

# **PREDICTING FINANCIAL DISTRESS OF PUBLIC COMPANIES LISTED IN AMMAN STOCK EXCHANGE**

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## **Abstract**

This study investigates the role of a set of financial ratios in predicting financial distress of publicly listed companies in Jordan. Using Logistic Regression and Discriminant Analysis a comparison has been made between the two models to determine which is more appropriate to use as well as which of the financial ratios are statistically significant in predicting the financial distress of Jordanian companies. During the period 2007 to 2011, the results show that both logistic regression and discriminant analysis can predict financial distress, and that Return on Equity (ROE) and Return on Assets (ROA) are the most important two financial ratios, which help in predicting the financial distress of public companies listed in Amman stock Exchange.

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**Keywords:** Financial Distress, Public Companies, Stock Exchange

## **1. Introduction:**

Most economies around the world suffered a setback and financial disasters due to the outbreak of the global financial crisis in 2008. This crisis has led to the bankruptcy of several publicly listed companies in the United States, Europe, Asia and other countries. As a result, economists, financial analysts and researchers debated the continuity of some companies and their ability to survive the financial crisis and, therefore, leading to the emergence of great

interest to find the best methods and financial indicators that can help in the prediction of financial distress companies.

As an emerging market, Amman stock Exchange has also suffered from the global financial crisis of 2008. Although the listing activity of public companies increased dramatically during the period prior to the global financial crisis but the loss of trust in the investment activity coupled with the bad performance of the economy have contributed to the great losses in value of public companies in Jordan after 2008. As a result, it appears to be worthy to provide a research into what financial ratios and statistical models that can be used to predict accurately financially distressed companies in Amman stock Exchange after the global financial crisis. Therefore, this research will attempt to answer two important questions:

1. Can financial ratios predict financial distress of Jordanian public companies, and if so which of these ratios are more statistically significant in explaining financial failure; and
2. Does the application of discriminant analysis provide a better method for predicting financial failure of Jordanian companies compared to logistic regression; and

## **2. Research Value and Objectives:**

This research is valuable particularly as the negative effect of the global financial crisis is still overshadowing financial performance of companies working both within and outside Jordan. Moreover, since financially troubled companies in Jordan are directly linked to the economy, bankruptcy of those companies will inevitably lead to losses for shareholders, employees and to the national economy. Therefore, the use of certain financial ratios and models to predict financial distress could help reduce losses and provide insight into the survival of such companies as well as assist banks and other financial institutions in regards to the assessment of the financial conditions of these companies in case of rescue.

Accordingly this research has many objectives. At first the research attempts to investigate the role of a set of financial ratios (current ratio, current liabilities to fixed assets, current liabilities to equity, working capital to equity, logarithm of total assets, pre- tax profit to total assets, net profit margin, book value per share, return on assets (ROA), return on equity (ROE), dividend per share, after tax profit to working capital, retained earnings to total assets, equity to total assets, equity to total liabilities, debt ratio, total liabilities to equity, long term debt to equity, fixed assets to equity, assets turnover, sales to equity, sales to working capital,

accounts payable turnover and logarithm of total asset turnover) can help predicting the financial failure of companies listed in Amman stock Exchange before it occurs.

Furthermore, the research seeks to use two methods in forecasting financial distress of public companies in Jordan, namely; discriminant analysis and logistic regression. The results of both methods will also be compared to decide which is more suitable in predicting financial distress.

### **3. Research Hypotheses**

To accomplish the research objectives the following hypotheses have been tested throughout the research:

1. The pre-decided set of financial ratios cannot predict financial distress of public Jordanian companies before it occurs.

2. There is no substantial difference between using discriminant analysis or logistic regression in predicting financial distress in Amman stock Exchange.

3. The pre-decided set of financial ratios can predict financial distress of public Jordanian companies when using discriminant analysis and logistic regression.

### **4. Previous Research:**

Altman (1968) was the first multivariate study to predict financial distress. The research employed 22 financial ratios to compare between 33 failed companies and 33 successful companies. Altman used multivariate discriminant analysis to develop a model to predict bankruptcy; namely, the “Z-score” model which predicts bankruptcy if the company’s score fell within a certain range. The results showed that five ratios, namely, working capital to total assets, retained earnings to total assets, profit before interest and tax to total assets, market value of equity to book value of total debt and sales to total assets can predict financial failure up to 95% in the first year, and then the prediction rate decreases to 36% in the fifth year before the failure.

