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A Survey of the Capability of Zavgren Bankruptcy Prediction in Determining the Bankruptcy Condition of the Companies Listed in TSE

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ABSTRACT

With the increase of trade volume in TSE and the fluctuations of this market, suitable tools that can predict financial condition of these companies are necessary. To predict the future condition of companies, various models are presented. The present study attempted to evaluate Zavgren model based on the market conditions of TSE in prediction of the bankruptcy of the companies listed in TSE. The results of the test of hypothesis showed that adjusted Zavgren model classified the companies into s successful and unsuccessful groups.
KEYWORDS: Bankruptcy prediction; Zavgren model; TSE

INTRODUCTION

One of the very important quality variables that should be observed in presenting the financial statements is activity continuance. The companies with various degrees of continuance power of activity are present in the market and are active. To turn quality variable of activity continuance to quantity variable and ranking the companies based on relative power of their activities and the effect of various factors and parameters affecting the relative power of the continuance of the activity of companies, are considered in the form of models and their performance is evaluated. One of the models is the conditional model presented by Zavgren (2001). The present study aimed to creative ability and for assurance of investors and creditors to determine the continuance of activity and identification of the accuracy value of Zavgren model, based on main ratios and coefficients.

REVIEW OF LITERATURE

The literature on relationship between financial ratios and bankruptcy prediction and continuing the activity and prediction capability of financial ratios date back to many years ago. The first empirical study was done by William Bior (1966) (Akbari and Ali Madda, 2000). The studies of Bior led to a model that is called uni-variate model. Bior in 1966 selected a set including 30 financial ratios that is the best ratios for evaluation of the health of a company and controlled the model based on four principles:

1- The net cash income of a company reduces bankruptcy probability.
2- The high net cash flow arising from the company activity in market lowers bankruptcy probability.
3- The high debt for each country increases their bankruptcy probability.
4- The required high cash revenue to operational costs increases the bankruptcy probability.

In these researches, he found that prediction reliability of each of the ratios is different. Also, the bankrupt companies not only have low cash flows than non-bankrupt companies, they have low cash revenue storage. He found that although bankrupt companies have low capital to cover their obligations they intend to get more loan than other non-bankrupt companies.

Bior in his study found that value of each ratio in reliability of the classification of the companies depends upon the bankrupt and non-bankrupt companies and the low classification error shows high value of each ratio (Safari, 2002).

After it was found Bior model is not a good criterion to predict bankruptcy due to some reasons as uni-variate variable, the researchers applied multi-variate models to predict bankruptcy and determining continuance or non-continuance of activity (Harunkalayi and Kadkhodayi, 2003).

Altman model is one of the most important models presented to evaluate the continuance of activity and bankruptcy prediction. Altman (2007) determined a model via multiple audit analysis and among 22 financial ratios

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to predict bankruptcy and 5 ratios were selected as combined as the best bankruptcy prediction. 5 Combined ratios were solvency, leverage profitability, flexibility and activity. His model was as followings:

$Z=1.1x_1+1.4x_2+3.3x_3+0.6x_4+0.99x_5$

X1=(working capital)/(Total asset)

X_2=(Retained earnings)/ Total asset

X3=Income before interest and tax (EBIT)/ total asset

X_4= Stock market evaluation/ Book value of debt

X_5=Total sale/Total asset

In this model, if calculated Z is smaller than 1.81, the company is bankrupt and if it is ranging 1.81, 2.675, the company is in bankruptcy area and if it is bigger than 2.675, its bankruptcy probability is very low. Altman to test his model applied 66 companies including 33 bankrupt companies and 33 normal companies. The success of his model was 95%.

Altman (1983) revised the model and presented a new model called Z'. The most obvious Altman revision is substitution of stock book value with its market value and changing the coefficients and model bankruptcy areas.

$$Z' = 0.717X_1 + 0.847X_2 + 3.1X_3 + 0.42X_4 + 0.998X_5$$

In this model, if the calculated value for the firms is less than 1.33, bankruptcy probability of the company is very high and if it is ranging 1.33, 2.9, the company is in bankruptcy area and it is possible and if Z' of company is greater than 2.9, bankruptcy probability of the firm is very low. Altman to test the revised model applied the sample with 33 bankrupt companies and 33 active companies.

In this test, the first type accuracy is lowered a little (91% to 94%) but the second type accuracy is remained as 97%.

Springate model (1987): The initial idea of this model was developed for the first time in Simon Frizer University by Gordon L.V. Springate. Like Altman, he applied audit analysis to select 4 financial ratios among 19 ratios as the best ratios to identify the healthy bankrupt companies.

Z=1.3A+3.07B+0.66C+0.4D

A= working capital/Total asset

B=Total asset/ specific earnings before tax and interest

C= Current debt/Specific earnings before tax

D= Total asset/Sale

If Z= 0.862, the company is bankrupt.

