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Examining the Impact of Deviation from Target Leverage on the Probability of Corporate Bankruptcy

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Abstract

Deviation of companies' leverage from optimal leverage can result in the imposition of costs and an increased risk of bankruptcy. In this study, we examine the effect of companies' deviation from optimal leverage on the probability of bankruptcy. For this purpose, data from 86 companies over a 6-year period were collected. The analysis and hypothesis testing were conducted using the statistical software EViews and logistic regression methodology. The results showed that deviation from target leverage for companies with leverage higher than the target leverage had a significant relationship with the risk of bankruptcy. In other words, the more a company's leverage exceeds its target leverage, the higher the probability of bankruptcy. However, for companies with leverage lower than the target leverage, no significant relationship was found with the probability of bankruptcy. On the other hand, leverage with a one-year and three-year lag had a significantly positive relationship with the probability of bankruptcy.

Keywords: *Bankruptcy Risk, Logit, Target Leverage.*

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1. Introduction

Capital Structure is an important managerial decision because it affects shareholders' returns and risks. The market value of stocks is influenced by capital structure decisions. An organization's financing decisions may affect the composition of its equity, which has implications for shareholders' income and risk, and in turn, impacts the cost and risk of bankruptcy. If an organization fails to align its capital structure with the target optimal leverage, the funds obtained through the issuance of debt and preferred stock can increase the risk of bankruptcy and reduce the market value of each share [1].

Research indicates that deviation from target leverage significantly impacts the probability of bankruptcy, such that companies facing leverage deviations, especially those with high deviation from the target leverage, experience financial constraints and, consequently, a higher likelihood of bankruptcy [2]. Kisgen (2009) demonstrated that an increase in leverage significantly raises bankruptcy risk, showing that a one standard deviation increase from the target leverage leads to a 156% increase in the probability of bankruptcy [3]. In a study conducted by Schandbauer (2014) on a large sample of U.S. financial institutions between 2000 and 2007, it was shown that deviation from target leverage primarily causes institutions far from their optimal leverage to strive to increase their financial flexibility by issuing different securities. Secondly, the lower the banks' capital and the further they deviate from their optimal leverage, the more they take risks [4]. Deviation from target leverage significantly impacts the probability of bankruptcy, as various studies have shown. Companies that are either over-leveraged or under-capitalized face higher risks, forcing them to adjust their capital structures to reduce financial difficulties [5].

Empirical evidence suggests that companies adjust their capital structures toward their target leverage at a rate of 5 to 13 percent per year, highlighting the importance of maintaining optimal leverage to reduce the probability of bankruptcy [6]. While the focus on target leverage is crucial, it is also necessary to consider that not all companies respond uniformly to deviations. Some may prioritize growth or market conditions over immediate adjustments, potentially increasing their bankruptcy risk in volatile environments [7, 8]. Ogur et al. (2022) explored whether financial leverage and product market competition increase or decrease financial bankruptcy risk. The results showed that financial leverage and competition in the product market have non-uniform effects on financial bankruptcy risks. The leverage effect follows an inverse U-shape, meaning companies with higher leverage are at one end of the spectrum and at risk of bankruptcy, while those with leverage lower than the target are at the other end of the spectrum. The majority of companies are at the highest point of the inverse U-shape [8]. Nguyen & Kien (2021) examined the relationship between debt maturity structure and bankruptcy risk. According to the results, leverage is positively associated with default risk. Short-term leverage shows a significant positive effect on bankruptcy risk, while long-term leverage does not show significant results. Companies exposed to short-term debt risk are more vulnerable to bankruptcy. Firms with better financial conditions and more concentrated industries experience a higher short-term leverage effect compared to their peers [7].

Moreover, companies with excessive leverage tend to take on higher risks, which can lead to negative short-term market reactions [9]. Research shows that financial institutions deviating from their target capital structure are likely to adjust their securities to increase financial flexibility and demonstrate to regulatory organizations that the company's risk is low. Thus, even the smallest tightening in government regulations can increase bankruptcy rates among highly leveraged companies due to higher borrowing costs and credit rationing, significantly affecting the bankruptcy risks associated with leverage [5, 10]. In this study, we aim to explore bankruptcy risk through the lens of leverage and capital structure changes and clarify the relationship between deviation from target leverage and bankruptcy risk within the frameworks presented.

