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Predicting Financial Distress in Tehran Stock Exchange

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Abstract

Companies incur significant costs from the financial distress. Predicting financial distress will have an important role in preventing bankruptcy. The aim of the present study is to predict the financial distress costs using the Leland and Toft models, during 1996 and 1998. This study examines data relating to 49 companies listed in the Tehran stock exchange collected over ten years from 2005 to 2014. Leland and Toft model (1996) considers the financial distress costs and benefits from the tax shield in general. However, Leland and Toft model (1998) considers the financial distress costs and benefits from the tax shield in detail by using γ parameter. According to the research findings, the companies working in automotive industry are bankrupt, but the companies working in food and beverage, pharmaceutical, base metals and cement industries have a good distance from financial default. The results help to improve the decision-making process and to avoid the financial distress.

Keywords: Financial Distress, Tax Shield, Leland and Toft model, Tehran Stock Exchange

1- Introduction

Financial distress prediction models have been developed and used for more than five decades for their ability to forecast whether a company will have certain financial problems or even go bankrupt in the next period. Economic consequence of company failure is great. Therefore, using a model by which it would be possible to identify financial distress is of great interest for investors, creditors, and other stakeholders. In such a way not only is it possible to predict a probability that a company will default, but also what is more important to make certain actions in order to prevent more serious consequences (Šarlija and Jeger, 2011).

Iran stock exchange market has developed for more than two decades, facing severe stock market boom or crash. Although Iranian companies are facing a crisis of confidence and trust that many experts have disputed too

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much, they have the consensus. One of them is that the quality of the Iranian listed companies is too poor to maximize the shareholders' value. Therefore, the timely prediction of a financial crisis can improve financial condition. In other words, financial health is one of the fundamental demands of all stakeholders. Therefore, providing a clear picture of the financial status of companies is very important to all of them (Parkinson, 2016).

This study is important to stakeholders and it will benefit them because it uses two of the most efficient models, Leland and Toft (1996 and 1998), to predict the financial distress in Tehran Stock Exchange for a ten-year period (2005-2014). This mathematical model has the potential to enhance the ability of a particular stakeholder to identify financial distress timeously, and, where applicable, to take appropriate remedial action to avoid failure. If it is a viable model, investors can use the model to determine whether the potential financial distress is of a temporary or permanent nature and whether the company's share price would be affected. However, if a stakeholder determines that the financial distress is of a more permanent nature, the stakeholder can avoid investment in this particular company, or an existing shareholder may decide to divest from the company.

The remainder of this paper is structured as follows. A brief review of background and related works is presented first. Some important issues with models for predicting financial distress are then discussed including an overview of the two models of Leland and Toft (1996 and 1998) used in this paper. The data and methodology used are then presented, followed by the results and conclusions.

2- Literature Review

The prediction of corporate financial distress and bankruptcy has long been a great interest of research initiating in the late 1960s. Generally in order to identify distress or bankruptcy, financial analysts and investors use different measures to evaluate it. Financial distress means a firm's financial failure to meet its obligations to creditors in a timely manner which can lead to bankruptcy if it continues. Bankruptcy occurs when a firm is unable to pay its debts which ultimately lead to the dissolution of the firm (Khaliq et al., 2014).

Lack of an optimal capital structure can be considered as one of the factors influencing financial distress. Costs of financial distress are costs

associated with a company having difficulty meeting its obligations. Costs of financial distress include (1) opportunity cost of not making optimal decisions (2) inability to negotiate long-term supply contracts and (3) loss of customers. The expected cost of financial distress increases as the relative use of debt financing increases and affects the cost of debt and equity (Nikumaram et al., 2012). Despite the fact that in recent years several studies have been carried out on the optimal capital structure, there still is practically little consensus with regard to its uniform optimal status. To a large extent, the origin of this disagreement could be due to the lack of uniformity amongst different researchers in how to estimate the current cost of future financial distresses (Ghazouani, 2013).

An optimal capital structure can be understood more tangibly by comparing the two fundamental researches by Andrade & Kaplan (1998) and Almeida & Philippon (2007), carried out on the costs associated with financial distresses. In the Andrade and Kaplan research, 31 firms acquired through leveraged buyout (LBO) that became financially distressed after the purchase, were studied. The time of the acquirement of the above-mentioned firms was the late 1980s. Andrade and Kaplan calculated the financial distress cost as a percentage of the firm's value (approximately six months before bankruptcy). According to their estimates, by declaring bankruptcy, the firms under study lost 10 to 23 percent of their market value through direct and indirect costs (by calculating the mean of two numbers 10 and 23, the cost of the financial distress was determined as 16.5%).

Using the estimates utilized by Andrade and Kaplan's, Almeida and Philippon (2007) achieved different results. That is, they found that the expected tax benefits and costs associated with the financial distress could balance each other. To estimate the probability of financial distress, they derived risk-adjusted default probabilities from the existing credit spread (yield spread of Treasury bonds and another bond with similar but lower quality maturities). This approach was consistent with Andrade and Kaplan's work as well as default/bankruptcy conditions. Almeida and Philippon used the 10-23 percent relative loss range of Andrade and Kaplan with respect to the current value and not the value near default that was predicted at the beginning. Of course, before a company has reached the margin of bankruptcy, this method could overestimate the current value of expected bankruptcy costs.