Springate tested this model by 40 companies and was faced with considerable result of 92.5%. In 1979, Batrace 2 applied Springate model for 50 companies and achieved accuracy rate 95%. In 1980, Sandsen 3 by 24 companies investigated the model and supported the accuracy of model with 89%.[*]

Zavgren model (2001)

The model formulated by Christian Zavgren applying Lofit statistical analysis is briefly as:

y = 0.238830,108 –0.108 x1 – 1.583x2 – 10.78x3 + 3.074x4 + 0.486x5 – 4.35x6 – 0.11x7

The independent Zavgren model variables are as:

x_1: Average invoices to sale

x2 :Average received accounts to average invoices

x3 Sum (cash invoice + Short-term investment) to total asset

x4 :Quick assets to current debts

x5 Operating earnings to (total asset-current debt)

x6 Long-term debt (Total asset-current debt)

x7 :Sale to (fixed asset + net working capital)

Bankruptcy probability $=1/(1+ e^{-Y})$

Application of logit model requires four stages:

First stage: A series of financial ratios are calculated in which in Zavgren prediction model, seven ratios are calculated.

Second stage: The result of each of the ratios in coefficients of each country is dedicated to that country and to calculate its coefficients in each country, Logit statistical analysis similar to regression analysis is used.

Third stage: The product of ratios by their coefficients is added and y is obtained.

Fourth stage: To calculate bankruptcy probability, we put company y in $1/(1+ e^{-Y})$ formula and bankruptcy probability of each company as a unique number is obtained.

[*] Sands. earl Gordon,(1984),Business failure prediction, journal of commercial bank lending,(july),pp25-37

In the required model, some variables with negative coefficients increase bankruptcy probability as E^{-Y} is reduced.

The variables with positive coefficients reduce bankruptcy probability as E^{-Y} is approached to "1". The output of the model that is the bankruptcy probability of the company is ranging 0 to 1. The greater this value and close to one, the more the bankruptcy probability of the company and vice versa. The smaller the value and close to 0, the lower bankruptcy probability for the company. Zavgren by financial statements of normal bankrupt companies calculated the coefficients of his model for five years. He considered bankrupt companies of 1980 and computed the coefficients of his model for five subsequent years 1975 to 1979. Then, based on the coefficients, the bankruptcy probability of a bankrupt company was evaluated and it was observed that during 1975 to 1979, company bankruptcy probability was ascending. Then, the changes of bankruptcy probability of the mentioned company with the stock price trend of the company during that years and it was observed that at the same time with the ascending trend of company bankruptcy probability, stock price was descending and it was reduced with the increase of bankruptcy probability.

As in Zavgren model, the normality of the population is not considered, it is close to reality and Altman model is applied in most of the populations with various conditions based on the assumption by which the model is formulated. One of the problems of it is that in Zavgren model, due to the unreliability to normality assumption, variables distribution and model ratios and direct use of non-parametric statistics analysis and Logit model to find the ratios coefficients and prediction model variables compared to the audit analysis models as Altman model, the calculated coefficients of the variables had low correlation.

Faghani Narm (2001), Rostami (2002) and Safari (2002)

In their research with titles "the relationship between financial ratios and bankruptcy prediction", "the relationship between relative ability of activity continuance and P/E ratio in evaluation of companies" and "relationship between financial ratios and continuance of companies activity" found that there is a significant association between financial ratios based on accruals and companies activity continuance. They applied z-score (Altman), Zavgren and multiple Discriminant analysis method (Discriminant analysis method) of logit model series in their analysis

Nabavi et al., (2010)

Nabavi et al., (2010) in a study « prediction of bankruptcy of companies by Logit model » presented a model for prediction of bankruptcy in the companies listed in TSE. To design the model, at first 9 financial ratios were used. Based on the study results, Logit model with defined explanatory variables had the highest prediction power to companies bankruptcy in Iran. Prediction accuracy of the model for bankruptcy year was 87.5% and for the year before bankruptcy was 72.5% and for two years before was 52.5%.

Ghodrati and Manavi Moghadam (2010)

Ghodrati and Manavi Moghadam (2010) in a study titled the investigation of the accuracy of bankruptcy prediction models in stock market found that Zmijewsky, Springate, CA score, Farajzade genetics, McKee Genetic Models had suitable prediction ability than other models.

Research purpose

The investors always are concerned about the return of the original and profit of their capitals. This mental concern obliged the pioneers of accounting and financial researchers search to present the models that can predict the ability of paying profit and activities continuance of companies as reliable and measurable and these searches led to presenting different types of bankruptcy prediction models. One of the models is Zavgren model. The main purpose of the study is the evaluation of the ability of Zavgren bankruptcy prediction in determining the bankruptcy of the companies listed based on the conditions and rules of Iran.