In a similar paper Altman, Haldeman, and Narayanan (1977) studied 53 bankrupt companies and a matched sample of 58 non-bankrupt companies throughout 1969 to 1975 period. Using 28 financial ratios and two statistical methods (discriminant and squared

discriminant analysis), the results showed that both models have the ability to predict bankrupt and non-bankrupt companies up to 92.8% in the year proceeding financial failure.

Sharma and Mahajan (1980) study developed a failure process model to predict business failure over the five-year period prior to the actual failure. The sample consisted of 23 failed companies and 23 successful companies during the period 1967-1970.

Mensah (1983) intended to predict failure 2 to 5 years before it occurs (the year proceeding failure was excluded considering that it was pointless to try to predict the failure by one year only as it would not be enough to take corrective actions). The sample consisted of 11 financially distressed companies and 35 successful companies for the period 1975 to 1978. The results showed that the percentage of error of forecasting in the second year before failure was only 3.3%, reflecting the ability of the model to predict financial distress two years before it occurs.

Using discriminant analysis Fulmer, Moon, Gavin and Erwin (1984) used step-wise multiple discriminate analysis to evaluate 40 financial ratios applied to a sample of 60 companies; 30 failed and 30 successful. This model was different as it focused on small firms. The research reported a 98% accuracy rate in classifying the tested companies one year prior to failure and 81% accuracy more than one year prior to bankruptcy.

Zavgren (1985) research used 7 financial ratios and logistic regression utilizing data from 45 failed companies and 45 successful companies. Results showed that of the model's accuracy in predicting failure reached up to 99%.

Altman and Franco Varetto (1994) compared the performance of the linear discriminant analysis and neural networks used in previous studies to predict failure. To test and compare the models financial information on 1000 Italian companies were used for the period 1982 to 1992. The results indicated that both types of diagnostic techniques displayed acceptable accuracy rate over 90%.

More recently Altman (2002) re-examined Altman (1968) Z-Score using three samples: 68 failed companies during the period 1969-1975, 110 failed companies during the period 1976-1995, and 120 failed companies during the period 1997-1999. The study concluded that the accuracy of the discriminant model ranges from 82% to 94% in the first year before financial distress, while in the second year the accuracy of the model decreases to a range between 68% and 75%.

In a relevant study, Ginoglou, and Agorastos (2002) used 16 financial ratio for 20 failed companies and 20 successful companies listed in the Greek Stock Exchange for period 1981-1985. The study used linear probability model, logit probit and discriminant analysis models to report that the three models' prediction rate range of 75%-85% for failed companies and 95%-100% for successful companies.

Charitou, Neophytou and Charalambous (2004) examined the incremental information content of operating cash flows in predicting financial distress in UK. Using neural networks and logit methodology on a matched pair of 51 failed and non-failed UK public over the period 1988-97, the results indicated that a model includes, a cash flow, profitability and a financial leverage variable produced an overall classification accuracy of 83% one year prior to the failure.

In the Middle East there are many studies that looked predicting financial failure. For example, Khamis (1989) used discriminant analysis on data from 46 public listed companies in Oman chosen on the basis of the rate of return on investment and Treynor index. Results indicated that the model is more accurate when based on a rate of return on investment shown by the rate of accuracy of the model in the first year which reached 91% and the second year of 81%.

Al-hindy (1991) used discriminant analysis and 6 financial ratios to build a model that predicts the full erosion of capital of public industrial enterprises in Egypt. The results showed that the accuracy of the model applied in forecasting financial distress reached 99.9% in the four years before the financial failure occurs, and 90% in the fifth year before the failure.

In a more recent study, Alrajaby (2006) study aimed at building a statistical model to predict financial failure of listed companies in Oman through the use of 25 financial ratios on 26 pairs of successful and failed companies during the period 1991-2002. This study used both discriminant analysis and logistic regression to find that both models can predict accurately corporate failure one year before it occurs (with a prediction rate of 96%).