Studying the bankruptcy status of the firms which is active in the railways sector in the US, Warner (1977) arrived at a similar conclusion. His research results showed that compared with seven years before bankruptcy, on average, 79% of the value of the firms was reduced. In another study, Davydenko (2007) examined a large number of bankruptcies in various industries. His research results indicated that, on average, bankruptcy of the firms occurred when their market value equalled 2/3 (two thirds) of the total debt. According to this study, the loss of 86.7% is necessary for bankruptcy.

Shin et al. (2005) proposed a bankruptcy prediction model using support vector machines. They compared the performance of their model with the performance of artificial neural networks. Their study showed that the support vector machine has a better performance in terms of both generalization and overall accuracy of the model. For carrying out this research, they used ten financial ratios between 1996 and 1999. In a study, Xavier Brédart (2014) tried to predict the probability of bankruptcy amongst Belgian firms between 2002 and 2012 using neural networks. According to the results of this study, the use of neural networks in predicting the probability of bankruptcy had a 80% success rate.

In his study, Almansour (2015) studied and examined the problems of predicting firms' bankruptcy. In this study, regression analysis was used to develop a prediction model on 22 bankrupt and non-bankrupt companies for the period of 2000-2003. According to the results of this study, ratios such as working capital to total assets, current assets to current liabilities, market value of equity to book value of debt, retained earnings to total assetand sales to total asset are good indicators in predicting the probability of bankruptcy. Cultera and Brédart (2016) in a study predicted the bankruptcy of Belgian small and medium-sized enterprises included a selection of financial ratios. The findings of their research showed that profitability and liquidity indicators are excellent financial indicators for predicting bankruptcy of Belgian small and medium enterprises.

Onur Oz and Yelkenci's research (2017) in their research showed that the theoretical model provides high-level prediction accuracy through its earnings components. The use of a large sample from different industries in distinct countries increases the validity of the prediction results, and contributes to the generalizability of the prediction model in distinct sectors. The results of this study fulfill the gap and extend the literature through a distress model, which has the theoretical origin enabling the

generalization of the prediction results over different samples and estimation methods.

Udin, ArshadKhan, and YasminJavid (2017) found insignificant impact of ownership structure on firms' likelihood of financial distress based on the dynamic generalized method of moments. However, the panel logistic regression results indicated that foreign shareholdings have a significant negative association with firms' likelihood of financial distress, in the case of Pakistan. An evidence of a negative and insignificant relationship between institutional ownership and financial distress was observed, which indicates the passive role of institutional investors in Pakistan. The results also reveal a positive and significant relationship between insider's ownership and likelihood of financial distress. This finding is consistent with the entrenchment hypothesis predicting that insiders are more aligned with their self-interest than outside shareholders' interest when their shareholding increases in the business. Furthermore, the results also reveal insignificant association between government shareholdings and the probability of financial distress. The reason could be the social welfare objective of the government entities rather than profit maximization.

Nagar and Sen (2017) attempted to examine whether financially distressed firms manipulate core or operating income through the false classification of operating expenses as income-decreasing special items. The sample of their study comprises firms in the USA with data from 1989 to 2010. They used the methodology given in McVay (2006) and multiple regressions. According to the findings of this study, managers of financially distressed firms are more likely to inflate core or operating income as compared to the healthy firms to meet or beat earnings benchmarks. They do so by misclassifying core or operating expenses as income-decreasing special items. Specifically, core expenses are shifted to income-decreasing special items like goodwill impairments, settlement costs, restructuring costs and write downs.

Saeedi and Aghaie (2010) in their research attempted to model the prediction of financial distress of firms listed in Tehran Stock Exchange using Bayesian networks. In their research, they used two models related to Bayesian networks and one model related to logistic regression. According to the results of this study, the first and second simple Bayesian network models that are based on conditional correlation and probability respectively, can distinguish bankrupt firms from non-bankrupt firms with an accuracy of 90% and 93% in turn. Eventually, the logistic regression

model, which is a linear model, can accurately distinguish bankrupt companies from non-recaptured companies with 90 percent accuracy.

Pourheidari and Koopaee Haji (2010) investigated the prediction of corporate financial distress using a model based on the linear discriminant function. In this research, while providing a model for predicting the financial distress and bankruptcy of firms, the predictive power of the model was tested as well. Numerous financial ratios were used in this study. The results of the study showed that with the help of the proposed model, up to five years before financial distress, financial distress can be predicted with a relatively high accuracy.

