



# Comparing predicative power of foreign adjusted bankruptcy through providing proposed model of bankruptcy in Iran

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(Communicated by Javad Vahidi)

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## Abstract

The aim of the present study was to compare productive power of foreign adjusted bankruptcy through providing proposed model of bankruptcy in Iran. This research is applied in terms of purpose and descriptive and correlational in terms of nature which through that bankruptcy models are studied according to the Shumway's hazard model (2001), and in the form of a logit model and accounting are evaluated based on Pourheydari's and Koopayee's model (2010). Accordingly, a sample including 1287 years, the company during 2006 to 2018 has been selected from Tehran Stock Exchange. For statistical hypothesis testing, receiver operating characteristics (ROC) was applied. Receiver operating characteristics is applicable in software like SAS, SPSS, and STATA. The results showed that Shumway's model (2001) provides a more accurate bankruptcy prediction of companies and this is the sign of superiority of the hazard model over classic models.

*Keywords:* Bankruptcy, Financial Crisis, Stock Exchange.

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## 1. Introduction

The recent financial crisis displayed vulnerability in companies involved in complex business relationships, relationships with financial institutions, and tax obligations etc. The threat of financial epidemic is increasing as long as economic complexity rises. The experience of economic complexity has brought signs of fragile financial stability in numerous companies. These companies respond to

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Received: June 2021 Accepted: July 2021

strong financial shocks that come from outside environment. Even if many studies be assigned to bankruptcy prediction, a general approach that makes a company able to identify business partners in the time of financial crisis has not been recommended. Early warning of the possibility of occurring financial crisis makes managements and investors able to take preventative measures such as changing operational policy, renewing organizational or financial structures or even optional settlement, or by reducing losses it improves social and personal resource allocation [5].

Companies' bankruptcy leads to the waste of resources and lack of exploitation of investment opportunities. Bankruptcy prediction can make companies aware of the financial distress and bankruptcy by designing indexes and proper patterns. The companies would be able to adopt a appreciate policy [13].

Investors and banks do not want to investigate in failing companies. To do so, to predict the bankruptcy of companies is very important. On the other side, because bankruptcy of companies has outcomes and these outcomes impact on employment, policymakers also look for failing companies in order to apply their protection policy to these companies or industries in time [16].

Many of writers assigned their research on bankruptcy [4] and they not only consider focus on the financial status important but also the prediction of future condition highly important. However, in recent years the number of companies that bankrupted has risen in all over the world and due to having more global level and complicated companies that have developed complicated plans in order to keep their real condition surviving it has been challenging to predict companies' bankruptcy and these companies. Likewise, it became very difficult to discriminate between loyal customers and potential swindlers as well [12].

Due to the importance of bankruptcy prediction, in recent years, research and academic associations have tried to provide models that are able to predict financial distress and bankruptcy with more accuracy.

The aim of this research is to compare productive power of foreign adjusted bankruptcy through providing proposed model of bankruptcy in Iran.

## 2. Literature review

Bankruptcy means reject to keep financial commitments [7]. Bankruptcy or financial fail of companies is an unpleasant event which is always billed important. Recently, evidence has shown that companies that face bankruptcy will experience a high decrease in their market capitalization. This fact leaves managers, investors, banks, and financial and credit institutions, and other stakeholders very vulnerable [1]. Bankruptcy usually impacts on the life of many. Boettcher et al [3] claim that bankruptcy normally violates human rights and principle of justice. Two criteria that are used to study the morality of actions. Some authors believe that bankruptcy is a natural cyclic event with cathartic events that makes up the current policies. On contrast, Kirkos [9], knows bankruptcy as a foreign economy and recognizes the attempt for preventing bankruptcy as one of the most important economic engineers' activities. For a right company, bankruptcy of a rival company provides an opportunity through which they can buy the fraction of broken company, reorganize it and sell it to get benefits. Another method has been provided by Boettcher et al [3] which advocates that bankruptcy has been designed in a way that after financial fail provides debtor with another chance and in this case bankruptcy is an option that is more moral and is more efficient.