## **5. Sample, Data and Methodology**

This research is based on the study of Alrajaby (2006) and uses a similar methodology. Data used throughout the research is obtained from published annual reports of all publicly listed companies in Amman Stock Exchange that are traded on regular basis during the period 2007 to

2011 and excluding financial and insurance companies. Insurance and financial companies are excluded from the sample due to the high leverage of these companies.

Following Altman, Haldeman, and Narayanan (1977) and Alrajaby (2006), successful and failed companies are classification based on average earnings per share during the study period. Specifically, the company is considered to be in financial distress if average earnings per share for the company is less than one and successful if average earnings per share is greater than one. Using this criteria 38 companies are considered successful with average earnings per share for the whole sample of 3.66 and 18 companies are considered distressed average earnings per share for the whole sample of -0.0028.

In order to attain the research objectives, univariate, multiple discriminate analysis and logistic regression are used to together with 24 ratios obtained from previous research and expected to predict financial distress of listed companies in Amman Stock Exchange after the global financial crisis. Table (1) shows variables definition.

**Table (1): Definitions of Independent Variables**

<b>Variable's Code</b>	<b>Variable's Calculations</b>
L1	Current Ratio = current assets/current liabilities
L2	Current liabilities to total fixed assets
L3	Current liabilities to equity
L4	Working capital to equity
L5	Logarithm of total assets
L6	Pre- tax profit to total assets
L7	Net profit margin = profit after tax/sales
L8	Book value per share = equity/number of shares outstanding
L9	Return on assets (ROA) = profit after tax/total assets
L10	Return on equity (ROE) = profit after tax/equity
L11	Dividend per share = dividends/number of shares outstanding
L12	after tax profit to working capital
L13	Retained earnings to total assets
L14	Equity to total assets
L15	Equity to total liabilities
L16	Debt ratio = total liabilities/total assets
L17	Debt to equity = total liabilities/equity
L18	Long-term debt ratio to equity
L19	Fixed assets to equity
L20	Asset turnover = sales/total assets
L21	Sales to equity
L22	Sales to working capital
L23	Receivables turnover = sales/average accounts receivable turnover of debtors (beginning + ending balances/2)
L24	Logarithm of asset turnover= log (sales/total assets)

## 6. Research Results

To test the first hypothesis univariate analysis, discriminant analysis and logistic regression are used. Table (2) shows mean, standard deviation, T test for difference between means and T significance of the research variables classified by successful and distressed companies. Results of the univariate analysis indicate that there are 7 statistically significant financial ratios that can discriminate between successful and distressed companies; namely, return on assets (ROA), return on equity (ROE), dividends per share, retained earnings to total assets, fixed assets to equity, assets turnover and sales to equity. The results of univariate are in line with results reported in previous research (for example, those reported by Altman, Haldeman, and Narayanan (1977) and Alrajaby (2006)).

**Table (2) Mean, Standard Deviation, T Test and T Significance of Research Variables Classified by Successful and Distressed Companies Listed in Amman Stock Exchange**

Code	Variables	Successful Companies		Distress Companies		T Test	Sig.
		Mean	S.D	Mean	S.D		
L1	Current Ratio	2.73	1.96	3.30	2.64	-0.90	0.37
L2	Current liabilities to total fixed assets	1.14	2.06	84.14	315.17	-1.64	0.10
L3	Current liabilities to equity	0.48	0.59	0.23	0.15	1.73	0.09
L4	Working capital to equity	0.23	0.32	0.19	0.15	0.51	0.61
L5	Logarithm of total assets	5.82	1.07	5.47	1.62	0.96	0.34
L6	Pre- tax profit to total assets	0.16	0.20	0.10	0.41	0.67	0.50
L7	Net profit margin	2.00	10.14	-1.97	5.64	1.55	0.12
L8	Book value per share	39.25	99.19	12.20	5.92	1.15	0.25
L9	Return on assets (ROA)	0.12	0.09	0.01	0.05	4.94	0.00*