Arab-MazarYazdi and Safarzadeh (2010) examined the potential of financial ratios to predict the financial distress using logit analysis. For this purpose, a sample of 279 firms (104 distressed firms and 175 firms without financial distress) that were listed on Tehran Stock Exchange for the period of 2003 to 2007 was selected. The criterion used to distinguish distressed firms from non-distressed ones was Article 141 of the Commercial Code. The results showed that the model has the ability to predict financial distresses. In a research entitled "Comparison of the Power of Different Artificial Intelligence Techniques in the Prediction of Financial Distress ", Pourzamani and Kalantari (2013) studied the financial status of firms listed in the Tehran Stock Exchange during the period of 1997-2010. For this purpose, they chose 72 firms from amongst the companies covered by Article 141 of the Commercial Code, and also 72 companies from the rest of the firms. According to the results of this study, there was no significant difference between prediction accuracy of the combined linear and nonlinear genetic algorithm and neural network method in predicting financial distress.

In a research, Talebniah and Khoshdel (2016) attempted to predict the bankruptcy of firms listed in the Tehran Stock Exchange using artificial neural network and genetic algorithm and compared the two methods together. The results of this study showed that among variables used in neural network, regression and genetic algorithm models, the three variables of current ratio, working capital to total assets, and earnings before interest and taxes (EBIT) against total net assets, based on the available data in the sample are inversely proportional to bankruptcy of the firms. The results of this research, while highlighting the high accuracy of neural networks in predicting the bankruptcy of firms indicated that using the results of this research and the proposed models one can suitably

prevent the financial distress and bankruptcy of the firms as well as their consequences.

In a research entitled "A Comparison of Different Methods of Selecting Predictor Variables for Predicting the Financial Distress of Companies Listed in Tehran Stock Exchange", Namazie et al. (2016) attempted to examine and compare the advantage of various methods of choosing predictor variables in predicting financial distress of firms listed in the Tehran Stock Exchange. The findings of the research demonstrated the advantage of using variable selection methods compared to not using these methods in predicting financial distress as well as the existence of a significance difference between the levels of advantage of these methods.

3- Research Methodology:

In terms of purpose, this research is an applied research and in terms of analysis method, it is an analytical-mathematical research. The present research tries to predict the financial crisis of companies using the mathematical Leland and Toft model (1996 and 1998).

3-1- Research Questions:

- How effective can the mathematical model of Leland and Toft (1996) be in predicting the cost of the financial crisis among the bankrupt active companies in the Tehran Stock Exchange?
- How effective can the mathematical model of Leland and Toft (1998) be in predicting the cost of the financial crisis among the active companies in the Tehran Stock Exchange before becoming bankrupt?
- Compared to the Leland and Toft model (1996), how effective can Leland and Toft model (1998) be in predicting the cost of the financial crisis among the active companies in Tehran Stock Exchange before becoming bankrupt?

3-2-Population and Statistical Sample:

The statistical population of this study was companies approved by the Tehran Stock Exchange. Companies operating in the auto, food and beverage, pharmaceuticals, basic metals and cement industries were selected as the statistical samples. The reasons for this choice were:

1. These companies have joined Tehran Stock Exchange before 2005.
2. The end of their fiscal year was March 29th.
3. During the research years, there was no change in their activity or their financial year.
4. Their data is accessible.

5. During the study period, they received short-term or long-term bank facilities.
6. During the research years, they were active in the Tehran Stock Exchange so that the daily value of their stocks could be seen on the stock exchange board. The research period is from 2005 to 2014.

3-3- Research Variables:

The variables used to predict the costs associated with the financial crisis (Table 2) are as follows:

Current value (v_t): This value represents the daily value of the shares of the companies under the study and its formula is as follows (ElKamhi et al., 2012):

Current (daily) value of the whole company= total numbers of shares* daily value of shares

Bankruptcy threshold (V_B): in this research the bankruptcy threshold was calculated based on Leland and Toft model and the formula is as follows (ElKamhi et al., 2012):

$$V_B = \frac{\frac{C}{r}\left(\frac{A}{rT} - B\right) - \frac{AP}{rT} - \frac{\tau C x}{r}}{1 + \alpha x - (1-\alpha)B}$$

The explanations related to the variables contained in the above formula are as follows:

- ✓ Financial default rate (α): This rate has been extracted from Andrade and Kaplan (1998) and the number is assumed to be 16.5%.
- ✓ C: it is the main and subsidiary repayments of the received loans in each period.
- ✓ T: it is the number of maturity dates related to the received loans.
- ✓ P: it is the total amount of the received loans in the mentioned period of time.
- ✓ R: The rate of interest is risk-free, and its number equals the interest rate that banks pay their customers as profits according to the license of central bank.
- ✓ A, B: it represents specific solutions of differential equations with partial derivatives; the details of which are beyond the scope of this research.
- ✓ T: it represents the tax rate and the following formula is used to calculate it (Almeida & Philippon, 2007):

$$\tau = \frac{company\ tax}{profit\ before\ (special) tax\ deduction}$$

σ: Unlevered asset fluctuations: it represents the rate of unlevered asset fluctuations of companies. In the present study, unlevered assets are assumed to be the shareholders' dividends (El Kamei et al., 2012). The standard deviation of shareholders' dividends over the ten years of the research period, 2005-2014, was used to calculate the rate of unlevered asset fluctuations. Regarding the unfavorable economic conditions and the significant inflation rate during the research period, the value of the shareholders' dividends of the listed companies had significant fluctuations. Therefore, for the relevance and reliability of the numbers, the shareholders' dividends was calculated in two different five-year periods -from 2005 to 2009 and 2010 to 2014. The following formula was used to calculate the mean:

$$\sigma_{mean} = \frac{Fluctuations\ of\ the\ first\ five\ years + fluctuations\ of\ the\ second\ five\ years}{2}$$

