, 2010); and was safe from bankruptcy in the year 2007 only.

c. Modified Z3 model: This model shows that the company was vulnerable to bankruptcy only in the year 2011; was in the gray area in the year (2012, 2013); and was safe from the risk of bankruptcy in the years (2004, 2005, 2006, 2007, 2008, 2009, 2010).

The analysis results reveal that all models agree that the company was vulnerable to bankruptcy in the year 2011 and was safe from the risk of bankruptcy in the year 2007. Furthermore, -score and Zeta models concur that the company was close to bankruptcy in the years (2004, 2005, 2011, 2012, 2013) and was in the gray area in the year 2009. Z-score and Z3 models agree that the company was invulnerable to bankruptcy in the years (2006, 2007, 2008, 2010).

Year	z-score	Top gray	Bottom gray	Zeta	Top gray	bottom gray	Z3	Top gray	Bottom gray
2004	1.48	2.99	1.81	0.76	2.9	1.23	3.47	2.60	1.10
2005	1.60	2.99	1.81	1.02	2.9	1.23	5.44	2.60	1.10
2006	3.03	2.99	1.81	2.50	2.9	1.23	7.26	2.60	1.10
2007	5.72	2.99	1.81	5.02	2.9	1.23	6.62	2.60	1.10
2008	3.49	2.99	1.81	2.82	2.9	1.23	6.88	2.60	1.10
2009	2.28	2.99	1.81	1.57	2.9	1.23	4.28	2.60	1.10
2010	3.13	2.99	1.81	1.84	2.9	1.23	4.86	2.60	1.10
2011	0.63	2.99	1.81	0.62	2.9	1.23	-3.94	2.60	1.10
2012	1.73	2.99	1.81	1.17	2.9	1.23	1.75	2.60	1.10
2013	1.48	2.99	1.81	1.03	2.9	1.23	2.43	2.60	1.10

Table (4) Iraqi Engineering Works

5. Modern Paints Industries

Table (4) presents the analysis of Altman models for Modern Paints Industries for the period 2004-2013. The following can be noticed from the table:

a. Z-score model: This model shows that the company was vulnerable to bankruptcy only in the year (2013); was in the stability (gray) area only in the years (2005, 2006, 2007, 2008, 2009, 2011, 2012); and was safe from the risk of bankruptcy in the years (2004 and 2010).

b. Zeta model: This model shows that the company was vulnerable to bankruptcy in the years (2005, 2007, 2009, 2013); was in the gray area in the years (2008, 2010, 2011, 2012); and was safe from bankruptcy in the years (2004, 2006).

c. Modified Z3 model: This model indicates that the company was never close to bankruptcy in any of the year under analysis (2004-2013).

The analysis results reveal that all models concur that the company was safe from bankruptcy in the year 2004. Z-score model and Zeta model agree that the company was vulnerable to bankruptcy in the year 2013 and was in the gray area in the years (2008, 2011, 2012) Furthermore, Z-score model and modified Z3 model agree that the company was safe from bankruptcy in the year 2010. Finally, Zeta model and modified Z3 model agree that the company was safe from bankruptcy in the year 2006.

Year	z-score	Top gray	Bottom gray	Zeta	Top gray	bottom gray	Z3	Top gray	Bottom gray
2004	14.87	2.99	1.81	9.29	2.9	1.23	39.08	2.60	1.10
2005	2.68	2.99	1.81	0.95	2.9	1.23	3.96	2.60	1.10
2006	1.93	2.99	1.81	4.71	2.9	1.23	14.28	2.60	1.10
2007	1.84	2.99	1.81	1.19	2.9	1.23	5.15	2.60	1.10
2008	1.98	2.99	1.81	1.30	2.9	1.23	5.32	2.60	1.10
2009	2.16	2.99	1.81	1.14	2.9	1.23	5.10	2.60	1.10
2010	19.84	2.99	1.81	1.30	2.9	1.23	5.28	2.60	1.10
2011	2.60	2.99	1.81	1.39	2.9	1.23	5.35	2.60	1.10
2012	2.24	2.99	1.81	1.30	2.9	1.23	5.01	2.60	1.10
2013	1.57	2.99	1.81	1.20	2.9	1.23	5.04	2.60	1.10

Table (5) Modern Paints Industries

6. National Company for Metallic Industries and Bicycles

Table (6) presents the analysis of Altman models for the National Company for Metallic Industries and Bicycles for the period 2004-2013. The following can be noticed from the table:

a. Z-score model: This model shows that the company was vulnerable to bankruptcy in the years (2006, 2007, 2008, 2010, 2011, 2012); was in the gray area only in the years (2004, 2009, 2013); and was safe from the risk of bankruptcy only in the year 2005.

b. Zeta model: This model shows that the company was vulnerable to bankruptcy in the years (2004, 2006, 2007, 2008, 2009, 2010, 2011, 2012); was in the stability area only in the year 2013; and was safe from bankruptcy in the year 2005 only.

c. Modified Z3 model: This model shows that the company existed in the gray area for one year only, 2006; and spent all the other years, (2004, 2005, 2007, 2008, 2009, 2010, 2011, 2012, 2013), in the non-vulnerability area.

The analysis results show that the three models concur that the company was safe from bankruptcy in the year 2005. Z-score model and Zeta Model concur that the company was vulnerable to bankruptcy in the years (2006, 2007, 2008, 2010, 2011, 2012) and was in the stability area in the year 2013).