L10	Return on equity (ROE)	0.18	0.13	0.00	0.07	5.49	0.00*
L11	Dividend per share	2.13	2.21	0.14	0.36	3.79	0.00*
L12	after tax profit to working capital	-1.31	7.87	-0.67	1.37	-0.34	0.73
L13	Retained earnings/total assets	0.13	0.12	-0.07	0.22	4.19	0.00*
L14	Equity to total assets	0.72	0.36	0.75	0.13	-0.34	0.73
L15	Equity to total liabilities	5.63	8.41	16.17	39.89	-1.57	0.12
L16	Debt ratio	0.29	0.19	0.23	0.11	1.17	0.24
L17	Debt to equity	0.66	0.79	0.42	0.38	1.22	0.23
L18	Long-term debt ratio to equity	0.17	0.28	0.15	0.31	0.27	0.78
L19	Fixed assets to equity	0.68	0.50	0.41	0.29	2.13	0.03*
L20	Asset turnover	0.58	0.53	0.29	0.32	2.15	0.03*
L21	Sales to equity	1.04	1.10	0.42	0.47	2.30	0.02*
L22	Sales to working capital	0.86	11.34	0.30	5.15	0.20	0.84
L23	Receivables turnover	17.04	95.98	10.27	12.09	0.77	0.44
L24	Logarithm of asset turnover	0.91	0.14	0.84	0.12	1.78	0.08

\* Significant at the 5% level

Equation (1) shows the results using discriminant analysis for the period 2007-2011. The model shows that ROE, fixed assets to equity, retained earnings to total assets and pre-tax profit to total assets are the most significant variables that discriminate successful and distress companies listed in Amman Stock Exchange. Chi-square value of the model is 35.22 (significant at the 1% level) which shows the statistical significance between the dependent and independent variables. Moreover the Canonical Correlation is 0.70 which emphasises the strong relationship between both dependant and independent variables.

$$DN = 0.69L10 + 0.62L19 + 0.57L13 + 0.51L6 \quad (1)$$

where DN is a discriminatory number

Equation (2) shows results obtained from using a logistic regression model. The logistic function includes the dependent variable P which represents the probability of a financially distressed company. If the value of the calculated P is greater than 50% then the company is financial distress while if the value of the calculated P is less than 50% then the company is successful.

The coefficients indicate that pre-tax profit to total assets, ROA and fixed assets to equity are the most ratios that can predict the dependent variable.

$$LN (P/ (1-P)) = 229.04 + 608.16 L6 - 2615.15L10 - 288.21L19 \quad (2)$$

where P is the probability that a company is financially distressed

Based on the results obtained earlier it can be noted that the first hypothesis can be rejected. The foregoing leads us to reject the first premise of the study.

To test the second hypothesis this research will use the accuracy of prediction of discriminant analysis versus logistic regression. Table (3) and Table (4) show the results of both models' accuracy rate.

Table (3) shows that the prediction's accuracy of discriminant analysis of successful companies is 84.2% that of financially distressed companies is 83.3%. It should be noted, however, that the closeness of results obtained throughout each year of the study period from the model is probably due average dividends as dependent variable. Moreover, the results obtained from the model have less accuracy in predicting financial failure compared to other international studies.

**Table (3) Prediction's Accuracy From Using Discriminant Analysis**

Year	Financial Status	Number of Companies	Company's Projected Group	
			Successful	Distressed
2007	Successful	38	32	6
			84.2%	15.8%
	Distressed	18	3	15
			16.7%	83.3%
2008	Successful	38	32	6
			84.2%	15.8%
	Distressed	18	3	15
			16.7%	83.3%
2009	Successful	38	32	6
			84.2%	15.8%
	Distressed	18	3	15
			16.7%	83.3%
2010	Successful	38	32	6
			84.2%	15.8%
	Distressed	18	3	15
			16.7%	83.3%
2011	Successful	38	32	6
			84.2%	15.8%
	Distressed	18	3	15
			16.7%	83.3%

Table (4) shows prediction's accuracy using logistic regression. The prediction's accuracy of the model of is similar to that obtained from using discriminant analysis. Specifically prediction's rate of successful companies is 84.2% and 83.3% for financially distressed companies. This result is close to the results reported in Charalambous, C., Neophytou, E., and A. Charitou (2004).