Downgrade Threshold: the mean of the lowest daily value of the company during the fiscal year was used to calculate this value (Elkamhi et al., 2012).

Distance to financial default: According to this criterion, the distance of financial default of companies can be determined. This criterion reflects the ability of companies to repay debts and fulfill obligations arising out of financial facilities. The formula is as follows (ElKamhi et al., 2012):

$$DTD = \frac{v_{t-}v_B}{\sigma}$$

If DTD< 0:

In this case, the company is experiencing a phase of financial default (crisis) and $v_t < V_B$. In this situation, the company is bankrupt, or is at the verge of a bankruptcy. Therefore, the continuity of the company's operation is in serious danger.

If $DTD > 0$

In this case the company moves away from financial default and therefore $v_t > V_B$.

Financial default costs(FDC)**:**this includes all direct and indirect costs after the company files a petition for bankruptcy. The costs of the financial

crisis during the bankruptcy are calculated according to the following formula (Leland and Toft, 1996):

$$FDC(V_t) = \alpha.(V_B{}^{1-x}).(v_t)^{-x}$$

In the above formula, X is an auxiliary variable to calculate the overall model of the financial default costs, and the details are beyond the scope of this study.

Tax shield $TS(V_t)$: this fits with the facility received by the company and in general, is calculated using the following formula. (Leland and Toft, 1996):

$$TS(V_t) = \frac{\tau C}{r}.(1 - (\frac{V_t}{V_B})^{-x})$$

Market leverage value of the company: To calculate this value, the following formula is used (Leland and Toft, 1996):

$$V_t^L = v_t + TS(V_t) - FDC(V_t)$$

In the above formula, L index is the sign of leverage.

The amounts of debts caused by financial facilities are calculated using the following formula. In this formula *T* represents *time* (Leland and Toft, 1996):

$$D(V_t) = \frac{C}{r} + \left(P - \frac{C}{r}\right)\left(\frac{1 - e^{-rT}}{rT} - I(v_t)\right) + \left((1-\alpha)V_B - \frac{C}{r}\right)J(v_t)$$

In the above formula $I(v_t)$and $J(v_t)$ are auxiliary variables to calculate the amount of debt in T which represents the period of time and the details are beyond the scope of this study.

Daily value of the shareholders' dividends: This value is calculated using the following formula (Leland and Toft, 1996):

$$E(v_t) = v_t + TS(v_t) - FDC(v_t) - D(v_t)$$

Liquidity crisis V_{cf}: it is calculated using the following formula (ElKamhi et al., 2012):

$$V_{cf} = \frac{\left((1-\tau).C + \frac{C}{P}\right)}{\left(\frac{1-\alpha}{T}\right) + \delta}$$

Costs of financial crisis before bankruptcyPBC:

The costs of financial crisis before bankruptcy are calculated in two situations using the following formulas (El Kamei et al., 2012):

When $V_B < V_D < v_t$:

$$PBC_{IG} = \Phi_{1,IG} v^{x_{1,IG}} + \Phi_{2,IG} v^{x_{2,IG}}$$

When $V_B < v_t < V_D$

$$PBC_J = \frac{\gamma v}{\delta + \gamma} + \Phi_{1J} v^{x_{1J}} + \Phi_{2J} v^{x_{2j}}$$

In the formulas above, the coefficients $\Phi_{1,IG}$, $\Phi_{2,IG}$, Φ_{1J} and Φ_{2J} are general answers to partial differential equations and there is no need to mention how they were calculated.

In the above formula, γrepresents losses caused by inefficiency and indicates the amount of damage that occurred in the company's current value.This loss might be caused by issues such as mistrust of customers, mismanagement and other costs related to financial crises before financial default. Since the losses of companies are mainly due to operating activities (operating costs and revenues), the following formula was used to calculate γ (ElKamhi et al., 2012):

$$\gamma = \frac{(i)\ Total\ operating\ expenses\ of\ the\ year - (i-1) Total\ operating\ expenses\ of\ the\ year}{(i)\ \text{Total earnings of the year} - (i-1)\ Total\ earnings\ of\ the\ year}$$

δ : The following formula was used to obtain the interest rate of dividends paid to the shareholders:

$$\delta = \frac{Proposed\ dividends}{attributable\ dividents}$$

Note: The models of Leland and Toft (1996) and Leland and Toft (1998) are the main criteria to extract and calculate the above variables.