2. Methodology

To estimate the probability of bankruptcy, we use the Ziegler model (2004). The dependent variable is the probability of bankruptcy, determined based on Ziegler's (2004) definition of the bankruptcy threshold for companies. Ziegler (2004) argues that a company's stock can be considered as call options issued on the company's assets, with the strike price equivalent to the nominal value of the debt issued by the company [11]. The bankruptcy threshold for companies is calculated as follows:

$$S = (1 - T) \times \frac{(I \times D)}{\frac{\partial^2}{2} + R_F}$$

where D represents the company's debt, III is the financing rate, σ\sigmaσ is the variance of the company's stock, T is the corporate tax rate, and R_f is the risk-free return

rate. A company-year observation is considered to be at the bankruptcy threshold (s) if its stock is traded at prices below the bankruptcy threshold in the stock exchange. The dependent variable in this research's models is a binary variable, with a value of 1 if the company is at the bankruptcy threshold and 0 otherwise.

The logit model used to examine the effects of leverage deviation from target leverage on the probability of bankruptcy follows Cuang et al. (2013). The effect of financial leverage is examined with one-year lag (Leveit-1), three-year lag (Leveit-3), and leverage changes over the past three years (ΔLeveit-3) using the following models. The control variables in these models include return on assets (X1), return on assets (X2), return on equity (X3), earnings before interest and taxes (X4), and the book-to-market ratio (X5). The company's financial leverage Devit-1 indicates the deviation of actual leverage from the target leverage. Leveit-1abv is a dummy variable that equals 1 if the company's leverage is above the target leverage or optimal leverage, and 0 if it is below the target leverage. Leveit-1bel is a dummy variable that equals 1 if the company's leverage is below the target leverage, and 0 if it is above the target leverage [12].

Uniform logit model:

$$SIT= Leve_{it-1} + Leve_{it-3}+ Dev_{it-1} * Leve_{it-1}^{abv} + Dev_{it-1} * Leve_{it-1}^{bel} +X1_{it}+ X2_{it} +X3_{it} + X4_{it} +X5_{it} + \acute{\varepsilon}_{it}$$

$$SIT= Leve_{it-1} + \Delta Leve_{it-3}+ Dev_{it-1} * Leve_{it-1}^{abv} + Dev_{it-1} * Leve_{it-1}^{bel} +X1_{it}+ X2_{it} +X3_{it} + X4_{it} +X5_{it} +\acute{u}it$$

$$SIT= Leve_{it-3} + \Delta Leve_{it-3}+ Dev_{it-1} * Leve_{it-1}^{abv} + Dev_{it-1} * Leve_{it-1}^{bel} +X1_{it}+ X2_{it} +X3_{it} + X4_{it} +X5_{it} +\acute{u}it$$

In principle, target leverage (Lit) is the structure that maximizes returns with different combinations of debt and equity. In this regard, there are generally two models to calculate the target structure. In the first model, based on the portfolio model presented by Jagadeesh and Titman (1993) in momentum theory, companies are first ranked based on their returns, and the top 10% of companies with the highest returns are selected. The average leverage of these companies for each year is calculated and used as the optimal target leverage ratio (Lit) for that year. In this study, considering the 86 sample companies, 9 companies (10%) were selected, and the target leverage ratio was extracted for each year.

3. Findings

In this study, the Tehran Stock Exchange was tested over a 6-year period. After extracting the target leverage and calculating the deviation of companies' leverage from the target leverage, the proposed regressions were tested.

Table 1. Results of the Estimated Uniform Logit Regression Model (1)

Variable	Coefficient	T-statistic	Significance Level
Intercept	1.655	3.89	0.000
Leveit-1	1.596	3.59	0.000
Leveit-3	2.471	2.19	0.041
Devit-1 * Leveit-1abv	2.334	2.99	0.011
Devit-1 * Leveit-1bel	-0.978	-0.84	0.500
X1it (Return on Assets)	-0.374	-5.44	0.000
X2it (Return on Equity)	-0.214	-4.68	0.000
X3it (Earnings Before Tax & Interest)	-1.564	-3.55	0.000
X4it (Book-to-Market Ratio)	-0.825	-4.38	0.000
X5it (Financial Leverage)	0.245	2.37	0.000

(p-value) LR = 325.426 (0.000); Hausman-Lemeshow Test: 4.31 (0.705); Pseudo R^2: 0.359

Table 2. Results of the Estimated Uniform Logit Regression Model (2)

Variable	Coefficient	T-statistic	Significance Level
Intercept	2.452	3.89	0.000
Leveit-1	2.911	3.65	0.000
ΔLeveit-3	2.438	2.30	0.040
Devit-1 * Leveit-1abv	2.334	2.99	0.011
Devit-1 * Leveit-1bel	-0.847	-0.87	0.510
X1it (Return on Assets)	-0.387	-5.88	0.000

X2it (Return on Equity)	-0.213	-4.68	0.000
X3it (Earnings Before Tax & Interest)	-1.425	-3.55	0.000
X4it (Book-to-Market Ratio)	-0.825	-4.38	0.000
X5it (Financial Leverage)	0.245	2.37	0.000