**Table (4) Prediction's Accuracy from Using Logistic Regression Model**

Year	Financial Status	Number of Companies	Company's Projected Group	
			Successful	Distressed
2007	Successful	38	32	6
			84.2%	15.8%
	Distressed	18	3	15
			16.7%	83.3%
2008	Successful	38	32	6
			84.2%	15.8%
	Distressed	18	3	15
			16.7%	83.3%
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2010	Successful	38	32	6
			84.2%	15.8%
	Distressed	18	3	15
			16.7%	83.3%
2011	Successful	38	32	6
			84.2%	15.8%
	Distressed	18	3	15
			16.7%	83.3%

Results in Table (3) and Table (4) illustrate that prediction's accuracy using discriminant analysis and logistic regression of financially distressed companies listed in Amman stock Exchange is 83.3% which leads to the rejection of the second hypothesis of this research.

To test the final hypothesis, discriminant analysis and logistic regression are used with the pre-decided financial ratios that can be used to distinguish between successful and unsuccessful companies listed in Amman stock Exchange.

Table (5) presents the most statistically significant financial ratios used in distinguishing distressed from successful companies in Amman Stock Exchange using discriminant analysis.

The table shows that during the year 2007 of the 24 ratios only current liabilities to total fixed assets, current liabilities to equity and ROE are the variables that statistically influence the identification of successful and distressed companies. In the second year of study; 2008, the only ratio that appears to be statistically significant in discriminating successful companies from failed companies is ROE. In the year 2009, current liabilities to equity and pre- tax profit to total assets are the most important ratios between all ratios used. In 2010, two ratios shown to be important from discriminant analysis, namely, pre- tax profit to total assets and retained earnings/total assets. Finally in the year 2011 the results show that pre- tax profit to total assets, ROE, retained earnings/total assets and fixed assets to equity are the only ratios that are statistically significant in the discriminant analysis model.

**Table (5) Financial Ratios that are Statistically Significant within the Discriminant Analysis in Identifying Successful and Distressed Companies during the Study Period**

Variable	2007	2008	2009	2010	2011
L2	0.74*				
L3	0.65*		0.56*		
L6			0.63*	0.65*	0.51*
L10	0.74*	0.74*			0.69*
L13				0.73*	0.57*
L19					0.62*

\* Significant at the 1% level

Table (6) shows that set of ratios from the 24 ratios used in the research that help in identifying successful companies and distressed companies within a logistic regression framework. In 2007, four financial ratios are found to predict financially distressed companies, namely, working capital to equity, ROE, retained earnings to total assets and sales to equity. Results obtained in the year 2008 show that ROE is the only ratio that is statistically significant in the logistic regression. In 2009 the results of the analysis show two financial ratios as statistically significant; current liabilities to equity and ROE. In 2010 current ratio, pre- tax profit

to total assets and equity to total liabilities are the most statistically significant variable. Finally in the year 2011, pre- tax profit to total assets, ROE and fixed assets to equity are statistically significant in predicting financially distressed companies listed in Amman Stock Exchange.

**Table (6) Financial Ratios that are Statistically Significant within the Logistic Regression in Identifying Successful and Distressed Companies during the Study Period**

Year	2007	2008	2009	2010	2011
	Coefficient				
<b>Constant</b>	-345.35*	-42.02*	154.75*	-163.39*	-311.53*
<b>X1</b>				83.60*	
<b>X3</b>			-28.18*		
<b>X4</b>	301.34*				
<b>X6</b>				12.10*	8.24*
<b>X10</b>		15.02*	4.01*		37.97*
<b>X13</b>					
<b>X15</b>				1.94*	
<b>X19</b>					8.24*
<b>X21</b>					3.9

\* Significant at the 1% level

Table (7) shows statistically significant ratios that predict financial failure in Amman Stock Exchange and are common among study years and both discriminant Analysis and logistic regression. From the table it appears that that ROE, pre- tax profit to total assets, current liabilities to equity, retained earnings to total assets and fixed assets to equity can predict financial distress using the two types of analysis and appear statistically significant during one year ore more of the study period. However, its appears that within the five-year period of study the strongest variable that distinguishes successful companies from financially failed companies is return on equity (ROE).