Study hypothesis

Based on the study purpose, the hypothesis is as:

There is a significance association between financial ratios based on Zavgren model with the bankruptcy of the companies listed in TSE.

STUDY METHODOLOGY

The present study purpose based on the problem and its purpose was applied as it is guided to the practical application of knowledge. The present study was descriptive in terms of performance (non-experiment). As the

significance relation between financial ratios in Zavgren model with activity continuance, describing the present study is correlation. The aim of predicting the quality variable of activity continuance (independent variable) is determined via financial ratios (dependent variables) in Zavgren model, in this study logit regression analysis is applied.

Study variables

a. Independent variable in the study based on Zavgren model is including the financial ratios applied in this model.

b. In Zavgren model, a dependent quality variable is activity continuance showing the bankrupt and non-bankrupt condition (with activity continuance) of the companies.

Study population and study sample

The study population of the present study is including all the companies listed in TSE during 2005-2011. Some of the common features of these companies by the researcher to determine study population are:

a. They are listed in TSE before 2005
b. Presented their financial statements during 2005-2011 to the stock market.
c. The end of their fiscal year is the end of Esfand of each year.
d. During the mentioned financial years, no activity or fiscal year is changed.
e. The required information to calculate the study variables are in the studied years.
f. There is no trade stopping more than 70 days.

The sampling method in this study was systematic selection. To select the bankrupt companies based on article 141 of commerce code, it is assumed that the bankrupt company is the one its retained loss is more than 50% of capital but as we can not consider the company that is bankrupt legally, it is considered bankrupt from content or nature levels, thus, the company was considered bankrupt with at least 2 subsequent retained loss of more than 50% of capital. The first year, this was happened, it is considered as bankruptcy year. It can be said that the companies with 2 years of above feature but they were excluded later of this legal article, they are excluded of the sample companies. Based on the limitations, 258 companies among companies listed in TSE were selected as sample and by considering the time period 7 years 2005-2011, totally 1150 companies were investigated.

Data collection

For data collection, library method was used and for collection of other required data, audited financial statements and notes of the companies listed in TSE were applied. Also, the site of TSE and Tadbirpardaz company software were used.

Hypotheses test

The main steps in hypotheses test are as followings:

First step: The calculation of financial ratios by Excel software

Second step: To test the hypotheses of logit statistical method of SPSS software was applied. In regression method, activity stopping logit is considered as dependent variable and two groups of companies are considered as activity continuance (successful) and activity stopping (unsuccessful) are its components (Gojarati, 1992, 517).

Regression is done by three methods of enter, forward and backward and in this study, backward method is used. In this method, at first all the independent variables entered the equation and the effect of all the variables on dependent variable was evaluated and gradually, weaker and less effective variables excluded from the equation and finally these stages continued as the significance test error achieved 10%. The backward method is also called screening method. In this method, adjusted R2 is increased with the reduction of independent variables as with the exclusion of some of the variables, this value is maximized but their exclusion is reduced again. In this case, important variables are recognized and are remained in the equation. Chi-square test in logistic regression analysis showed that the variable or independent variables had effect ton dependent variable or not. If significance level of chi-square is lower than 0.05, at least one of the independent variables affect the dependent variable.

THE STUDY RESULTS

Zavgren model and its independent variables are as:

$Y = 23883/0 – 108/0x_1 - 583/1x_2 - 78/10x_3 + 074/3x_4 + 486/0x_5 - 35/4x_6 - 11/0x_7$

x1= Average invoices to sale

x2= Average received accounts to average invoices

x3= Sum(cash invoice+ short-term investment) to total assets

x4= Quick assets to current debts
x5= Operating earnings to (total asset –current debt)
x6= Long-term debt to (total asset –current debt)
x7= Sale to (fixed asset+ net working capital)
(Data of x6 variable were not complete and were not applied in logistic regression analysis)

In the following table, chi-square test of Zavgren model is shown. As it was said, chi-square of the model showed that the variable or independent variables had any effect on dependent variable or not. Chi-square of the model was 160.194 and its sig was lower than 5%. Thus, independent variables had effect on dependent variable. In the following table, to analyze, the final stage (fifth) and significance level of the row are considered.

Table 1- Chi-square test

		Chi-square	Degree of freedom	Significance level
Stage 1	Step	164.297	6	.000
	Blok	164.297	6	.000
	Model	164.297	6	.000
Stage 2	Step	-.007	1	.933
	Block	164.290	5	.000
	Model	164.290	5	.000
Stage 3	Step	-.032	1	.857
	Block	164.258	4	.000
	Model	164.258	4	.000
Stage 4	Step	-.031	1	.861
	Blok	164.227	3	.000
	Model	164.227	3	.000
Stage 5	Step	-4.033	1	.045
	Block	160.194	2	.000
	Model	160.194	2	.000

The following Table showed that prediction model predicted 0.6% of the bankrupt companies and 100% of the successful companies accurately and generally the accuracy of the model prediction was 88.4%. This can be said that to classify the predicted dependent variable with cutting value 0.5 was compared and classification was done.