3-4- Calculation model for financial default costs

The model used to calculate the financial default costs that somehow includes the sum of discounted costs of the financial crisis is as follows (Leland and Toft, 1996):

$$FDC_t = E_t^Q \left[\int_t^{\infty} e^{-rs}\, \varphi(V_s).ds \right]$$

(Model-1)

In this model, φrepresents financial default costs and can be identified at any desirable time.$\varphi$is also a function of the company's current value. T represents time. φ is also one of the parameters affecting the environment of the company. In this model, Q represents the expected time regarding the adjusted risk probabilities which provides the possibility to calculate all costs related to the future financial default$s: s > t$ at a risk-free interest

rate *(r)*.In this model, *r* is the risk-free interest rate- a rate that The Central Bank of the Islamic Republic of Iran announced for banks to receive interest on loans given to customers.$s$is a sub-variable for integrating. The $e$symbol represents the Euler number and in fact is an irrational number the value of which is 2.718. The E symbol is the expected value related to the random variable inside the brackets. The main problem in the above model is how to formulate index for Euler's phi function $\varphi(.)$. In this research, it is assumed that all costs related to financial default are combined at the time of the declaration of bankruptcy. Graham's research (2000), Molina (2005), and Almeida& Philippon (2007) are examples of the above hypothesis. This assumption is also common in structural literature (Chen, 2010). This means that a financial default occurs when the value of a non-leveraged company (v_t) falls below the bankruptcy threshold (V_B) for the first time. If this is the case, the costs related to the financial crisis are as follows (Leland and Toft, 1996):

$$\varphi(v_t) = \begin{cases} 0 & before\ bankrupcy \\ \alpha.V_B & at\ Bankruptcy \end{cases}$$

In the above model, α represents the financial default rate and its value is equal to 16.5 percent. According to the above model, the prevailing assumption is that companies will not experience any cost related to a financial default before bankruptcy is announced. The requirements to identify the costs related to a financial default prior to a bankruptcy or during the bankruptcy are as follows:

A. Determining threshold for the value of company assets (V_D); this is the distance between investment grade (This rating implies the expectation for the lowest credit risk) and speculative rank(this rating reflects the expected possibility of increasing credit risk, especially when adverse economic changes occur).
B. When the value of the company is in a speculative state, Costs related to the financial default incur with a fixed rate (γ)and proportional to the value of the company's assets.
C. When a company's value falls below the bankruptcy threshold for the first time (V_B,) a default occurs; therefore, the additional costs of bankruptcy proportional to the company's value incur in default (V_B). The above items are summarized within the following model (Leland and Toft, 1998):

$$\varphi(v_t) = \begin{cases} 0 & When\ the\ firm\ is\ rate\ investment\ grade. \\ \gamma.v_t.dt & when\ the\ firm\ is\ rate\ speculative\ grade. \\ \alpha.V_B & at\ bankrupcy \end{cases}$$

4- Research findings

In this section, first descriptive statistics and then inferential statistics are discussed.

Table 1: Descriptive statistics at the level of the total variables of research

Statistical values / variables	Number of observations	Min	Max	Average	S.D.	Skewed	Probability value of Kolmogorov and Smirnov test
Current value(V_t)	490	9/51	17/33	13/39	1/41	0/099	0/20
(V_B)Financial impairment value	490	7/64	17/89	12/67	1/80	0/669	0/20
Financial default cost(FDC_t)	490	6/33	16/09	10/87	1/79	0/703	0/20
Tax shield(TS_t)	490	3/81	16/25	10/47	1/85	0/721	0/20
Financial default costs before bankruptcy (PBC_t)	333	3/84	13/31	9/32	1/73	-0/264	0/20
(Total Debt)	490	10/45	18/39	13/25	1/56	1/152	0/20

Source: Research findings

Table 1 shows the results of descriptive statistics of all companies. 490 companies were observed for all examined variables, but only 333 companies were observed for the variable of cost of financial crisis before bankruptcy (PBC). During the research period, according to the model, 157 companies were considered bankrupt during the fiscal year, and their current value was practically less than the value of their bankruptcy threshold, and thus lacked the minimum items related to the costs of a financial crisis before bankruptcy. Due to the great value (figure) of the studied variables, natural logarithm was used to test the variables. Since the probability of the Kolmogorov-Smirnov test for all variables is 0.20 and 0.20 is greater than 0.05, therefore all the data related to the test variables are considered normal.

It is not logical to provide an analysis of the total sample size (49 items) because the daily values of the companies during the period of the study

were significantly different. For example, the maximum current (daily) value of 49 companies owned by IranKordro Company on 20 March, 2015 was 33.542 million Iranian Rials while the current value of the studied companies owned by Marvdadasht Sugar Company on 19 March, 2009 was 33.542 million Iranian Rials. Therefore, the standard deviation of the data of the current value (261, 999, 3 million Iranian Rials) is very high and makes it practically impossible to analyze all the companies.
The research findings based on each of the studied variables at the level of each separate industry are shown in the following table.

