Accounting and Auditing with Application

www.aaa.reapress.com

Acc. Aud. Appl. Vol. 3, No. 1 (2026) 1–16.

Paper Type: Original Article

The Impact of Financially Distressed Customers with an Emphasis on the Role of External and Internal Financing

Fatemeh Okhravi[1,*], Seyed Hesam Vaghfi[2]

[1] Department of Khayyam Non-Governmental University, Mashhad, Iran; okhravihasty@gmail.com.

[2] Department of Management, Economics and Accounting of Payame Noor University, Tehran, Iran; vaghfi@pnu.ac.ir.

Citation:

Received: 12 July 2025 *Revised: 22 September 2025* *Accepted: 24 November 2025*	Okhravi, F., & Vaghfi, S. H. (2026). The impact of financially distressed customers with an emphasis on the role of external and internal financing. *Accounting and Auditing with Application, 3*(1), 1-16.

Abstract

From the perspective of the Resource Dependence Theory, customer concentration reflects a firm's reliance on a limited number of key clients, which can increase operational and liquidity risks and exacerbate the likelihood of financial distress. Conversely, according to the pecking order theory of financing, access to internal financing, as a low-cost and stable resource, can mitigate the negative effects of customer concentration and serve a protective role against financial distress. This study aims to examine the impact of customer concentration on financial distress among firms listed on the Tehran Stock Exchange, with a particular focus on the moderating role of internal and external financing. The statistical population consists of 145 listed firms over the period 2018–2024, analyzed using panel logistic regression. The results indicate that customer concentration has a positive and significant effect on corporate financial distress. Furthermore, internal financing plays a significant inverse moderating role in reducing the impact of customer concentration on financial distress, whereas external financing does not exhibit a significant moderating effect. These findings highlight the importance of managing internal resources and reducing reliance on major customers to prevent financial distress. Beyond enriching the literature on financial distress and risk management, this study provides practical guidance for managers and policymakers seeking to enhance corporate financial resilience through effective customer and financing strategies.

Keywords: Customer concentration, Internal financing, External financing, Financial distress, Firms listed on the Tehran stock exchange.

1 | Introduction

In today's competitive and dynamic business environment, firms must establish and strengthen relationships with key customers to maintain and expand their market share. While these relationships can serve as valuable

Corresponding Author: okhravihasty@gmail.com

https://doi.org/10.22105/aaa.v3i1.88

sources of revenue and cash flow stability, excessive reliance on a limited number of customers may lead to heightened dependency and increased financial risks. Customer concentration refers to the extent to which a substantial portion of a firm's sales depends on a small number of clients, a condition that can expose the firm to significant revenue fluctuations and financial hazards [1].

Research indicates that high customer concentration can enhance customers' bargaining power, compelling firms to offer financial concessions such as trade credit. This, in turn, transfers liquidity and operational risks to the firm. Moreover, dependence on a limited client base may create severe volatility in cash flows, such that the loss of a key customer could result in a sudden decline in revenue and disruption in the financial supply chain.

Financial distress refers to a condition in which cash inflows from short-term operational activities and financial resources are insufficient to cover cash outflows. This situation arises when the internal rate of return on a firm's investments, either currently or in the near future, falls below the cost of capital. From a funds management perspective, financial distress occurs when cash generated from operations is inadequate to meet cash outflows. In other words, financial distress encompasses events that accelerate the likelihood of bankruptcy, such as breaches of loan covenants [2].

On the other hand, access to external financing, such as bank loans or debt issuance, can help firms manage the risks associated with customer concentration. Firms capable of obtaining external resources can secure liquidity to withstand financial shocks and avoid entering financial distress. However, when interest rates rise and lending standards become stricter, accessing external finance becomes more challenging. This situation is particularly risky for firms heavily dependent on a few customers, as the ability to raise new funds diminishes during financial difficulties.

Furthermore, high customer concentration can increase a firm's cost of capital, as investors perceive higher risk. Firms may resort to earnings management or reduce transparency to maintain relationships with major customers, actions that can undermine investor confidence. In this context, the quality of internal controls also plays a crucial role in moderating the effects of customer concentration on financial risk. Empirical evidence suggests that strong internal controls can mitigate the adverse impacts of customer concentration on financial risks.

One of the most critical factors influencing a firm's financial stability and resilience is the structure and quality of its relationships with major customers. Concentrated customers are defined as those who account for a substantial portion of a firm's sales and, consequently, wield significant power in determining transaction terms and negotiations. In such circumstances, excessive reliance on a small number of customers can expose firms to considerable financial and operational risks. One of the adverse consequences of such concentration is an increased likelihood of financial distress during periods of liquidity shortages or declining demand from major customers [3].

1.1 | Problem Statement

Customer concentration and its associated increase in the likelihood of financial distress among firms is a critical issue in corporate finance and risk management, widely discussed in the financial literature and empirical research. High customer concentration refers to a firm's dependence on a small number of key customers, which can expose the firm to significant revenue fluctuations and liquidity risks. Firms that derive a substantial portion of their revenue from a few major customers may face ssevere liquidity and operational cost challenges if one of these customers reduces orders or delays payments. This situation directly increases the likelihood of financial distress [4].

Studies indicate that customer concentration leads to imbalances in operational cash flows and a reduction in firms' financial flexibility. When a company relies on a few large customers, its ability to cope with economic shocks and sudden market changes diminishes. In such cases, the firm may be forced to use high-cost financial resources or sell assets at a loss to cover liquidity shortfalls. Over the long term, this process can lead to a

reduction in working capital and an increase in debt pressures, ultimately driving the firm toward financial distress [5].

Furthermore, customer concentration can have indirect effects on strategic decisions and investment choices. To maintain long-term relationships with key customers, firms may opt for low-risk, short-term projects and avoid high-risk, high-return investments. Although this conservative strategy may strengthen business ties with major clients, it can reduce the firm's capacity to increase long-term profitability and return on investment, thereby gradually escalating financial risk and the likelihood of financial distress [6]. Empirical research has also shown that customer concentration is a predictor of financial distress in firms. A study by Campello and Gao [3] revealed that excessive customer concentration increases liquidity risk and exerts pressure on financial resources, and in critical situations, firms with high concentration face a higher likelihood of financial problems and distress compared to those with a more diversified customer base.