To this day, various models have been introduced for bankruptcy prediction of companies by researchers and each has achieved some results. From historical dimension, the first attempt to use "financial ratio" for predicting bankruptcy has been done by Paul Fitzpatrick's-prominent American

economist and researcher (1931). But Henry William Biover was the first person whose researches ended up in a model for prediction of bankruptcy [10].

The most effective research about bankruptcy was provided in an article entitled "financial ratio for predicting bankruptcy" by the prominent American economist, Edward I Altman, in 1968. Mostly his article is remembered as a new approach in prediction of bankruptcy [2]. In his study, Altman by using multi discriminant analysis models and financial ratio provided the most famous bankruptcy prediction model.

Ogachi et al [15] have examined appropriate model for company bankruptcy. The results of their study showed that capital flows, total assets, and working capital ratio have positive relationship with bankruptcy. On the other hand, stock turn, debt to equity ratio, debt turnover, debt ratio and current ratio have negative relationship with bankruptcy. Finally, they concluded that stock turn, capital flows, debt to equity ratio, debt turnover, total assets, debt ratio and current ratio, and working capital ratio are the most important ratios for bankruptcy.

Li and Faff [11] examined different bankruptcy approaches and their combinations as well, and they found out that - for big companies with high liquidity - creditors should enhance use of market based information. On the contrary, companies with earnings management and higher accrual earning manipulation that show information asymmetry should take an approach based on accounting ratio. Additionally, use of market based information should increase during financial crisis.

Jia et al [8] studied bankruptcy prediction through systematic risk. The results showed that national systematic risk in bankruptcy risk of comparative study companies, bankruptcy prediction of companies has higher precision comparing to accounting based or market based approaches. This result is more powerful when a given company would have higher stock fluctuations, while comparing to the market is smaller and also has more current liabilities.

Vaziri [17] in a research have studied bankruptcy prediction of companies that included 70 bankrupt companies, 70 non-bankrupt companies during 2010-2018. Using logistic regression model and random jungle as well as through applying selected financial ratios, two models were extracted for predicting bankruptcy. The results showed that random jungle model had unfair advantage over logistic regression model.

### 3. Methodology

This research is applied in terms of purpose and descriptive and correlational in terms of nature by which bankruptcy models are studied through the Shumway's hazard model (2001) that in the form of a logit model describes relation (3.1) – Pourheydari's and Koopayee's accounting model that will be expressed in the relation 3.2.

A. Shumway model (2001):

$$P_{i,t}(Y_{i,t+1}) = \frac{1}{1 + e^{-at - bxi.t}} \quad (3.1)$$

$P_{i,t}$  = is probability of bankruptcy of company  $i$  in year  $t$ . If the company have been bankrupted in next 12 months, 1 is considered as 0.

$X_{i,t}$  = is an independent vector variable, and  $B$  is a column vector of estimated coefficients and  $a$  is intercept.

Shumway's model (2001) includes these independent variables:

$NITA$  = net income total assets

$TLLTA$  = total liabilities total assets

$EXRET$  = equals logarithmic excess return of company to the return exchange stocks of Tehran.

$SIGMA$  = deviation of annualized daily returns three months before portfolio formation.

RSIZE= logarithms of the stock market value of company to market capitalization of total stock of Tehran.

B. Pourheydari and Koopayee accounting model (2010):

$$\begin{aligned}
 P = & 20784/3K1 + 80384/1K2 \\
 & + 61363/1K3 + 50094/0K4 + 16903/0K5 \\
 & + 39709/1K6 + 12505/0K7 + 33849/0K8 + 42363/0K9
 \end{aligned} \tag{3.2}$$

In which:

$P$  is financial crisis of company

$K1$  is earning before property taxes

$K2$  is retained earnings to total assets

$K3$  is working capital to assets

$K4$  is equity to debts

$K5$  is earning before taxes to income

$K6$  is current assets to current debts

$K7$  is net profit margin

$K8$  debts to assets

$K9$  is the size of company (logarithms of net sales)