Table 2: Estimated costs of financial crisis in the sample industries (as average)

industry / variables	automobile manufacturing	Sugar industry	diary	pharmaceuticals	Base metals	cement
Distance to default(DTD)	-3/96	2/58	0/37	4/01	2/02	5/01
Unlevered asset fluctuations (σ)	2/073/880	61/926	50/946	182/609	252/450	233/635
Current value(v_t)	7/631/997	315/224	341/443	1/194/154	1/193/856	1/820/777
Bankruptcy threshold value(V_B)	15/852/570	155/701	322/707	461/349	630/279	651/265
Downgrade value (V_D)	-	181/382	382/483	522/369	819/870	820/613
Total debts(D_t)	23/989/834	207/062	442/260	583/389	1/009/482	989/960
Financial default costs(FDC_t)	2/615/674	25/690	53/246	76/122	103/996	107/458
Tax shield(TS_t)	794/213	16/901	26/946	65/488	63/153	59/818
Liquidity crisis (V_{cf})	10/866/972	87/344	176/375	218/252	404/480	319/464
Prior bankruptcy costs(PBC_t)	-	23/067	41/639	51/983	165/073	124/050
Market value of equities	-4/185/668	210/861	118/116	896/448	769/535	1/377/938
market leverage value	5/810/536	306/435	315/143	1/183/519	1/153/014	1/773/136

Source: Research findings

Note 1: The figures in the above table are in billion Rials and are rounded. Many calculations are not mentioned. It might be useful to point out that on average, 600 calculations were performed using Excel software and MATLAB software (2014) for each company.
Note2: according to the research findings (Table 2), the daily value of the shareholders' dividends in the auto industry is negative. This indicates negative goodwill. This means

that the market value of the companies which is active in auto industry cannot cover their debts.

Note 3: Receiving bank facilities was one of the main criteria for sample selection. Therefore, companies active in industries such as petrochemicals and gas that did not receive financial facilities during the study period were excluded from sampling. In addition, many companies active in the oil industry which were not involved in the stock market in 2005 or their number in the related industry was less than five were excluded from sampling.

Some important financial ratios that have a significant role in identifying and determining the costs related to the financial crisis are as follows.

Table 3: Financial ratios related to the financial crisis in the sample industries (as average)

industry / Variables	auto	sugar	diary	pharmaceuticals	base metals	cement
Distance to default (DTD)	-3/96	2/58	0/37	4/01	2/02	5/01
Ratio $\frac{current\ value}{total\ debts}$	0/32	1/52	0/77	2/05	1/18	1/84
Ratio $\frac{bankrupcy\ treshold}{total\ debts}$	0/66	0/75	0/73	0/79	0/62	0/66
Ratio $\frac{bankrupcy\ treshold}{current\ value}$	2/08	0/49	0/94	0/39	0/53	0/36

Source: Research findings

Before providing any analysis, it should be noted that due to respect for financial reputation and trustworthiness and in order to avoid breaching trust, no company is mentioned in the study by name, and calculations and analyses are presented only based on the average of each industry(the data and analyses related to each company are available and reserved).

To carry out the calculations related to the auto industry, the Leland and Toft model (1996) was used. The reason for using this model is that auto industry was in the bankruptcy bracket. To perform the calculations related to the other industries, Leland and Toft model (1998) was used. The value of the bankruptcy threshold of the studied industries was calculated based on the financial default rate $\alpha = 0/165$and other costs related to financial crisis (such as interest cost). In order to calculate the value of the bankruptcy threshold, costs were considered as a single value rather than as separate values. According to the results of the research and performed analyses, both Leland and Toft models, (1996) and (1998), had the necessary efficiency to predict bankruptcy costs.

In this section, the differences between the two models of Leland and Toft, (1996) and (1998) are described. Leland and Toft model (1996) is only able to perform calculations related to a debt with a specific maturity date, but Leland and Toft model (1998) is capable of performing calculations related to different debts with different maturity dates. Another difference is that since in Leland and Toft model (1996) the amount of α(0/165) is assumed mathematically constant, the costs of the financial crisis and the tax shield before the bankruptcy are more general and less accurately calculated. However, in Leland and Toft model (1998) due to the use of more details and gamma parameter, the ratio of the amount of X is considered separately for each year and therefore the costs of the financial crisis and the tax shield are calculated more accurately for each year. Therefore, in comparison with model (1996), model (1998) has more potential to predict the cost of a financial crisis before bankruptcy and this confirms the validity of the third hypothesis. In the following section, the analysis of each industry is presented separately in detail.