These findings are consistent with international studies; for example, Deng and Xiao [7] found that Chinese firms with high customer concentration were more likely to rely on costly short-term debt and face liquidity problems during financial crises, which increases the risk of financial distress. Another factor contributing to the increased likelihood of financial distress in firms with high customer concentration is the strong bargaining power of major customers. Large customers, due to their substantial share of a firm's revenue, can impose stricter payment terms, contract conditions, or even significant discounts. These conditions place additional pressure on the firm's financial resources, and in the event of economic downturns or reduced orders, the firm may be unable to meet its financial obligations, ultimately leading to financial distress [8].

Multiple empirical studies have demonstrated that customer concentration is a key indicator in predicting firms' risk of financial distress. For instance, Campello and Gao [3] found that firms with high customer concentration, due to cash flow pressures and reduced financial flexibility, are more vulnerable to financial and economic crises compared to firms with a diversified customer base. These findings are consistent with international evidence. Deng and Xiao [7] showed that Chinese firms with high concentrations of major customers are compelled, during recessions and economic crises, to rely on costly short-term debt, which further increases the likelihood of financial distress. One of the main drivers of this heightened risk is the bargaining power of major customers. Large customers, due to their substantial contribution to a firm's revenue, can impose stricter contractual terms and extended payment schedules. This pressure directly affects the firm's financial resources, potentially forcing it to rely on high-cost financing or to sell assets at a discount to maintain liquidity. Although such short-term measures may preserve relationships with key customers, over the long term they weaken the firm's financial structure and elevate the risk of financial distress [9], [10]. Customer concentration also has indirect effects on firms' strategic and investment decisions. For example, firms that are overly dependent on major customers may prefer to invest in low-risk, short-term projects to maintain relationships with key clients. Although this conservative approach can strengthen business ties, it reduces the firm's capacity for innovation and long-term growth, thereby increasing financial risk and the likelihood of financial distress [11].

Research has shown that firms with high concentrations of major customers face greater liquidity pressures. These pressures may compel firms to incur higher costs for external financing or increase leverage to cover cash flow fluctuations, all of which contribute to a higher probability of financial distress [12]. Furthermore, customer concentration can negatively affect operational flexibility and a firm's ability to manage financial risks, such that the firm may lack the capacity to respond promptly to sudden market changes, exacerbating the risk of financial distress [3]. From a practical perspective, reducing customer concentration and diversifying the customer base is a key strategy to mitigate financial distress risk. Firms can enhance their financial and operational flexibility by increasing the number of customers and decreasing reliance on major clients. Additionally, implementing long-term contracts, advance payments, and diversifying revenue sources can improve cash flow management and reduce the likelihood of financial distress [10]. Overall, customer concentration creates high dependency and increases the bargaining power of key customers, placing pressure on cash flows and reducing firms' financial flexibility. These factors, combined with decreased strategic

flexibility and constraints on high-risk investments, significantly elevate the likelihood of financial distress. Therefore, the intelligent management of customer concentration and the adoption of customer diversification strategies, along with effective financial risk control, are essential for reducing the probability of financial distress and enhancing corporate sustainability [9], [10], [12]. A key aspect of examining customer concentration and its impact on financial distress is its direct relationship with operational cash flow and overall financial stability. Firms that rely heavily on a small number of major customers effectively expose a substantial portion of their revenue to fluctuations in demand from key clients. This dependency limits independent financial decision-making, and during crises, firms may be forced to rely on costly or short-term financing to secure liquidity. Cash flow pressures, in addition to increasing financing risk, may lead to an inability to meet current obligations, further heightening the probability of financial distress [7], [13]. Customer concentration also exerts indirect effects on firms' managerial and strategic decisions.

Managers of firms with high customer concentration, due to significant dependence on a few clients, often tend to limit high-risk, long-term investments and focus instead on low-risk, short-term projects. While this conservative approach can help maintain relationships with key customers, it reduces the firm's capacity for innovation, long-term growth, and financial performance. In other words, high customer concentration may render firms more vulnerable to economic shocks and sudden market changes, thereby directly increasing the likelihood of financial distress [11], [14]. Recent research has also shown that the bargaining power of major customers can substantially amplify financial pressure. Large customers, due to their significant contribution to a firm's revenue, can impose stricter contractual terms and longer payment periods. These pressures not only affect the firm's liquidity but, over the long term, may lead to increased short-term debt and higher external financing costs, consequently raising the probability of financial distress [9], [10]. Another effect of customer concentration is the reduction of both operational and financial flexibility. Firms that are highly dependent on a limited number of customers face greater constraints when responding to market changes, limiting their ability to react swiftly and offset revenue declines. This decreased flexibility, in addition to increasing liquidity risk, may compel firms to adopt costly short-term measures during crises, ultimately threatening their financial health [12]. From a managerial perspective, diversifying the customer base and reducing concentration is one of the most effective strategies to mitigate the risk of financial distress. Firms can reduce dependence on major customers by attracting new clients and creating diverse revenue streams.

Moreover, implementing advance payment contracts, establishing varied credit lines, and carefully managing cash flows can alleviate pressures stemming from customer concentration and enhance financial sustainability [7], [10]. In summary, customer concentration is a key factor in increasing the likelihood of financial distress. It heightens financial dependence, reduces operational flexibility, and increases liquidity risk. Additionally, the bargaining power of major customers amplifies contractual and financial pressures, rendering firms more vulnerable during crises. Therefore, the intelligent management of customer concentration, the adoption of customer diversification strategies, and effective financial risk control are essential for reducing the probability of financial distress and enhancing corporate resilience [10], [12] Financing is one of the key tools that firms use to manage risks and maintain financial sustainability. This type of financing includes obtaining bank loans, issuing debt securities, or raising capital from external investors, and it can play a critical moderating role in the relationship between firms and key customers, thereby influencing the impact of customer concentration on financial distress. Firms that are dependent on a limited number of customers effectively expose a large portion of their revenue to fluctuations and the bargaining power of these clients. In such circumstances, external financing can operate in two ways: it may either mitigate the adverse effects of customer concentration or, under certain conditions, exacerbate them [9].