Separating point: 15.8907

If  $p < 15.8907$ , company has financial crisis if not the company does not experience financial crisis. For testing hypothesis, receiver operating characteristic (ROC) was applied. While ROC is executable via this software; AS, SPSS, and STATA, difference in area under the curve, according to the models correlation, is not executable. To make receiver operating characteristic these phases were done:

1. Probability of bankruptcy of obtained sample companies, the sample were arranged from bigger to smaller ones.
2. According to the number of bankrupt samples 10 to 100 portfolios were formed. In this research due to the lack of the number of samples and bankrupt companies, 10 portfolios were formed.
3. The percent of bankrupt companies in every year for each portfolio was calculated (number of companies that in fact have bankrupted every year collecting for all years of portfolio was divided by total bankrupt sample). The percent of bankrupt companies totally formed y-axis for all portfolios.
4. Number of companies in each portfolio collect formed x-axis
5. Bankruptcy prediction for each model was executed and receiver operating characteristic was designed.

In this research, area under curve using Wilcoxon signed-rank test and standard error from area under curve were calculated based on relations of (3.3), (3.4), and (3.5). Then, its statistical test was executed according to relation (3.6). To compare area under curve of two different models (determined as (3.1) and 3.2) from  $Z$  statistical distribution was normally applied to describe relation (3.7). The area under curve is certain scale of the capability of prediction models.

$$(A) = \sqrt{\frac{A(1 - A) + (n_f - 1)(Q_1 - A^2) + (n_{NF} - 1)(Q_2 - A^2)}{n_f n_{NF}}} \tag{3.3}$$

	Area	Std. Error <sup>a</sup>	Asymptotic Sig. <sup>b</sup>	Asymptotic 95% Confidence Interval		z
				Lower Bound	Upper Bound	
Pourheydari & Koopayee	.574	.031	.019	.513	.635	3.102
Shumway	.673	.013	.000	.613	.734	-

Table 1: Results of Shumway's sensitivity analysis

$A$  = area under curve of receiver operational indexes.

$n_f$  = number of failing companies.

$n_{NF}$  = number of unfailing companies.

$$Q_1 = \frac{A}{2 - A} \quad (3.4)$$

$$Q_2 = \frac{2A^2}{1 + A} \quad (3.5)$$

$$Z = \frac{A}{Se(A)} \quad (3.6)$$

$$Z = \frac{A_1 + A_2}{\sqrt{(Se(A_1))^2 + (Se(A_2))^2 - 2rSe(A_1)Se(A_2)}} \quad (3.7)$$

$Se(A)$  = standard error from area under curve

$r$  = correlation between two models

Data is extracted from basic financial statements, explanatory notes of sample companies from the Tehran Stock Exchange website, and Rahavard Moving software. To evaluate data, EView version 9 has been used.

Samples including two bankrupt and non-bankrupt companies. The main criteria for selecting failing companies is article 141 of commence act. Accordingly, those companies that are subjected to this article for two years are recognized as bankrupt companies. Generally, number of samples contains 100 companies from accepted companies in Tehran Stock Exchange from 2006 to 2018 (1287 observations, 215 observations were bankrupt, 1072 were non-bankrupt) have been selected. Receiver operating characteristic is a method used for assessment of advisability of prediction parameters. To do so, two groups of companies - one was under article 141 and another group was not under that article - are considered as dependent variables. Then, using accrual and actual earning management variables and through log it regression bankruptcy prediction model is estimated. Finally, model performance is examined in terms of forecast accuracy and error.

