

# A comparative study of bankruptcy prediction models of Fulmer and Toffler in firms accepted in Tehran Stock Exchange

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**ABSTRACT:** The recent bankruptcies of the mega-corporations worldwide and the fluctuations in Stock Exchange in Iran have created the need for instruments to measure the financial capabilities of the firms. Financial ratios are considered to be one of the tools to measure financial capabilities of the companies. Also several models are used to predict bankruptcy. The environmental changes and the exceeding competition between the entities have limited achieving the expected profit for them. Thus, the financial decision making has become more important compared with the past and has forced the mangers to use the advanced techniques in order to make benefit of the new controlling methods. This research is carried out to present the theoretical fundamentals of the research and compare the results of utilizing Falmer and Toffler models in order to predict the companies' bankruptcy. Thus, the data related to 90 firms accepted in Tehran Stock Exchange for the years between 2005 and 2010 were tested. To analyze the data, we used the non-parametric binomial statistical methods. The results showed that in predicting the firms' status with Wilcoxon's statistical method, there is a meaningful difference between the results of the two models. Also, in forthcoming studied it was found out that Falmer's model acts more conservatively in bankruptcy prediction than Toffler model.

**Keywords:** bankruptcy, Falmer's model, Toffler model, bankruptcy prediction.

## INTRODUCTION

Investment and reliability of the investors is the most important issue discussed about financial management for individuals and legal entities. A lot of researches have been carried out about decision making processes in advanced industrial countries. The presence of tools and suitable models for assessing the financial status of organizations is one of the issues which can help the decision makings of the investors. If an investor can not have an exact assessment of the intended investment he/she wouldn't make an optimal selection. Bankruptcy prediction models are among instruments used to decide about investing in a company. The investors always want to avoid the risk of damaging their main and peripheral capital by predicting the bankruptcy possibility of a company. Thus, they try to find methods to estimate the financial bankruptcies of the companies because when bankruptcy happens, the price of the firms' stocks decrease significantly (ahmadie kashani et al., 2005)

Regarding the fact that the business failure of a company can impose high expenses and heavy losses for the beneficiaries, its prediction is very useful. If we could predict the bankruptcy with more precision and rapidly, the company can protect the business better and it can minimize the danger of losing jobs and even it may halt firm's bankruptcy (rahnomaye roudposhti et al., 2009)

The development of a prediction model has been studied in academic and business situations from long ago as an important and broad issue. Bankruptcy prediction can have a significant effect on the decisions of lending and profitability of financial entities (soleimanie amiri et al., 2003).

### **Statement of the problem**

In last 40 years, the bankruptcy prediction of firms has changed into a main research subject in financial literature. A lot of academic researches have tried to discover the best bankruptcy prediction models based on the present data and statistical techniques. And not only in the developed countries but also in developing countries the researchers have done many activities to design new models and have presented several bankruptcy prediction models regarding the different economic and financial environments (cheeneebash et al., 2009)

Bankruptcy prediction models are among techniques and instruments to predict the future status of the firms which estimate the probability of bankruptcy to happen by using an aggregation of financial ratios. The ability to predict financial and business bankruptcy is important both regarding the viewpoints of private investors and the social viewpoint because it is a clear sign of the incorrect resources appropriation. The primary awareness of bankruptcy prediction enables the management and investors to prevent it and recognize the desirable opportunities of investment from the undesirable chances (beaver, 1966)

Regarding the fact that financial bankruptcy prediction of the companies is one of the most important issues in financial decision making in Stock Exchanges (due to the outcomes and its costs in national economy level and in microeconomics and the stock exchange fluctuations in Iran and also the worries of capital owners) and that the results of inappropriate decision makings as a result of the incorrect prediction will lead to the financial crisis; we need to present a model of the probable occurrences of the bankruptcy in companies to avoid the waste of national wealth in the form of human and physical capitals. In this paper we will try to investigate this issue. In order to predict the bankruptcy of the sample firms in this research, we have used the two models of Toffler and Falmer and then compared the prediction results of these two models with each other.