Firms that derive a substantial portion of their revenue from a limited number of major customers are exposed to customer concentration risk. Such concentration can increase the bargaining power of key customers, potentially placing the firm in a vulnerable financial position during adverse market conditions or in the event of the termination of relationships with major clients. Conversely, the loss of one or more key customers can lead to sudden declines in cash flows and disrupt financial and operational planning, which over the long term can exacerbate financial distress. Multiple studies have confirmed this relationship. For instance Ni et al. [9],

in a study of industrial firms in China, found that high customer concentration significantly increases the risk of bankruptcy and financial distress, particularly in firms with limited cash resources or heavy reliance on major customers. In the finance literature, external financing is recognized as an effective tool for managing liquidity risks and funding working capital. When firms face high customer concentration, the ability to access financial resources from debt and equity markets can mitigate the adverse effects associated with the loss of key customers. In such circumstances, access to external financing enables firms to offset liquidity shocks caused by reduced sales or the termination of major customer relationships, thereby preventing severe declines in financial capacity and financial distress. A recent by Kwak et al. [15], examining manufacturing firms in South Korea, found that firms with better access to external financing, particularly study bank loans and debt issuance, were less likely to experience financial distress in the context of customer concentration. This effect was especially pronounced in capital-intensive industries and among small- and medium-sized enterprises.

Soleimani and Safari [16], in their study titled "the relationship between knowledge management, financial risk-taking, and financial distress in banks," found a significant and negative relationship between knowledge management and financial distress in banks. The results also indicated a significant inverse relationship between financial risk-taking and financial distress. Based on these findings, banks seeking to avoid financial distress must continuously improve their knowledge management and financial risk-taking practices in accordance with internal and external changes. Given that knowledge and environmental risks are constantly evolving, banks are compelled to adopt policies that integrate knowledge management, risk-taking strategies, and the management of potential risks to remain competitive. This study holds high practical value in supporting the operational success and financial resilience of banks.

Nazari Amrouabadi [17], in the study titled "examining the effect of Chief Executive Officer (CEO) Power on financial distress with an emphasis on the moderating role of cash holdings in firms listed on the Tehran Stock Exchange," found that CEO power has a significant negative effect on financial distress in firms; specifically, as CEO power increases, the likelihood of financial distress decreases. The study also demonstrated that cash holdings play a significant negative moderating role in the relationship between CEO power and financial distress.

Haque and Kleymenova [18], in their study titled "managerial ownership and financial distress: evidence from the Chinese stock market," found that managerial ownership exhibits a negative relationship with financial distress at both low (below 12%) and high (above 18%) ownership levels, where managerial and shareholder interests are aligned. This indicates that, at these levels, managerial ownership can contribute to improving a firm's financial condition. However, within the intermediate range, or the entrenchment zone (12–18%), managerial ownership is positively associated with financial distress, suggesting that in this range, it may exacerbate the firm's financial vulnerability.

Furthermore, the study revealed that investment in Research and Development (R&D) plays a mediating role in the relationship between managerial ownership and financial distress. Ni et al. [9] found that high major customer concentration increases the bargaining power of these customers over suppliers, thereby exacerbating the financial constraints faced by supplying firms. Small and non-state-owned companies are particularly affected by these pressures and are more vulnerable. Using advanced machine learning techniques, the authors identified firms that are most adversely impacted by customer concentration, approximately 15% of all firms, primarily small non-state-owned enterprises.

Major customers in strong bargaining positions can exert pressure on dependent suppliers, negatively affecting their financial conditions. Consistent with this prediction, their analysis demonstrates that customer base concentration can enhance the bargaining power of downstream customers in supplier–customer interactions, significantly intensifying financial constraints for upstream firms. The study further introduces a novel machine learning approach to analyze the heterogeneous effects of customer concentration, enabling the identification of approximately 15% of firms, particularly small non-state-owned companies, as the most vulnerable to customer concentration, where the dominant bargaining effect is observed.

Li et al. [19], in their study titled "predicting financial distress risk using corporate governance metrics," analyzed data from Chinese firms over a 17-year period and found that, although corporate governance alone is insufficient for accurately predicting financial distress, its combination with financial ratios and macroeconomic factors significantly enhances predictive power. The proposed model also highlights the role of state ownership, board independence, institutional investors, and CEO characteristics in the financial distress prediction process.

1.2 | Section Titles

From the perspective of research objectives, the present study falls within the category of applied research, as its findings can be utilized by investors, creditors, managers, and capital market regulators to identify factors influencing financial distress in firms and to improve financial decision-making. In terms of nature and methodology, this study is descriptive–correlational and ex post facto, meaning that the researcher examines relationships between variables using historical data without manipulating them. Given that the data are extracted from the financial statements and disclosed information of firms listed on the Tehran Stock Exchange and organized as firm–year observations, the dataset has a panel structure. Moreover, because the dependent variable financial distress is binary, taking values of zero or one, conventional linear regression methods are unsuitable. To correctly estimate the relationships, limited dependent variable models are employed. Specifically, this study uses a panel logistic regression model to test the hypotheses. This approach allows for estimating the probability of financial distress as a function of customer concentration, external financing, and their interactive effects.

Additionally, the model controls for unobserved heterogeneity across firms that may affect the likelihood of financial distress. To examine the moderating role of external financing in the relationship between customer concentration and financial distress, an interaction term, the product of customer concentration and external financing, is included in the empirical model. Furthermore, to reduce estimation bias and increase explanatory power, a set of control variables reflecting firms' financial and structural characteristics is incorporated into the model. Model estimation is conducted, and the statistical significance of the estimated coefficients is evaluated using appropriate tests. The overall goodness-of-fit of the model is assessed, and data analysis is performed using Stata software.

The statistical population of this study comprises all firms listed on the Tehran Stock Exchange. The sample consists of a subset of the population that accurately reflects its main characteristics. To ensure that the sample is representative of the target population, a systematic elimination method was employed. Specifically, the following five criteria were applied, and only firms meeting all these criteria were included in the sample, while the remaining firms were excluded:

I. Firms must have been listed on the Tehran stock exchange prior to 2018 (1397 in the Iranian calendar) and remain active on the exchange through the end of 2024 (1403).