(p-value) LR = 321.325 (0.000); Hausman-Lemeshow Test: 3.11 (0.802); Pseudo R^2: 0.359

Table 3. Results of the Estimated Uniform Logit Regression Model (3)

Variable	Coefficient	T-statistic	Significance Level
Intercept	1.901	5.77	0.000
Leveit-3	1.524	4.87	0.000
ΔLeveit-3	2.641	2.94	0.048
Devit-1 * Leveit-1abv	2.321	2.89	0.080
Devit-1 * Leveit-1bel	-0.957	-0.79	0.530
X1it (Return on Assets)	-0.374	-5.44	0.000
X2it (Return on Equity)	-0.214	-4.68	0.000
X3it (Earnings Before Tax & Interest)	-1.564	-3.55	0.000
X4it (Book-to-Market Ratio)	-0.825	-4.38	0.000
X5it (Financial Leverage)	0.245	2.37	0.000

(p-value) LR = 411.87 (0.000); Hausman-Lemeshow Test: 4.29 (0.715); Pseudo R^2: 0.359

The above logit models predict a uniform relationship between the probability of bankruptcy and leverage. The results report the uniform logit models. The overall significance of the regression was evaluated using the LR test. All three models are statistically significant at the 95% confidence level based on the relevant test statistic. The coefficient of the leverage variable with a one-year lag is positive and significant in all three models, indicating that higher leverage increases the probability of bankruptcy in the following year. This is also true for the leverage variable with a three-year lag, as its coefficient is positive and significant in both models.

The results suggest that companies with high-leverage financing policies are more likely to face bankruptcy in the coming years. Regarding the control variables, the fitted results of all three models show that the coefficients of each variable have either positive or negative signs depending on their relationship with bankruptcy risk.

The Pseudo R^2 and the Hausman-Lemeshow Test were used to evaluate the goodness-of-fit of the models. The R^2 for all three models is 0.359. The null hypothesis of the Hausman-Lemeshow test is that the model has adequately explained the dependent variable. The test statistic confirms the appropriate fit for all three models.

4. Discussion and Conclusion

This study aimed to examine the impact of leverage deviation from target leverage on the probability of bankruptcy in companies listed on the Tehran Stock Exchange. Over a six-year period, data from 86 companies were analyzed using logistic regression models to determine the relationship between leverage deviations and bankruptcy risk. The results show that deviation from target leverage, particularly when leverage exceeds the target, significantly increases the probability of bankruptcy. Furthermore, this relationship holds true across both short-term (one-year lag) and long-term (three-year lag) leverage deviations. Control variables, such as return on assets, return on equity, earnings before interest and taxes, and the book-to-market ratio, were also found to influence the likelihood of bankruptcy in expected ways.

The findings indicate that companies with higher-than-optimal leverage are at an increased risk of bankruptcy, aligning with previous studies. For example, Ziegler (2004) emphasized that higher leverage increases financial risks, especially in environments with economic volatility [11]. The results of the one-year and three-year leverage lags show a positive and significant relationship with bankruptcy risk, supporting the findings of Marinani (2024) that firms with high leverage deviations face more financial constraints and are more likely to encounter bankruptcy [2]. This study further supports Schandbauer (2014), who found that deviations from target leverage are often corrected by firms through securities issuance, yet they still face increased risks when leverage remains high [4].

The negative impact of leverage deviation on bankruptcy probability, particularly when leverage exceeds the target, underscores the importance of maintaining an optimal capital structure. Companies that deviate from this optimal point are more exposed to financial distress, as highlighted

by Ralph et al. (2011) and Hovakin & Li (2009). The inverse U-shape effect of leverage found in this study suggests that firms with high leverage face greater risks at one end of the spectrum, while those with lower leverage benefit from reduced bankruptcy risk. This finding aligns with the results of Ogur et al. (2022), who pointed out that the relationship between financial leverage and bankruptcy risk is not linear, with firms at the extreme ends of the leverage spectrum experiencing heightened financial vulnerability.

The significant and negative coefficients of return on assets (X1it), return on equity (X2it), earnings before interest and taxes (X3it), and the book-to-market ratio (X4it) provide additional insight into the financial health of the companies studied. These findings indicate that companies with better financial performance, as measured by higher returns and profitability, are less likely to experience bankruptcy. This is consistent with the findings of Wang et al. (2018), who noted that firms with higher liquidity and profitability have a lower risk of financial distress, especially during economic downturns. Additionally, Kisgen (2009) demonstrated that companies with high leverage tend to engage in riskier financial behaviors, which can negatively impact their short-term market reactions, further supporting the results of this study [3].