4.1. Automotive Industry:

In the automotive industry, six companies were selected as samples. According to Table 2, the distance to default (D2D) in the automotive industry (average) is equal to -3.96 times. This means that the current value of the automotive industry is 3.96 times lower than the industry's endogenous bankruptcy threshold ($v_t < V_B$), and the standard deviation of non-leveraged assets is also high. Therefore, according to the Leland and Toft models, the firms under study in this industry – albeit during the study period – are practically considered bankrupt. The ratio of total industry debt to current value in this industry is equal to 3.14, which indicates that the value of debt in the automotive industry is 3.14 times as much as the current (closing) value. The ratio of the endogenous bankruptcy threshold of the industry to total industry debt is 0.66. Therefore, the endogenous bankruptcy threshold (including the principal of the loans and subordinated debt) of the automotive industry occurs at the level of 66% of the total debt of this industry. The ratio of the endogenous bankruptcy threshold to the current value in the automotive industry is 2.08, which in fact is indicative of the inadequacy of the firm's financial strength in repaying its debt.

The tax shield caused by the received financial facilities is a significant figure. This subject matter indicates that in the automotive industry, on average, the firms have used short-term (general and limited partnership)

and long-term financial facilities much more than their current value. According to the data listed in the tax shield row, it can be seen that the tax benefits from the received financial facilities are by no means able to cover the financial distress costs as well as bankruptcy costs. Based on the calculated liquidity crisis, the amount of cash and cash (liquid) assets is much lower than the current value of the company and therefore (on average) the automotive industry is facing a liquidity crisis. In addition, the current value of equity is negative (less than the amount of debt) which means that the automotive industry is considered somewhat bankrupt. Because the current value of the leverage of the firms (debt financed assets) is at a high level the firms active in the automotive industry are facing serious financial problems.

4.2. Sugar Industry:

Sugar industry is one of the food and drink industries subsectors and the number of selected firms from this sector for study is 10 firms. According to Table 2, the distance to default in this industry is 2.58 times. This means that on average the distance to default for the firms' active in this sector is at a moderate level. As can be seen in Table 3, the ratio of total debt to current value in this industry is 0.66. This shows that the total value of debt in this industry is 66% of its current (closing) value. The ratio of the endogenous bankruptcy threshold to the total value of debt in the sugar industry is 0.75. This fact shows that the endogenous bankruptcy threshold of this industry is roughly 75 percent of the total value of its debt. The ratio of endogenous bankruptcy threshold to the current value in the sugar industry is equal to 0.49. This means that on average, the current value of this industry is almost twice as much as its bankruptcy threshold, and its distance to default point is at a relatively good level.

Compared to the costs of the financial fault (25,690), the calculated figure for the financial distress cost before the bankruptcy (23,067) has a more accurate approximation and more details. These costs are caused by a decrease in the firm's current value due to such factors as customer mistrust, management failure, inadequate investment, more competitive business environment and annual operating losses. According to the calculations tabulated in Table 2, the current (closing) value of the sugar industry has the potential capacity to achieve sufficient liquidity (i.e. ($v_t > v_{cf}$)], therefore, this industry (on average) does not face liquidity crisis. Furthermore, the current value of equity in this industry is positive.

4.3. Dairy Industry:

The dairy industry is a subsector of the food and beverage industry and the number of selected companies from this industry for the study is five firms. According to table 2, the distance to default in this industry is 0.37 times. This means that on average the distance to financial distress among the firms in this industry is at a weak level. The ratio of total debt to current value in this industry is equal to 1.3. This indicates that the total value of debt in the industry constitutes about 130% of its current (closing) value. The ratio of the endogenous bankruptcy threshold to the total value of debt in the dairy industry is equal to 0.73. This indicates that the endogenous bankruptcy threshold occurs at about 73% of its total debt. The ratio of the endogenous bankruptcy threshold to the current value in the dairy industry is equal to 0.94. This means that, on average, the current value of this industry is almost equal to its bankruptcy threshold and so in this industry the distance to default is not at a satisfactory level.

Compared to the financial distress costs (53,246), the calculated figure for the financial distress costs before bankruptcy (41,639) has a closer approximation and more details. The current value of equity in the dairy industry is positive, but it has less leverage value.

4.4. Pharmaceutical Industry:

Ten firms were chosen as samples in the pharmaceutical industry. According to table 2, the distance to default in the pharmaceutical industry (on average) is equal to 4.01 times. This means that the current value of the pharmaceutical industry is 4.01 times higher than the endogenous bankruptcy threshold of the industry ($V_B > v_t$), and also the standard deviation of non-leveraged assets is at a lower level. The ratio of total debt to current value in this industry is equal to 0.49. This indicates that the total value of the debt in this industry is about half its current (closing) value. The ratio of the endogenous bankruptcy threshold to the current value in the pharmaceutical industry is equal to 0.39. This means that on average the current value of this industry is more than 2.5 times as much as its bankruptcy threshold and so in this industry, the distance to default point is at a suitable level. The daily value of equity in the pharmaceutical industry is positive, but at the same time it is less than the leverage value.