II. This version preserves precise dates and maintains formal academic tone consistent with journal standards.

III. You can provide the next criterion, and i will continue translating it in the same style.

IV. Firms' fiscal year must end in Esfand (March 20–21), and they should not have changed their fiscal year or primary line of business during the period 2018–2024 (1397–1403).

V. Investment and financial intermediary companies, including leasing firms, insurance companies, holding companies, banks, and financial institutions, are excluded from the sample due to their distinct reporting structures.

VI. Financial data for the firms must be available for the period 2018–2024 (1397–1403).

VII. Firms should not have experienced trading suspensions exceeding six months.

VIII. After applying all the above criteria, 145 firms remained as the screened population, all of which were included in the sample. Consequently, our observations cover the period from 2018 to 2024 (1397–1403).

1.1.1|Dependent variable: Financial distress

In this study, to measure financial distress, following [20], the A-score model—an adjusted version of the Altman model is employed.

$$\mathrm{T-score\ A} = 0.291(\mathrm{WC/TA}) + 2.458\,(\mathrm{RE/TA}) - 0.301(\mathrm{EBIT/TA}) - 0.079\,(\mathrm{BVE/TL}) - 0.05(\mathrm{TS/TA}),$$

where:

I. Working capital to total assets ratio = X1 (WC/TA)

II. Retained earnings (accumulated deficit) to total assets ratio= X2 (RE/TA)

III. Earnings before interest and taxes (operating income) to total assets ratio= X3 (EBIT/TA)

IV. Book value of equity to total liabilities ratio= X4 (BVE/TL)

V. Net sales to total assets ratio= X5(TS/TA)

Accordingly, the ranges of the adjusted Altman model, based on the alignment with different stages of financial distress and bankruptcy [21], are defined as follows:

I. If $T < -0.14$, the probability of bankruptcy is very high (95%).

II. If $-0.14 < T < 0.02$, the firm is in a stage of severe financial distress.

III. If $0.02 < T < 0.36$, the firm experiences a cash shortfall and inability to meet financial or commercial obligations.

IV. If $0.36 < T < 0.6$, the firm is in a stage of incipient financial distress, and if $T > 0.6$, the firm is considered to have financial health.

1.1.2|Independent variable: Customer concentration

The customer concentration of firm i in year t is calculated based on the sales share to major customers, according to the following formula. In line with International Accounting Standards Board (IASB) Standard 131, whenever sales revenue from a single customer exceeds 10% of a firm's total revenue, that customer must be disclosed in the financial statements; this rule serves as the basis for this study.

In this study, customer concentration is measured using the Herfindahl–Hirschman Index (HHI):

1.1.3|Market concentration index herfindahl–hirschman index

The HHI for market concentration is calculated as follows:

$$\mathrm{HHI} = \sum_{n=1}^{\infty} \mathrm{S\,i\hat{}2},$$

where:

K denotes the number of active firms in the market.

Si represents the market share of firm i, calculated as follows:

$$\mathrm{Si} = \mathrm{XJi}\sum\mathrm{XJ},$$

where:

Xi denotes the sales of the firm, and i indicates the industry type.

Moderating variables: external and internal financing

In this study, the external financing variable is measured as the ratio of total debt to total assets of the firm. This ratio indicates the degree to which the firm relies on external financial resources in its capital structure. A higher value of this ratio suggests a greater dependence on external financing. Additionally, internal financing is measured using the changes in retained earnings and legal reserves relative to the firm's total assets.

2 | Control Variables

I. Return on Assets (ROA): measured by dividing net income by the total assets of the firm [2].

II. Firm size: measured by the natural logarithm of the firm's total assets [2].

III. Stock return: represents the monthly stock return, with data directly extracted from Rahavard Novin software [2].

IV. Tobin's Q ratio: measured by dividing the market value of assets (market value of equity plus book value of debt) by the book value of total assets of the firm [2].

V. Sales growth: measured by dividing the difference in sales between the current year and the previous year by the sales of the previous year [2].

2.1 | Data Analysis Tools

In this study, Stata version 17 software has been used for data analysis and hypothesis testing. This software is a powerful and fast statistical tool, offering extensive capabilities for statistical analysis and multiple tools for data management, as well as providing programming functionalities for users. Its capabilities are vast, incorporating the latest discovered methods in many branches of statistics.

2.2 | Dependent Variable: Financial Distress

In this study, financial distress is measured using the A-score-T model, an adjusted version of Altman's model, following the methodology of [20].

$$\mathrm{T-score\ A} = 0.291(\mathrm{WC/TA}) + 2.458\,(\mathrm{RE/TA}) - 0.301(\mathrm{EBIT/TA}) - 0.079\,(\mathrm{BVE/TL}) - 0.05(\mathrm{TS/TA}),$$

where:

I. Working capital to total assets= (X1, WC/TA)

II. Retained earnings to total assets= (X2, RE/TA)

III. Earnings before interest and taxes to total assets= (X3, EBIT/TA)

IV. Book value of equity to total liabilities= (X4, BVE/TL)

V. Net sales to total assets= (X5, TS/TA)

Accordingly, the ranges of the modified Altman model, based on the alignment with different stages of financial distress and bankruptcy [21], are defined as follows:

I. If T<−0.14T < -0.14T<−0.14, the company faces a very high probability of bankruptcy (95%).

II. If −0.14<T<0.02-0.14 < T < 0.02−0.14<T<0.02, the company is considered to be in a state of severe financial distress.

III. If 0.02<T<0.360.02 < T < 0.360.02<T<0.36, the company is in a stage of cash shortfall and is unable to meet its financial or commercial obligations.