Year	z-score	Top gray	Bottom gray	Zeta	Top gray	bottom gray	Z3	Top gray	Bottom gray
2004	2.31	2.99	1.81	0.81	2.9	1.23	2.75	2.60	1.10
2005	7.80	2.99	1.81	5.72	2.9	1.23	22.61	2.60	1.10
2006	0.69	2.99	1.81	0.60	2.9	1.23	2.40	2.60	1.10
2007	1.14	2.99	1.81	0.84	2.9	1.23	3.10	2.60	1.10
2008	1.65	2.99	1.81	1.20	2.9	1.23	4.06	2.60	1.10
2009	1.87	2.99	1.81	1.09	2.9	1.23	3.83	2.60	1.10
2010	1.62	2.99	1.81	1.01	2.9	1.23	2.82	2.60	1.10
2011	1.59	2.99	1.81	1.20	2.9	1.23	3.46	2.60	1.10
2012	1.38	2.99	1.81	1.19	2.9	1.23	3.68	2.60	1.10
2013	1.98	2.99	1.81	1.78	2.9	1.23	5.14	2.60	1.10

Table (6) National Company for Metallic Industries and Bicycles

7. Electronic Industries Company

Table (7) presents the analysis of Altman models for the Electronic Industries Company for the period 2004-2013. The following can be noticed from the table:

a. Z-score model: This model shows that the company was vulnerable to bankruptcy in the years (2005, 2006, 2007, 2008, 2010, 2011, 2012, 2013); was in the gray area only in the year 2009; and was safe from the risk of bankruptcy only in the year 2009.

b. Zeta model: This model shows that the company was vulnerable to bankruptcy in the years (2004, 2005, 2006, 2008, 2010, 2011); was in the gray stability area in the years (2007, 2009, 2012, 2013); and was never safe from bankruptcy.

c. Modified Z3 model: This model shows that the company was vulnerable to bankruptcy only in the year 2010; spent only one year in the gray area; whereas remained safe from bankruptcy in the years (2004, 2006, 2007, 2008, 2009, 2011, 2012, 2013).

The results of the above analysis reveal that the company came close to bankruptcy only in the year 2010. Z-score and Zeta models agree that the company was vulnerable to bankruptcy in the years (2005, 2006, 2008, 2010, 2011). Furthermore, Z-score model and modified Z3 model agree that the company was safe from bankruptcy in the year 2009.

Year	z-score	Top gray	Bottom gray	Zeta	Top gray	bottom gray	Z3	Top gray	Bottom gray
2004	2.49	2.99	1.81	0.98	2.9	1.23	3.23	2.60	1.10
2005	0.55	2.99	1.81	0.67	2.9	1.23	2.57	2.60	1.10
2006	1.28	2.99	1.81	1.13	2.9	1.23	3.29	2.60	1.10
2007	1.79	2.99	1.81	1.51	2.9	1.23	4.76	2.60	1.10
2008	1.52	2.99	1.81	1.21	2.9	1.23	3.90	2.60	1.10
2009	3.83	2.99	1.81	1.52	2.9	1.23	4.07	2.60	1.10
2010	1.00	2.99	1.81	0.54	2.9	1.23	0.67	2.60	1.10
2011	1.59	2.99	1.81	1.16	2.9	1.23	5.78	2.60	1.10
2012	1.40	2.99	1.81	1.25	2.9	1.23	5.84	2.60	1.10
2013	1.34	2.99	1.81	1.29	2.9	1.23	5.52	2.60	1.10

Table (7) Electronic Industries Company

Table (8) presents the results summary of the cases of bankruptcy, uncertain bankruptcy and non-bankruptcy for the study sample, in accordance with each model.

Case\Model	Bankruptcy		Uncertainty		Non-bankruptcy		Total
	No.	Percentage%	No.	Percentage%	No.	Percentage%	
Z-score	36	42.4	19	34	15	21.7	70*
Zeta	40	47	26	46.4	4	5.8	70
Z3	9	110.6	11	19.6	50	72.5	70
Total	85	100	56	100	69	100	210

* The number (70) is the outcome of applying the models to 7 companies for 10 years.

The above table shows a discrepancy between cases of bankruptcy, uncertainty and non-bankruptcy as per each model. Rates of bankruptcy cases varied among the three models. Zeta model showed the highest rate, 47%, whereas Z-score model came second with 42.4%, and Z3 model came last with 10.6%.

There were disparities also in the uncertain cases of bankruptcy. Z3 model showed the highest rate, 46.4%, whereas Z-score model came second with 34%, and Zeta model came last with 19.6%.

Non-bankruptcy cases in turn varied among the three models. Z3 model showed the highest rate, 72.5 %, whereas Z-score model came second with 21.7%, and Zeta model came last with 5.8%.

This disproves that the hypothesis stating that: there is no discrepancy at the level of using Altman models to predict bankruptcy of industrial companies listed at the Iraqi Stock Exchange. The analysis results proved that there is a clear discrepancy at the level of using Altman models to predict bankruptcy of industrial companies listed at the Iraqi Stock Exchange.

Conclusions and Recommendations

Conclusions:

1. There is a discrepancy between the results of the three models in predicting bankruptcy for all companies because of the differences in percentages weight for each model.

2. Most companies fall within the gray are, which indicates a weakness in performance and inability to make satisfactory profits for shareholders.

3. Companies results reveal that most of them suffer from sever stagnation and that most of them do not distribute any profits at all or distribute very little profits.

4. The companies representing the sample of the study seek to remain in the market as long as it can despite their weak performance because of its fear of bankruptcy and having to liquidate its activities.

5. In general, the three models predicted that the companies are certainly on the verge of bankruptcy.

Recommendations:

1. Saving the companies from bankruptcy requires offering them for investment.

2. Companies' activities can be subsidized by the government through long-term loans and monitoring the companies' performance.

3. Companies of similar activities may be merged to raise their capitals.

4. Non-productive companies may be transferred into the private sector by auctioning them.

5. Some companies may change their nature of business and enter other types of activities. For example, the Metallic Industries and Bicycles my start manufacturing desk furniture.

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