### **Review of related literature**

Several researches have been carried out to study the bankruptcy prediction capability by patterns which use financial ratios as the independent variables.

- Beaver, (1966) was the first researcher working in the field of bankruptcy prediction. He chose 6 ratios from among 30 financial ratios which he considered that were the best criteria to measure the health of each company (iliati, 2008)
- Altman, (1968) was the first person who posed the multi-variable bankruptcy prediction patterns. He wanted to predict entities' bankruptcy by using a multiple differentiating analysis method and using the financial ratios as independent variables. He proposed his well-known pattern called Z1 rank pattern which was common in business bankruptcy prediction. He chose 5 ratios from among 22 financial ratios, which were considered to be the best ratios for bankruptcy prediction by him, by this method. Altman aggregated these 5 ratios to present a pattern which was considered to have the best performance among other financial ratios. Later on there were some criticisms against Z pattern. Analysts, accountants and even managers believed that Z pattern is useful only for the public entities. Altman succeeded to modify and remove the problems of the pattern in his following studies and presented a new pattern called Z' (ghadire moghaddam et al., 2009)
- Springate, (1978) continued Altman's studies. He used the independent flowing capital to total assets, profit before taxation to total assets, profit before taxation to current debt, and sales to total assets variables to present a model with %92.5 precision (mehrani et al., 2005)
- Zmijeski, (1984) used financial ratios, liquidity, performance, and leverage to present his appropriate pattern. These ratios were not chosen based on the theoretical fundamentals but were mostly based on his precious experiences in the previous studies. Zmijeski's pattern was designed based on a sample including 40 bankrupted companies and 800 companies without bankruptcy (zmijewski, 1984)
- The pattern presented by him was one of the simplest patterns of bankruptcy prediction in which the principle of the less number of independent variables was observed well (pongstat et al., 2004)
- Zee et al, (2011) carried out a research about bankruptcy prediction (financial distress) by using support vector machine (SVM) and multiple differentiation analysis (MDA) in Chinese manufacturing companies. The experimental results showed that the prediction capability of SVM is more than MDA. Besides that, internal governance and external market variables were also added as macroeconomic variables to the prediction variables. The results showed that these variables have theoretical and practical relationships with bankruptcy in Chinese companies (xie et al., 2011)
- Wallace, (2004) designed a model by using a neural network method. In this model, he used the key financial ratios which were reported as the best ratios in the previous bankruptcy studies. The ratios used by him were as follows: flowing capital to total assets, cash flows to total assets, net profit to total assets, total liabilities to total assets, current assets to current liabilities, fast assets to current liabilities. Wallace's

model had a total precision of %94 and he investigated 65 different financial ratios in the previous studies (Wallace, 2004)

- Dimitras et al, (1996) carried out a multi-dimensional research about financial crisis to improve business crisis prediction. They investigated 158 papers and categorized financial ratios and models or methods used, based on country, industry, and period. Although many approaches were proposed to overcome the limitations of differentiation analysis in 1980s, their findings showed that differentiation analysis technique was the most common system in financial crisis researches(dimitras et al., 1996)
- Some of the most important researches carried out about bankruptcy prediction patterns in Iran are as follows:

Soleimani-e-Amiri, (2003) presented the data about 30 safe and 30 bankrupted companies in a research paper entitled: "Studying the predictor indexes of bankruptcy in Iranian environmental conditions" and posed a model by using a multiple regression model to predict the financial crisis in firms accepted in Tehran Stock Exchange and tested them until 3 years before the financial crisis. The results showed that the model mentioned had categorized the total sample appropriately in one, two and three years before financial crisis with %95, %83, and %95 accuracies, respectively. In this model, the closer the amount of Z to zero, the bankruptcy possibility will be more, and the closer the amount of Z to 1, the bankruptcy possibility of the firm will be less (soleimanie amiri et al., 2003)

- Ahmadi-e-kashani, (2005) studied the adjustments of coefficients of Altman's pattern in instruments and home appliances and based on the results Altman's adjusted pattern could differentiate the bankrupted and non-bankrupted companies in the industry mentioned with %90.7 precision (ahmadie kashani et al., 2005)
- Raei et al. (2004) used artificial neural networks in their research entitled: "Firms' financial distress prediction", to predict the financial distress in 80 manufacturing companies and used a multiple variable differentiation analysis model as a comparative model. According to the findings they concluded that artificial neural networks model has a meaningfully more precision than differentiation analysis model in predicting the financial distress of those companies (raei et al., 2004).