#### 4. Estimation of model and evaluation of findings

Table 1 illustrates that area under curve of Pourheydari's and Koopayee's model is 0.574, Shumway's model is 0.673. It shows that standard error in classic models is more than hazard one. These differences display priority of Shumway's model upon classic models. As it has been expressed in methodology part, statistic Z shows difference in area under curve. According to statistical hypothesis, if the difference is bigger than or equal to 1.96, it will be meaningful and if it is smaller than

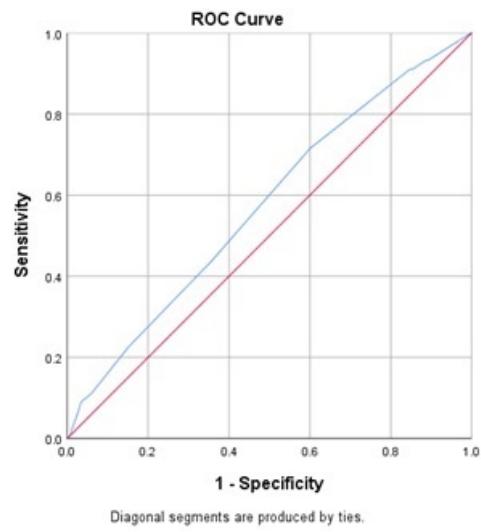


Figure 1: Classification Graph

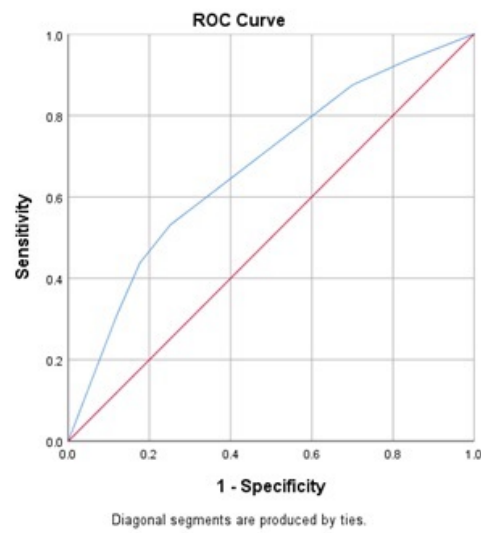


Figure 2: Pourheydari's and Koopayee's sensitivity analysis

1.96, the difference will not be meaningful. Because the difference in area under curve is more than 1.96, with rejecting the hypothesis of area under curve equality and accepting that the difference between area under curve of hazard model and classic models and because the more area under curve is, the model is more accurate, Shumway's model (2001) is more accurate in predicting bankruptcy of companies. These show that this model is better than classic models.

## 5. Conclusion and recommendations

Despite extensive researches on prediction of bankruptcy, a comprehensive model - based on well-known financial theories - has not been found to predict bankruptcy. Therefore, most of investigations will result in better understanding of financial crisis phenomena that in turn enhances the probability of finding a more appropriate model to prediction. Prediction of bankruptcy affects economic prosperity of all countries. Having a precious model that is able by default to predict financial crisis signs in time is vital for all companies. Thus, companies are in a need of a proper model that could easily discriminate bankruptcy signs.

All investigations provided an overall model for all industries totally. Since every industry has its own qualities, when a bankruptcy prediction model is provided for all industries totally, it is not possible to say that this model contains certain properties of each industry. On the other hand, investors and all consumers of designed model specific to each industry are able to check companies financial situation of each industry in terms of bankruptcy, using designed model specific to each industry and they can make right decision.

Preliminary findings of the research hypothesis testing showed that Shumway's model (2001) is more accurate in prediction of bankruptcy and it is why this model is superior to other classic models. Indirectly, it is consistent with Ogachi et al [12], Li and Faff [9], Jia et al [6], and Vaziri et al [17] researches.

It is recommended that if researchers are going to recommend bankruptcy prediction model of companies - for those industries that it is possible to extract a bankruptcy prediction model - using these techniques, other techniques and models, provide proper bankruptcy prediction models and compare them together. Researchers can study the effects of corporate governance variables, conservatism, and size of companies in predictive accuracy of bankruptcy in their future investigations. There are some suggestions based on the results of this research: Tehran Stock Exchange to accept new companies in this field can apply the model of this study to predict their financial performance. Manufacturing companies can also predict their financial performance using this model. And if they are going to be broken, they can take appropriate measures to prevent it. Most of stakeholders use companies rankings and assessment of their activities. Therefore, it is recommended that all investors and stakeholders of this industry apply suggested models in the present study for the industry besides other study and evaluations.

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