IV. If 0.36<T<0.60.36 < T < 0.60.36<T<0.6, the company is in a latent stage of financial distress.

V. If T>0.6T > 0.6T>0.6, the company is considered financially healthy.

2.3|Independent Variable: Customer Focus

The customer focus index of firm i in year t is calculated based on the proportion of sales to major customers, according to the following formula. In line with IASB standard interpretation 131, whenever sales revenue from a single customer exceeds ten percent of the firm's total revenue, the customer's identity must be disclosed in the financial statements. This criterion serves as the basis for the present study. In this study, "customer focus" is measured using the HHI:

2.3.1|Market concentration index herfindahl–hirschman index

The market concentration index is calculated using the following formula:

$$HHI=\sum_{n=1}^{\infty} Si^2,$$

where:

I. K Number of active firms in the market

II. S_i Market share of firm i, calculated as follows:

$$Si = XJi\sum XJ,$$

where:

I. X_i company sale and i industry type.

II. Moderating variable: external and internal financing

In this study, the external financing variable is measured as the ratio of total company debt to total assets. This ratio reflects the extent to which the firm relies on external financial resources within its capital structure. A higher value of this ratio indicates a greater dependence on external financing. To measure internal financing, changes in retained earnings and statutory reserves relative to total assets are used.

2.3.2|Control variables

I. ROA: measured by dividing net profit by total assets of the firm [2].
Firm size: measured as the natural logarithm of total assets [2].

II. Stock return: represents the monthly stock return, with data directly obtained from the Rahavard Novin software [2].

III. Tobin's Q ratio: measured by dividing the market value of assets (market value of equity plus the book value of debt) by the book value of total assets [2].

IV. Sales growth: measured as the difference between current-year and previous-year sales divided by previous-year sales [2].

The present study focuses on examining the impact of customer concentration on corporate financial distress, with particular emphasis on the moderating role of financing. It investigates the relationship between market structural characteristics and corporate cash flows, as well as the likelihood of financial distress, while analyzing both internal and external factors influencing firms' financial vulnerability.

The temporal scope of the study encompasses the years 2018 to 2024, covering a seven-year period. The spatial scope is limited to the Tehran stock exchange. For data analysis and hypothesis testing, Stata version 17 was employed. This robust statistical software provides extensive capabilities for statistical analyses and data management, alongside programming functionality. Its wide range of features incorporates many of the latest methodologies across diverse statistical domains.

To examine the general characteristics of the variables and conduct a detailed analysis, descriptive statistics are required. *Tables 1- 4* presents the descriptive statistics of the variables used in this study.

Table 1. Descriptive statistics of the study variables.

Maximum	Minimum	Standard Deviation	Mean	Number	Symbol	Variable Name
0.994	0	0.130	0.043	1008	CC	Customer-centric
1.805	0.031	0.222	0.495	1008	Lev	Foreign financing
0.782	_0.562	0.173	0.093	1008	ExtF	Domestic financing
0.620	_0.623	0.164	0.185	1008	ROA	Return on assets
22.26	11.379	1.715	16.044	1008	Size	Firm size
7.934	_0.716	1.517	0.909	1008	Ret	Stock return
14.008	0.622	2.206	3.185	1008	Qtobin	Q-Tobin ratio
3.744	_0.689	0.459	0.531	1008	Growth	Sales growth

The average firm size is 16.044, indicating that the sample companies are predominantly within the range of medium to large firms. The difference between the minimum (11.379) and maximum (22.26) values highlights significant variability in the scale of the firms' operations. This heterogeneity in size could impact access to financial resources, bargaining power, and the financial resilience of the companies.

The stock return variable has an average value of 0.909, suggesting that, on average, the stocks of the examined companies have provided positive returns for shareholders. However, the high standard deviation of 1.517 and the wide range from -0.716 to 7.934 indicate substantial fluctuations in stock returns and the high risk associated with the capital market during the observed period. These fluctuations may reflect macroeconomic conditions and the prevailing uncertainties in the financial market.

Table 2. Frequency distribution of financial distress.

Percentage	Number	Explanations
66.07	666	The companies have not experienced financial distress.
33.93	342	The companies have experienced financial distress.
100	1008	Total

As shown in *Table 2*, the total number of companies for the years under study is 1008, of which 342 companies, or 33.93%, have experienced financial distress.

2.3.3 | Hypothesis testing (inferential findings)

This section presents the data analysis using inferential statistics. In this part, the research models are examined using logistic regression, and the final model is fitted. Additionally, Akaike's Information Criterion (AIC) and Schwarz's Bayesian Information Criterion (BIC) are employed to assess the adequacy of the control variables. The Hosmer-Lemeshow test and the prediction accuracy percentage are also used to evaluate the goodness-of-fit of the research models.

2.3.4 | Result of Hypothesis 1 testing

Hypothesis 1. "Customer concentration has a positive and significant impact on the financial distress of companies." Therefore, the hypothesis can be expressed as follows:

The regression model is formulated as follows:

$$\text{Distress}_{it} = \alpha_0 + \beta_1 \text{CC}_{it} + \beta_2 \text{ROA}_{it} + \beta_3 \text{Size}_{it} + \beta_4 \text{Ret}_{it} + \beta_5 \text{Qtobin}_{it} + \beta_6 \text{Growth}_{it} + \varepsilon_{it}$$

Table 3. Results of hypothesis 1 testing.

Multicollinearity	Significance Level or P-Value	Z-Statistic	Standard Error	Coefficients	Symbol	Variable
1.02	0.040	2.05	0.614	1.258	CC	Customer concentration
1.09	0.000	_14.27	0.906	_12.938	ROA	Return on assets
1.20	0.203	_1.27	0.058	_0.075	Size	Firm size
1.20	0.175	1.36	0.041	0.056	Ret	Stock return
1.32	0.046	_2.00	0.034	_0.068	Qtobin	Tobin's Q ratio
1.05	0.012	2.50	0.178	0.446	Growth	Sales growth
---	0.021	2.31	0.982	2.270	Intercept	
Other Informational Statistics						
426.10					Likelihood Ratio (LR) Statistic	
0.0000					Significance level of the LR (prob.)	
0.3357					McFadden's R-squared	

The results in *Table 3* indicate that the customer concentration variable has a significance level of less than 5%, and its coefficient is positive. Therefore, customer concentration has a positive and statistically significant impact on corporate financial distress, and *Hypothesis 1* is accepted at the 95% confidence level. The control variable sales growth has a positive coefficient and a significance level of less than 5%, indicating a significant and direct relationship with the dependent variable. In contrast, the control variables ROA and Tobin's Q ratio have negative coefficients and significance levels of less than 5%, suggesting an inverse and statistically significant relationship with the dependent variable. McFadden's R-squared is 33%, which means that the independent and control variables in the model explain 33% of the variation in the dependent variable. The LR statistic is 426.10, with a significance level of less than 5%, indicating that the fitted model is sufficiently robust and valid.