Table 2- Classification table

	Observed		Predicted		
			Company condition		Accuracy percent
			Bankrupt	Successful	
Stage 1	Condition of company	Bankrupt	1	156	.6
		Successful	0	1186	100.0
	Total percent				88.4
Stage 2	Condition of company	Bankrupt	1	156	.6
		Successful	0	1186	100.0
	Total percent				88.4
Stage 3	Condition of company	Bankrupt	1	156	.6
		Successful	0	1186	100.0
	Total percent				88.4
Stage 4	Condition of company	Bankrupt	1	156	.6
		Successful	0	1186	100.0
	Total percent				88.4
Stage 5	Condition of company	Bankrupt	1	156	.6
		Successful	0	1186	100.0
	Total prediction accuracy				88.4

In the next table, the entered variables in the model and Wald test results were shown. Based on Wald test, the significance level of each of the independent variables is lower than 0.5 to be significance in regression line. Indeed, Wald test shows which variables have significant effect on dependent variable (company condition). The following table is consisting of some stages and in the first stage, all independent variables entered regression model as their Wald statistics significance level is more than 0.05 and due to the lack of significance, they were excluded from regression line and these stages are repeated as all the variables stay in regression line and all are significant. Thus, we should consider the final stage.

Table 3- The existing variables in regression line

		β coefficient	SD	Wald	Degree of freedom	Significance level	Exp(B)
Stage 1	**x1**	-.032	.019	2.877	1	.090	.969
	x2	.036	.037	.908	1	.341	1.036
	x3	-.020	.098	.042	1	.837	.980
	x4	3.055	.307	98.739	1	.000	21.215
	x5	.000	.005	.007	1	.932	1.000
	x7	.000	.001	.031	1	.860	1.000
	Constant	.290	.159	3.346	1	.067	1.337
Stage 2	**x1**	-.032	.019	2.881	1	.090	.969
	x2	.036	.037	.908	1	.341	1.036
	x3	-.020	.098	.042	1	.838	.980
	x4	3.055	.307	98.810	1	.000	21.227
	x7	.000	.001	.031	1	.860	1.000
	Constant	.290	.158	3.339	1	.068	1.336
Stage 3	**x1**	-.032	.019	2.889	1	.089	.969
	x2	.036	.037	.908	1	.341	1.036
	x3	-.020	.098	.042	1	.838	.980
	x4	3.053	.307	98.855	1	.000	21.179
	Constant	.292	.158	3.418	1	.064	1.339
Stage 4	**x1**	-.032	.019	2.881	1	.090	.969
	x2	.036	.037	.907	1	.341	1.036
	x4	3.052	.307	98.747	1	.000	21.165
	Constant	.291	.158	3.387	1	.066	1.337
Stage 5	**x1**	-.034	.019	3.204	1	.073	.967
	x4	3.117	.305	104.756	1	.000	22.576
	Constant	.314	.156	4.054	1	.044	1.369

The results of the above Table showed that among all independent variables of Zavgren model, only x4 was significant at regression line (significance level lower than 0.05) and other variables due to the lack of significance (significance level more than 0.05) were excluded in regression equation. Thus, general model of logistic regression is as followings:

$$\ln(\frac{p}{1-p}) = .304 + 3.117(X\ 4)$$

CONCLUSION

Based on the fitted model of Zavgren model in this study:

$$\ln(\frac{p}{1-p}) = .304 + 3.117(X\ 4)$$

It can be concluded that Zavgren model for the successful companies in 100% and bankrupt companies in 60% correct answers were given. Generally, prediction accuracy of the model was 88.4%. Thus, H1 is supported, in other words, there is a significant relation between financial ratios based on Zavgren model and continuance of the activities of companies listed in TSE. Thus, (Hajiha, Qaemmaghami, 2012) in the investigation of the role of conservative accounting in reduction of bankruptcy risk of the company some evidences of Iran capital market based on Zavgren bankruptcy model, there was an association between accounting conservatism and companies bankruptcy risk base don Zavgren model.

Based on the test result, the prediction ability of bankruptcy of final fitted model of Zavgren in this study it is recommended to the investors, banks, government, auditors, managers and other financial information users that to evaluate the condition of companies and decision making to sale and buying, of the company's stock, giving loan, evaluation of the performance and investigation of their activity continuity, the extracted model in this study is applied.

Regarding the successful companies, the successful company is the one their retained earnings to capital are high and in a time period 4 years are not at loss. Based on the activity continuance, in this study, it is assumed that the company with four years of profitability can have activity continuance.

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