4.5. Basic metals industry:

Nine companies were selected as samples in the basic metals industry. According to table 2, the distance to default in the basic metals industry (on average) is 2.02 times. This means that the current value of the basic

metal industry is about twice as much as the industry's endogenous bankruptcy threshold, and therefore, ($V_B > v_t$). The ratio of the total value of debt to the current value in this industry is 0.84. This fact indicates that the total value of debt in this industry is 84% of its current (closing) value. The ratio of the endogenous bankruptcy threshold to the current value in the basic metals industry is 0.62. This means that on average, the industry's current value is about 1.6 times as much as the bankruptcy threshold, so in this industry, the distance to default point is at a moderate level. The value of current equity in the basic metals industry is positive, but at the same time it is less than the leverage value.

4.6. Cement industry:

Nine companies were chosen as samples in the cement industry. According to table 2, the distance to default in the cement industry (on average) is 5.01 times This means that the current value of the cement industry is 5.01 times higher than the endogenous bankruptcy threshold ($V_B > v_t$), and the standard deviation of non-leveraged assets is also low. The ratio of total debt to current value in this industry is 0.54. This fact indicates that the total value of debt in this industry is slightly more than half of its current (closing) value. The ratio of the endogenous bankruptcy threshold to the current value in the cement industry is 0.66. This means that on average the current value of this industry is more than 1.5 times as much as its bankruptcy threshold and therefore, in this industry, the distance to default point is at an appropriate level. The value of the current equity in the cement industry is positive, but at the same time less than the leverage value.

5- Discussion and Conclusion:

According to the trade-off theory, capital structure is based on a trade-off between tax savings and distress costs of debt. It deals with the two concepts – cost of financial distress and agency costs. An important purpose of the trade-off theory is to explain the fact that corporations usually are financed partly with debt and partly with equity. If the costs associated with the financial distress are properly measured, the firm will reach the sustainable balance (Molina, 2005; Almeida & Philippon, 2007). In this research, attempts were made to provide appropriate estimates of the costs associated with financial distress (1) during bankruptcy or (2) before bankruptcy. The above distinction is important because in the general context previous studies related to financial distresses either

sought to calculate and determine the value of a firm after a default or tried to restructure the debts. However, when the costs associated with the financial distress occur before the declaration of bankruptcy, the conditions change. In addition, losses due to bankruptcy do not play a decisive role in the adoption of debt financing decisions. Therefore, considering the costs of such issues as relationships with shareholders, inadequate investments, and risk transfer and their occurrence would increase the likelihood of bankruptcy is necessary.

According to the Leland and Toft model, if the distance to default is less than zero, practically the current value of the firm is less than the value of the bankruptcy threshold of the firm. Therefore, the current value of the firm will not be able to cover the debts resulted from received financial facilities, interest cost and endogenous bankruptcy threshold calculated by the model. Accordingly, the company will bear costs called bankruptcy costs. There is no difference between direct and indirect costs in the model here. However, if the distance to the financial default is greater than zero, then the current value will be more than the required financial strength required to cover the debts resulted from financial facilities and interest costs.

According to findings of this research, the value of debt in the automotive industry is more than three times as much as its current value. In addition, the value of equity is negative (less than the amount of debt). Since the current leverage value of this industry (assets financed from debt) is at a high level, the companies active in the automotive industry face serious financial problems and so this industry can be considered somehow bankrupt. On average, the current value of the sugar industry is almost twice as much as its bankruptcy threshold, and also the distance to default point is at a fairly good level. Therefore, the sugar industry has the potential to provide adequate liquidity and therefore it is not faced with liquidity distress. The research findings show that the total value of the debt of the dairy industry is about 130% of its current (closing) value and also the ratio of the endogenous bankruptcy threshold to the total value of the debt is 0.73. Thus on average, the current value of this industry is almost equal to its bankruptcy threshold and consequently the distance to default point in this industry is not at a suitable level.

According to the research findings, the current value of the pharmaceutical industry is about four times as much as the endogenous bankruptcy threshold as well as twice as much as its debt. Therefore, the

distance to default point in the pharmaceutical industry is at an appropriate level. In the basic metals industry, the current value is about twice as much as the endogenous bankruptcy threshold and the ratio of total debt to current value equals to 0.84. The value of equity in the basic metals industry is positive, but at the same time less than the value of leverage. Therefore, in this industry, the distance to default point is at a moderate level. The research findings indicate that the current value of the cement industry is about five times as much as the endogenous bankruptcy threshold of the industry and the ratio of the total value of debt to the current value is about half. The value of equity in the cement industry is positive, but at the same time less than the leverage value. As a result, in this industry, the distance to default point is at a good level.

According to the findings of the present study, the Leland and Toft model possesses the required capabilities to predict financial distress in the Tehran Stock Exchange. Therefore, all stakeholders of firms can make timely and accurate predictions about the financial distresses that would be faced by their firms, and eventually prevent their bankruptcy.

According to the research findings, the automotive and dairy industries do not use debt to finance themselves. Because of the amount of debt in equity is very high in these industries. It is suggested that sugar, pharmaceuticals, basic metals and cement industries should pay attention in customer orientation and investing enough in human resources and equipment in order to be able to compete with their foreign counterparts.

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