2.3.5 | Result of Hypothesis 2 testing

Hypothesis 2. "External financing moderates the relationship between customer concentration and financial distress." Therefore, the hypothesis can be expressed as follows:

The regression model is formulated as follows:

$$\text{Distress}_{it} = \alpha_0 + \beta_1 \text{CC}_{it} + \beta_2 \text{Lev}_{it} + \beta_3 (\text{CC}_{it} \times \text{Lev}_{it}) + \beta_4 \text{ROA}_{it} + \beta_5 \text{Size}_{it} + \beta_6 \text{Ret}_{it} + \beta_7 \text{Qtobin}_{it} + \beta_8 \text{Growth}_{it} + \varepsilon_{it}$$

Table 4. Results of hypothesis 2 testing.

Multicollinearity	Significance Level (P-Value)	Z-Statistic	Standard Error	Coefficients	Symbol	Variable
4.31	0.082	1.74	1.248	2.174	CC	Customer concentration
1.47	0.664	0.43	0.184	0.079	Lev	External Financing
4.43	0.388	_0.86	2.168	_1.872	CC*Lev	Customer concentratio* external financing
1.45	0.000	_13.85	0.932	_12.913	ROA	Return on assets
1.21	0.181	_1.34	0.059	_0.078	Size	Firm size
1.20	0.212	1.25	0.042	0.052	Ret	Stock return
1.32	0.054	_1.93	0.034	_0.065	Qtobin	Tobin's Q ratio
1.05	0.015	2.44	0.177	0.433	Growth	Sales growth
---	0.020	2.32	0.989	2.295	Intercept	
Other Informational Statistics						
425.57					LR Statistic	
0.0000					Significance level of the LR (prob.)	
0.3347					McFadden's R-squared	

The results in *Table 4* indicate that the interaction variable (customer concentration × external financing) has a significance level greater than 5%. Therefore, external financing does not moderate the relationship between customer concentration and financial distress, and *Hypothesis 2* is rejected at the 95% confidence level. The control variable sales growth has a positive coefficient and a significance level of less than 5%, indicating a significant and direct relationship with the dependent variable. Conversely, the control variable ROA has a negative coefficient and a significance level of less than 5%, suggesting a significant and inverse relationship with the dependent variable. McFadden's R-squared is 33%, indicating that the independent and control variables in the model explain 33% of the variation in the dependent variable. The LR statistic is 425.57, with a significance level below 5%, confirming that the fitted model is sufficiently robust and valid.

2.3.6 | Result of Hypothesis 3 testing

Hypothesis 3. "Internal financing moderates the relationship between customer concentration and financial distress." Therefore, the hypothesis can be expressed as follows:

The regression model is formulated as follows:

$$\text{Distress}_{it} = \alpha_0 + \beta_1 \text{CC}_{it} + \beta_2 \text{ExtF}_{it} + \beta_3 (\text{CC}_{it} \times \text{ExtF}_{it}) + \beta_4 \text{ROA}_{it} + \beta_5 \text{Size}_{it} + \beta_6 \text{Ret}_{it} + \beta_7 \text{Qtobin}_{it} + \beta_8 \text{Growth}_{it} + \varepsilon_{it}$$

Table 5. Results of hypothesis 3 testing.

MultIcollIneaRity	Significance Level (P-Value)	Z-Statistic	Standard Error	Coefficients	Symbol	Variable
1.10	0.159	1.41	0.635	0.894	CC	Customer Concentration
1.37	0.000	_4.05	0.871	_3.532	ExtF	Internal financing
1.18	0.020	_2.32	0.253	_0.589	CC*ExtF	Customer concentration* internal financing
1.28	0.000	_12.09	0.992	_11.997	ROA	Return on assets
1.23	0.629	_0.48	0.061	_0.029	Size	Firm size
1.21	0.025	2.24	0.045	0.102	Ret	Stock return
1.33	0.092	_1.69	0.034	_0.057	Qtobin	Tobin's Q Ratio
1.08	0.000	3.98	0.204	0.812	Growth	Sales growth
---	0.109	1.60	1.016	1.631	Intercept	
Other Informational Statistics						
484.78					LR statistic	
0.0000					Significance level of the LR (prob.)	
0.3813					McFadden's R-squared	

The results in *Table 5*. indicate that the interaction variable (customer concentration × internal financing) has a negative coefficient and a significance level of less than 5%. Therefore, internal financing exerts a negative moderating effect on the relationship between customer concentration and financial distress, and Hypothesis 3 is accepted at the 95% confidence level. The control variables stock return and sales growth have positive coefficients and significance levels below 5%, indicating a significant and direct relationship with the dependent variable. In contrast, the control variable ROA has a negative coefficient and a significance level below 5%, indicating a significant and inverse relationship with the dependent variable. McFadden's R-squared is 38%, suggesting that the independent and control variables in the model explain 38% of the variation in the dependent variable. The LR statistic is 484.78, with a significance level below 5%, confirming that the fitted model is robust and sufficiently valid.

2.3.7 | Ensuring the adequacy of control variables

Table 6. Adequacy of the research control variables.

Schwarz BIC	AIC	Model Description
891.5445	857.2183	Model 1 with control variables
1273.341	1263.534	Model 1 without control variables
Adequacy of control variables	Adequacy of control variables	Result
908.0806	863.9379	Model 2 with control variables
1234.658	1215.039	Model 2 without control variables
Adequacy of control variables	Adequacy of control variables	Result
848.8661	804.7234	Model 3 with control variables
1091.295	1071.676	Model 3 without control variables
Adequacy of control variables	Adequacy of control variables	Result

2.3.8|Model prediction accuracy (%)

Another goodness-of-fit measure, applicable only to logistic and probit models, is the prediction accuracy percentage.