**Table (7) Statistically Significant Financial Ratios Obtained from Discriminant Analysis and Logistic Regression and Their Frequency throughout Study Years**

<b>Variable's Code</b>	<b>Variable</b>	<b>Frequency of Results Obtained from Discriminant Analysis Throughout Study Years</b>	<b>Frequency of Results Obtained from Logistic Regression Throughout Study Years</b>
<b>L1</b>	<b>Current Ratio</b>		1
<b>L2</b>	<b>Current liabilities to total fixed assets</b>	1	
<b>L3</b>	<b>Current liabilities to equity</b>	2	1
<b>L4</b>	<b>Working capital to equity</b>		1
<b>L6</b>	<b>Pre- tax profit to total assets</b>	3	2
<b>L10</b>	<b>ROE</b>	3	4
<b>L13</b>	<b>Retained earnings to total assets</b>	2	1
<b>L15</b>	<b>Equity to total liabilities</b>		1
<b>L19</b>	<b>Fixed assets to equity</b>	1	1
<b>L21</b>	<b>Sales to equity</b>		1

## **7. Conclusion and Recommendation of the Research**

This research is an attempt to study the role of a set of financial ratios in predicting financial distress of publicly listed companies in Amman Stock Exchange. During the period 2007 to 2011 and using logistic regression and discriminant analysis the results show that Return on Equity (ROE), Return on Assets (ROA) and some other ratios appear to are predict financial distress of public companies in Jordan. The results seem robust and do not change with the model used.

However, further research in this area is needed in order to help investors in the Jordanian market to avoid investment in financially distressed companies and to help management of

financially distressed companies avoid financial distress by making corrective actions long before distress occurs.

### **References:**

Al-Rajaby, M. (2006), “Using Financial Ratios to Predict Failure of Jordanian Public Companies Using Discriminant and Logit Analysis”, Arab Journal of Administrative Sciences, Kuwait University, 13, 149-173.

Altman, E. (1968), “Financial Ratios, Discriminate Analysis and the Prediction of Corporate Bankruptcy”, Journal of Finance, 23, 589-609.

Altman, E. (2002), “Corporate Distress Prediction Model in a Turbulent Economic and Basel II Environment”, Social Science Research Network, NYU Working Paper No.FIN-02-052, 10-16.

Altman, E. and G. Franco Varetto (1994), “Corporate Distress Diagnosis: Comparison Using Linear Discriminant Analysis and Neural Network: (the Italian experience)”, Journal of Banking and Finance, 18, 505-529.

Altman, E., Haldeman, G. and P. Narayanan (1977), “Zeta Analysis: A New Model to Identify Bankruptcy Risk of Corporations”, Journal of Banking and Finance, 1, 29-54.

Charalambous, C., Neophytou, E., and A. Charitou (2004), “Prediction of Corporate Failure: Empirical Evidence for the UK”, European Accounting Review, 13: 465-497.

Fulmer, J., Moon, J., Gavin T. and J. Erwin (1984), “Bankruptcy Classification Model for Small Firms”, Journal of Commercial Bank Lending, 66, 25-37.

Ginoglou, D., and A Konstantinos (2002), “Corporate Failure of Problematic Firms in. Greece with LPM, Logit, Probit and. Discriminant Analysis Models”, Journal of Financial Management and Analysis, 15, 1-15.

Hindi, M. (1991), “Predicting Technical Bankruptcy of Public-sector Companies in Egypt”, The Scientific Magazine of Faculty of Economics, University of Qatar, 2, 59-125.

Khamis, B. (1989), “Using Financial Ratios to Predict High Successful and Low Successful Industrial Companies”, Unpublished MPhil Thesis, University of Jordan, Amman, Jordan.

Mensah, Y. (1983), “The Differential Bankruptcy Predictive Ability of Specific Price Level Adjustments: Some Empirical Evidence”, The Accounting Review, 58, 246-288.

Sharma, S. and V. Mahagan (1980), “Early Warning Indicators of Business Failure” Journal of Marketing, 44, 80-89.

Zavgren, C. (1985), “Assessing the Vulnerability to Failure of American Industrial Firms: A Logistic Analysis”, *Journal of Business Finance and Accounting*, 12, 19-45.