### **Research Methodology**

The method used in this research is measuring the correlations by using the historical data in the form of post-occurrence, i.e. using the past data. Information and data were gathered from the basic financial statements of the sample companies such as: balance sheet, income statement, cash and other data published by firms in stock exchange. Also the information about theoretical issues was collected from library resources including books, magazines and professional accounting websites.

### **Statistical Sample**

Regarding the inaccessibility of the exact data of financial statements of the firms out of stock exchange, the statistical population of this research involves firms accepted in Tehran Stock Exchange in a period between 2005 and 2010. Thus, total amount of firms in this statistical sample society included 90 firms and they all have had the following conditions:

They should have been accepted in Tehran stock exchange before 2005.

Their financial statements should have been presented to Tehran stock exchange during the time period between 2005 and 2010.

Their financial statements should end on 29th. of Esfand (20th. of March).

The complete information about the firms should be accessible.

The firms selected should not include those such as: banks, insurance companies, holding companies and investment companies.

### **Research variables and models under investigations**

Doing any research requires the identification and description of every variable in it. Variables are divided into two categories based on the roles they have in the research. They are: 1- Independent Variables, and 2- Dependent Variables.

**Dependent Variable:** There is a dependent variable with two states in this research. It talks about the companies' status whether they are financially successful or bankrupted.

**Independent Variable:** The independent variables in this research are the financial ratios.

Since in this research we have used two models to study the bankruptcy or the state of not being bankrupted in companies, first Falmer's model and its independent variables are mentioned and then we will refer to Toffler model and its variables.

#### ***In Falmer's Model we have***

$$F=5.52 X1+.212 X2+.073 X3+1.27 X4-.12 X5+2.335 X6+.575 X7+1.082 X8+.894 X9-6.075$$

Where;

F: total index

X1: accumulated profits ratio to total assets

X2: the ratio of sales to total assets

X3: the ratio of profit before taxation to owners' equity

X4: the ratio of operational cash flows to total liabilities

X5: the ratio of liability to total assets

X6: the ratio of current liability to total assets

X7: total logarithm of tangible assets

X8: the ratio of flowing capital to total liabilities

X9: the ratio of logarithm before interest and tax to interest cost

If  $F < 0$ , the company will be categorized as a bankrupted firm.

#### ***In Toffler model we have***

$$Z=0/53 X1+0/13 X2+0/18 X3+0/16 X4$$

Where;

Z= total index

X1 = Ratio of net income to total assets

X2 = Working Capital

X3 = Debt to equity ratio (financial risk)

X4 = Liquidity

Z: the amount of dependent variable resulted from the pattern (overall index)

If  $Z < 0$  the company will be categorized as a bankrupted firm.

#### ***Questions and Research hypotheses***

This research is trying to answer the following questions:

- Regarding Falmer's model which companies are bankrupted and which ones are not bankrupted?
- Regarding Toffler model which companies are bankrupted and which ones are not bankrupted?
- Is there a meaningful difference between Falmer's and Toffler models' results?
- Which of the two models selects more conservatively?

Two hypotheses were suggested to answer the main research questions as follows:

***Hypothesis 1:*** There is a meaningful difference between the results of the two models of Falmer's and Toffler in predicting the bankruptcy of a company.