Table 7. Model prediction accuracy percentages.

Overall Prediction	Dependent Variable Name	Model Name
%82.03	Financial distress	Model 1
%82.35	Financial distress	Model 2
%70.81	Financial distress	Model 3

Based on the results in *Table 7*, it can be observed that the model prediction accuracy in the research models exceeds 50%.

2.3.9|Goodness-of-fit of the regression model

In the Hosmer-Lemeshow test, a significance level greater than 5% indicates a satisfactory fit of the regression model; otherwise, the fitted model is considered insufficiently valid.

Table 8. Hosmer-Lemeshow test results for the research regression model.

Hosmer-Lemeshow Test		Test Name | Hypothesis
Significance Level of the Test	Test Statistic Value	
0.0872	13.80	Model 1
0.4656	4.61	Model 2
0.0648	14.72	Model 3

Based on the results in *Table 8*, it can be observed that the significance level of the Hosmer-Lemeshow test for the research models exceeds 5%, indicating a satisfactory fit of the regression model.

The results of *Hypothesis 1* testing indicate that customer concentration has a positive and statistically significant impact on the likelihood of financial distress in companies. In other words, as a company's dependence on a limited number of customers increases, the likelihood of facing financial difficulties and being unable to meet its obligations also rises. This finding suggests that while high customer concentration

may lead to sales stability in the short term, it poses significant financial risks for companies in the long run. From a theoretical perspective, this result can be explained through the resource dependence theory and the bargaining power theory. A high dependency on major customers weakens the company's bargaining power, as large customers can impose unfavorable pricing, credit, or timing conditions, putting pressure on the company's cash flows. This pressure can ultimately lead to an increase in liquidity risk and the onset of financial distress. The findings of this study align with those of [3] , who showed that excessive customer concentration increases liquidity risk in companies.

Additionally, the study by Ni et al. [9] states that high customer concentration leads to higher business risk and reduced financial stability for companies. These results suggest that customer concentration can act as a risk amplifier for financial distress. On an international scale, the findings of this study are consistent with those of [9] ,[22] further supporting the notion that customer concentration heightens financial risk. These studies have shown that customer concentration, by increasing the bargaining power of major customers, exacerbates the financing constraints faced by companies and makes them more vulnerable to financial shocks.

Additionally, Dhaliwal et al. [23] reported that customer concentration is associated with higher debt costs, which, in turn, can increase the likelihood of financial distress. In summary, the results of *Hypothesis 1* confirm that customer concentration, particularly in unstable economic environments, can be a significant risk factor for the financial health of companies. The results of *Hypothesis 2* testing indicate that external financing has not played a meaningful moderating role in the relationship between customer concentration and financial distress. This finding suggests that access to external financial resources does not necessarily enhance companies' ability to neutralize the negative effects of customer concentration on their financial condition. One possible reason for this outcome could be related to the conditions of the capital market and the financial system. Companies with high customer concentration are perceived by creditors and investors as having higher income risk. As a result, these companies either face restrictions in accessing external financial resources or secure financing at a higher cost.

Therefore, external financing does not only fail to mitigate the risk but can, in some cases, impose additional financial pressure on the company. This result is in line with the findings of [9], [22], who showed that customer concentration exacerbates financing constraints and that companies dependent on major customers, especially small and non-public firms, are most severely affected. Additionally, Dhaliwal et al. [23] demonstrated that customer concentration leads to higher debt costs, which can reduce the effectiveness of external financing. In contrast, this finding does not align with the results of [19], who reported a positive moderating role for external financing. This inconsistency may stem from differences in the structure of financial markets, the level of development of credit systems, and the economic conditions of the country under study. Overall, the rejection of *Hypothesis 2* suggests that, under the conditions examined in this research, external financing, on its own, is not an effective tool for mitigating the negative effects of customer concentration on companies' financial distress. The results of *Hypothesis 3* testing show that internal financing plays a significant inverse moderating role in the relationship between customer concentration and financial distress.

In other words, in companies with stronger internal financial resources, the negative impact of customer concentration on financial distress is diminished. This finding aligns with the pecking order theory of financing, which posits that companies prefer to use internal resources first for financing due to their lower cost and the reduced risk of information asymmetry. The presence of internal cash flows and cash retention increases a company's financial flexibility, making it more resilient to shocks from dependence on major customers. The findings of this study align with theoretical results and the research by Nazari Amrouabadi [17], who demonstrated that cash retention plays a negative moderating role in reducing financial distress.

Additionally, the study by Soleimani and Safari [16] suggests that improving resource management and financial risk tolerance can significantly reduce the likelihood of financial distress. On an international level, these results indirectly correspond with the findings of [24], [25] who emphasized the importance of internal

financial indicators in predicting and managing financial distress. In conclusion, the results of *Hypothesis 3* suggest that, unlike external financing, a company's internal financial strength plays a key and effective role in controlling the negative consequences of customer concentration. Internal financing can thus be considered a strategic tool for mitigating the risk of financial distress, warranting the attention of managers.

Given the confirmed positive and significant impact of customer concentration on corporate financial distress, it is recommended that managers of publicly listed companies avoid excessive reliance on a limited number of clients when formulating sales and marketing strategies. Diversifying the customer base and expanding target markets can help mitigate risks associated with the bargaining power of major customers, income fluctuations, and ultimately reduce the likelihood of financial distress. Considering the lack of confirmation regarding the moderating role of external financing in the relationship between customer concentration and financial distress, it is advised that companies exercise caution when relying solely on external financial resources to offset risks arising from customer concentration. Decisions regarding the use of external financing should carefully account for financial costs, credit constraints, and the potential effects on exacerbating financial distress risks. In light of the confirmed inverse moderating role of internal financing, it is recommended that companies strengthen their internal financial resources, including increasing retained earnings, improving operational cash flows, and maintaining adequate cash reserves, in order to enhance their financial flexibility. This approach can reduce the negative effects of customer concentration on financial distress and bolster the financial resilience of companies in times of crisis.

Conflict of Interest

The authors declare no conflict of interest.