The insignificant results for the leverage deviation below the target (Devit-1 * Leveit-1bel) indicate that companies with lower-than-optimal leverage do not face a significantly increased risk of bankruptcy. This result contradicts some of the findings in the literature, such as Nguyen & Keen (2021), who suggested that even firms with low leverage might experience financial challenges under certain conditions [7]. However, it aligns with Cathcart et al. (2024), who found that firms with lower leverage often have more flexibility to adjust their capital structure without facing immediate financial distress [5].

The study's findings contribute to the broader literature on corporate finance by emphasizing the critical role of capital structure management in mitigating bankruptcy risk. As firms deviate from their target leverage, particularly in the upward direction, they expose themselves to financial difficulties, which can eventually lead to bankruptcy. This conclusion supports the capital structure theory that maintaining optimal leverage is essential for a firm's long-term financial stability [13]. Moreover, the findings underscore the importance of financial flexibility, as firms that deviate too far from their target leverage—either upward or downward—are more likely to experience financial distress [2].

In summary, this study confirms the significant role of capital structure and leverage management in determining bankruptcy risk. Firms that maintain leverage close to their target levels are better positioned to avoid financial distress, while those with excessive leverage are more likely to face financial challenges. These findings align with the existing literature, including the works of Ziegler (2004) and Alexander & Schandlbauer (2014), all of whom emphasized the importance of optimal leverage in reducing bankruptcy risk [4, 11]. The implications of these findings are relevant for both corporate managers and policymakers, as they highlight the need for careful leverage management to avoid financial distress and ensure long-term sustainability.

Despite the significant findings of this study, there are several limitations that should be acknowledged. First, the sample size of 86 companies may not be representative of the broader population of firms in different industries or regions. This limitation could affect the generalizability of the findings to other markets or economic environments. Second, the study focuses exclusively on the Tehran Stock Exchange, which operates in a unique economic and regulatory environment. This context-specific focus may limit the applicability of the findings to other countries or exchanges with different financial structures. Additionally, the six-year period studied may not capture the full range of economic cycles, including periods of recession or boom, which could influence the relationship between leverage deviation and bankruptcy risk.

Moreover, the use of logistic regression models, while effective in identifying relationships between variables, may not fully capture the complexity of financial decision-making and the dynamic nature of capital structure adjustments. There may be other factors, such as macroeconomic conditions, firm size, and management practices, that were not included in the models but could play a significant role in determining bankruptcy risk. Finally, the reliance on historical financial data may not account for changes in market conditions or regulatory environments that could impact firms' capital structure decisions and bankruptcy probabilities.

Future research could address some of the limitations identified in this study. Expanding the sample size to include more companies across different industries and regions would provide a more comprehensive understanding of the relationship between leverage deviation and bankruptcy risk. Additionally, conducting similar studies in other stock exchanges and economic environments would allow for cross-country comparisons and the identification of potential

differences in how leverage deviations impact bankruptcy risk in different contexts.

Another avenue for future research could involve examining the role of macroeconomic factors, such as interest rates, inflation, and economic growth, in moderating the relationship between leverage deviation and bankruptcy risk. By incorporating these external variables, future studies could provide a more nuanced understanding of the factors that influence firms' financial decisions and their likelihood of experiencing financial distress. Furthermore, exploring the impact of corporate governance practices and management strategies on capital structure decisions could shed light on how internal company dynamics affect financial outcomes.

Lastly, longitudinal studies that span longer periods, including multiple economic cycles, would help capture the full spectrum of market conditions and their effects on bankruptcy risk. This would allow researchers to examine whether the relationships observed in this study hold true during periods of economic downturn or whether different patterns emerge in response to changing market dynamics.

For corporate managers, this study highlights the importance of maintaining optimal leverage levels to reduce the risk of bankruptcy. Companies should regularly review their capital structure and make adjustments as needed to ensure that their leverage is aligned with industry benchmarks and market conditions. In particular, firms with high leverage should be cautious about taking on additional debt, as this could increase their financial vulnerability and lead to bankruptcy.

Policymakers should consider implementing regulations or guidelines that encourage firms to maintain leverage within safe limits. This could involve providing incentives for firms to manage their capital structure more effectively or introducing penalties for companies that take on excessive debt. Such measures would help reduce the overall risk of financial instability in the economy.

Lastly, financial institutions and investors should pay close attention to companies' leverage levels when making lending or investment decisions. Firms with leverage significantly above their target levels may pose a higher risk of default, and investors should factor this into their risk assessments. By carefully monitoring leverage deviations, financial institutions can make more informed decisions and help mitigate the risk of bankruptcy in the market.

Authors' Contributions

Authors equally contributed to this article.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

All procedures performed in this study were under the ethical standards.

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