***Hypothesis 2:*** Falmer's model acts more conservatively in bankruptcy prediction than Toffler model.

#### ***Data Analysis***

To analyze the data extracted from financial statements of the sample firms, we used EXCELL software. First, the data related to financial ratios were categorized in two models of Toffler and Falmer's regarding the financial ratios and companies in isolation and then, the amounts of F and S were calculated for each company. Next, financial ratios were calculated based on the averages of 6 fiscal years for each company and they were put into Falmer's and Toffler models again and then the amounts of F and S were calculated for each company. These data were used to test the research hypotheses and the amounts of F and S of each fiscal year were used as other information. Then we used the two ranking tests of Wilcoxon (binomial statistical method) to study about the existence of a meaningful difference between the results of the two models and we used even dependent t test to identify the more conservative model. In these tests, the lack of a meaningful difference between the two models was our null hypothesis (zero hypotheses). While the other hypothesis (the researcher's hypothesis), approved the existence of a meaningful difference. If the output amount of tests is more than 0.05, the hypotheses will be rejected and null hypotheses will be approved. While, if the amount is less than 0.05, the counter-hypotheses will be approved.

**Research Results**

The results of Toffler model showed that 27 firms out of 90 firms under investigation were introduced as bankrupted and the rest are not bankrupted. Also the results of Falmer's model showed that 63 firms out of 90 firms under investigation were introduced as bankrupted and the rest are not bankrupted. Table 1 shows the results of answering the first and second research hypotheses. To answer the third question of the research related to the existence of a meaningful difference between the results of the two models, we should state that the results of Wilcoxon's tests show the hypotheses' approval. In fact Wilcoxon's test approves the existence of a meaningful difference between the two models. It should be noted that since the data related to the two models were qualitative data, number 1 was assigned for bankrupted firms and number 0 was appropriated to firms not bankrupted in order to quantify the data and solve the problem statistically. Table 2 shows the results of this test. To answer the last question, we used even dependent t test to determine the more conservative model. The results showed that Falmer's model acts more conservatively compared with Toffler model. Table 3, shows the results.

Table1 . The results of the two models investigated

Firms	Toffler		Falmer	
	NO.	Percent	NO.	Percent
Bankrupted	27	30	63	70
Not bankrupted	63	70	27	30

As it can be seen in the table above, the number of bankrupted firms regarding Toffler model equals almost %30 of the total firms, while this ratio is %70 regarding Falmer's model. Thus, it seems that there is a meaningful difference between the results of the two models.

Table 2. The results of Wilcoxon's tests

Test (Wilcoxon's)	Test results	Hypotheses under investigation
T-F	0.000	Hypotheses approved

Table 2, shows the results of Wilcoxon's tests. As it can be observed, the amount of Wilcoxon's test's sig. equals 0.000 and it is less than 0.05. Thus, regarding Wilcoxon's test, the research hypothesis is approved and it means that there is a meaningful difference between the results of the two models investigated.

Table 3. The results of even dependent test

Test (even dependent)	average	Criterion deviation	Test Statistics	Sig.
T-F	0.4	0.49	7.703	0.000

Table 3 shows the results of studying the second hypothesis. As it can be seen in the table, the amount of sig. in this test equals 0.000 and it is less than 0.05. It shows that the outputs resulted from Falmer's model are meaningfully bigger than those of Toffler. In other words, Falmer's model acts more conservatively than Toffler model.

**CONCLUSION**

**Conclusions and Suggestions**

As it can be observed, the results of predicting the status of being bankrupted or not being bankrupted among firms accepted in Tehran Stock Exchange by using Toffler model and falmer's model from among 90 firms under investigation, were 27 and 63 bankrupted firms, respectively. Thus, a meaningful difference between the results of the two models regarding Wilcoxon's test was observed. Also the results of other investigations showed that Falmer's model acts more conservatively in predicting firms' bankruptcy than Toffler model. The results of the present research showed that using different models to predict bankruptcy, not only identifies the status of organizations, but also can help to avoid bankruptcy by investigating financial statements. Finally, using models such as Altman, Ahlson, Shirata and ... are suggested in future researches.

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