Data Availability

All data are included in the text.

Funding

This research received no specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

[1] Cohen, D. A., & Li, B. (2020). Customer-base concentration, investment, and profitability: The US government as a major customer. *The accounting review*, *95*(1), 101–131. https://doi.org/10.2308/accr-52490

[2] Shan, Y. G., Wang, Y., Wu, W., & Zhen, W. (2023). Does the achilles heel of guarantee networks drive financial distress? *International review of financial analysis*, *87*, 102635. https://doi.org/10.1016/j.irfa.2023.102635

[3] Campello, M., & Gao, J. (2017). Customer concentration and loan contract terms. *Journal of financial economics*, *123*(1), 108–136. https://doi.org/10.1016/j.jfineco.2016.03.010

[4] Cheng, C. B., Chen, C. L., & Fu, C. J. (2006). Financial distress prediction by a radial basis function network with logit analysis learning. *Computers & mathematics with applications*, *51*(3–4), 579–588. https://doi.org/10.1016/j.camwa.2005.07.016

[5] Cohen, J. R., Krishnamoorthy, G., & Wright, A. (2004). The corporate governance mosaic and financial reporting quality. *Journal of accounting literature*, 87–152. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1086743

[6] Johnson, L. (2013). Catastrophe bonds and financial risk: Securing capital and rule through contingency. *Geoforum*, *45*, 30–40. https://doi.org/10.1016/j.geoforum.2012.04.003

[7] Deng, Z. J. W. &Xiao-L. (2006). Corporate governance and financial distress: Evidence from Chinese listed companies. *The Chinese economy*, 5–27. https://doi.org/10.2753/CES1097-1475390501

[8] Ke, J., & Wang, Q. (2023). Research on financial distress prediction models of Chinese listed companies in pharmaceutical manufactures based on machine learning. In *2023 2nd international conference on artificial intelligence, internet and digital economy (ICAID 2023)* (pp. 544-552). Atlantis Press. https://10.0.11.175/978-94-6463-222-4_59

[9] Ni, J., Cao, X., Zhou, W., & Li, J. (2023). Customer concentration and financing constraints. *Journal of corporate finance*, *82*, 102432. https://doi.org/10.1016/j.jcorpfin.2023.102432

[10] Ruan, L., & Liu, H. (2021). Financial distress prediction using GA-BP neural network model. *International journal of economics and finance*, *13*(3), 1. https://10.5539/ijef.v13n3p1

[11] Do, T. K., Huang, H. H., & Le, A. T. (2023). Customer concentration and stock liquidity. *Journal of banking & finance*, *154*, 106935. https://doi.org/10.1016/j.jbankfin.2023.106935

[12] Boubaker, S., Cellier, A., Manita, R., & Saeed, A. (2020). Does corporate social responsibility reduce financial distress risk? *Economic modelling*, *91*, 835–851. https://doi.org/10.1016/j.econmod.2020.05.012

[13] Campbell, J. Y., Hilscher, J., & Szilagyi, J. (2008). In search of distress risk. *The journal of finance*, *63*(6), 2899–2939. https://doi.org/10.1111/j.1540-6261.2008.01416.x

[14] Kim, T., Kim, H.-D., & Park, K. (2023). Customer concentration and firm risk: The role of outside directors from a major customer. *Journal of banking & finance*, *152*, 106870. https://doi.org/10.1016/j.jbankfin.2023.106870

[15] Kwak, K. T. , Lee, S.W., Hong., S. (2024). Understanding multihoming strategies in e-commerce: Impact of seller characteristics and marketing resources on business performance. Business Strategy And The Environment. *Wiley Online Library.* https://dx.doi.org/10.2139/ssrn.4896247

[16] Soleimani, O., & Safari, M. (2023). He relationship between knowledge management, financial risk-taking, and financial distress in banks. *Accounting and management outlook*, *6*((85)), 189–203. https://jafci.com/index.php/jafci/article/download/120/81/727

[17] Nazari Amrouabadi, M. (2022). The impact of CEO power on financial distress with an emphasis on the moderating role of cash holdings in companies listed on the Tehran Stock Exchange. *Journal of innovative research approaches in management and accounting*, *6*((21)), 1003–1020. https://majournal.ir/index.php/ma/article/view/1500

[18] Haque, S., & Kleymenova, A. (2023). Private equity and debt contract enforcement: Evidence from covenant. *Finance and economics discussion series (Feds)*. https://doi.org/10.17016/FEDS.2023.018

[19] Li, Z., Chen, G., French, D., & Wang, J. (2019). Customer concentration and corporate financial policies: International evidence. *Journal of corporate finance*. https://10.1016/j.jcorpfin.2020.101590

[20] Kordestani, G., Bakhtiari, M., & Biglari, V. (2011). Ability of combinations of cash flow components to predict financial distress. *Business: theory and practice*, *12*(3), 277–285. https://20.1001.1.28210166.1390.9.34.4.2

[21] Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *The journal of finance*, *23*(4), 589–609. https://doi.org/10.1111/j.1540-6261.1968.tb00843.x

[22] Wang, L., Zhang, Q., & Wong, P. P. W. (2022). Purchase intention for green cars among Chinese millennials: Merging the value--attitude--behavior theory and theory of planned behavior. *Frontiers in psychology*, *13*, 786292. https://doi.org/10.3389/fpsyg.2022.786292

[23] Dhaliwal, D., Judd, J. S., Serfling, M., & Shaikh, S. (2016). Customer concentration risk and the cost of equity capital. *Journal of accounting and economics*, *61*(1), 23–48. https://doi.org/10.1016/j.jacceco.2015.03.005

[24] Liang, D., Tsai, C. F., Lu, H. Y. R., & Chang, L. S. (2020). Combining corporate governance indicators with stacking ensembles for financial distress prediction. *Journal of business research*, *120*, 137–146. https://doi.org/10.1016/j.jbusres.2020.07.052

[25] Chen, C. C., Chen, C. D., & Lien, D. (2020). Financial distress prediction model: The effects of corporate governance indicators. *Journal of forecasting*, *39*(8), 1238–1252. https://doi.org/10.1002/for.2684