Business Failure Prediction Model Using Accounting Anomalies Indices

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Abstract: The main purpose of this study was to identify and analyze the relationships between accounting anomalies and the prediction of the probability of business failure in companies listed on the Tehran Stock Exchange. Based on research methods and data collection, this study is quantitative, descriptive, analytical, and causal in nature. In terms of its objective, it is considered an applied research. The statistical population of this research included all companies listed on the Tehran Stock Exchange. A sample of 148 companies was randomly selected. In order to analyze the collected data, the t-test was used to test the significance of the regression model. The statistical software employed in this study was EViews. The results indicated that there is a significant relationship between business failure and accounting anomalies ($p < 0.05$). In other words, the observed difference in the mean business failure prediction between the groups is statistically significant. The mean difference between the two groups was -0.258, indicating that the average business failure prediction in one of the groups (most likely the "post-failure" group) is lower than in the other group. This difference may indicate a considerable reduction in the prediction of business failure.

Keywords: business failure, accounting, anomaly indices, stock exchange

1. Introduction

The existence of risk related to the possibility of business failure serves as a positive motivator for companies to enhance their efficiency in production. Conversely, it should be noted that issues such as employment and the potential of a firm to restructure itself after business failure justify the design of a mechanism for restructuring the debts of a financially distressed company, as business failure imposes high transaction costs on both parties. Therefore, since the presence of healthy economic competition leads to the exit of inefficient firms from the economic activity cycle and enhances the average efficiency of the remaining firms, the process of business failure plays an important role in revitalizing a country's economy and also increases consumer welfare, as efficient firms produce goods and services at lower costs and sell them at lower prices. Consequently, legislators, aware of this issue, enact rules to systematize the business failure process [1-3].

High-quality financial reporting (disclosure), by reducing information asymmetry, decreases the likelihood of adverse selection and moral hazard, and through enhancing the ability of shareholders and lenders to monitor and

control managerial activities, reduces monitoring costs for managers, thereby forcing managers to select appropriate and efficient projects, lowering the company's financing costs and risks, and ultimately increasing the firm's value and investment efficiency [4, 5].

Bankruptcy is a state in which a company is unable to obtain sufficient financial resources to continue its operations. Research conducted in the field of bankruptcy prediction indicates that most researchers consider bankruptcy criteria as indicators of financial distress and have used various models to predict it. However, in financial literature, it is emphasized that companies enter the cycle of bankruptcy years before the actual bankruptcy occurs, with various economic events happening during the pre-bankruptcy period. Companies may experience losses and a decline in the value of securities a year or years before bankruptcy. Therefore, bankruptcy prediction may not be timely or useful for evaluating company performance, especially for investors. Moreover, using the term bankruptcy as a criterion for financial distress may not be valid, as financially sound companies may voluntarily declare bankruptcy for strategic reasons. Even if a company does not go bankrupt, failure to repay debts on time will result in renegotiation of loan contracts and shareholder claims, leading to losses for both shareholders and creditors. In bankruptcy situations, managers are inclined to provide positive information to the capital market to prevent the company's value from declining; thus, financial statement manipulation undermines the essence of financial reporting [6, 7].

In recent years, Iran's business and economic environment has witnessed significant changes in the capital market and the expansion of joint-stock companies, along with the increase in the number of companies listed on the stock exchange. The emergence of agency theory and the inevitable separation of ownership from management has highlighted the necessity of corporate governance mechanisms to prevent fraud and deter its occurrence, aiming for proper corporate reporting aligned with corporate governance standards and the country's general economic policies, including economic transparency, integrity, and prevention of corrupt activities in the capital market. One of the objectives of financial reporting is to provide information useful for investors, creditors, and other current and potential users in making investment, credit, and other decisions [5, 8-10]. According to accounting standards, the responsibility for preparing and presenting financial statements lies with the board of directors or other governing bodies of the business entity (Accounting Standard No. 1, Clause 7). Additionally, the primary responsibility for fraud prevention and detection rests with executive managers and corporate governance bodies. With increased authority in corporate governance structures, managers may engage in opportunistic behaviors and make decisions that serve their personal interests rather than those of shareholders, or conversely, act in the shareholders' interests to maintain the company's reputation and avoid delisting from the stock exchange. Part of the emphasis in research and academic sources on corporate scandals and the collapse of large companies in the United States, such as Enron and WorldCom, and in Europe, such as Vivendi in France, is related to financial reporting fraud due to weak corporate governance [11].

Sometimes, business failure signals that a firm's managers are not competent in managing resources effectively, and therefore, changing managers can save the firm from business failure. Over the past decades, researchers in social sciences, including accounting, finance, strategy, and organizational studies, have examined the topic of business failure and its causes and consequences. Despite several studies on the causes of business failure, the integration of this research stream in social sciences needs improvement. Studies have been conducted on the present topic. Handijani Fard et al. (2024) showed that the term "business failure" has higher co-occurrence with terms such as "performance," "strategy," "innovation," "failure," "growth," and "behavior." Additionally, the term "entrepreneurial failure" has greater co-occurrence with terms like "decision-making," "self-confidence,"

"perspective," "learning from failure," "resilience," and "self." Based on content analysis results, studies were categorized into six main groups: 1) typologies of business failure, 2) post-business failure processes, 3) bankruptcy prediction models and ratios, 4) determinants of business survival and growth, 5) individual factors influencing entrepreneurial failure, and 6) environmental and institutional factors affecting business failure. Practical recommendations and suggestions for future research were also provided [8]. Naderi Bani et al. (2021) found that size, book-to-market ratio, profitability, asset growth, working capital accruals, investments, the number of issued shares, and external financing are not considered anomalies in the Fama and French three-factor model at the company level [12]. Kia Mehr and Janani (2020) stated that in all three capital asset pricing models (the Fama and French three-factor model, 2001; the Carhart four-factor model; and the Fama and French five-factor model, 2014), stock market anomalies affect capital asset pricing and increase portfolio risk premiums [7].

Analyzing the causes and failures of major companies that have incurred significant losses, especially for shareholders, reveals that weak corporate governance systems contributed to these failures. Due to underdeveloped corporate governance mechanisms in Iran, particularly during the COVID-19 pandemic, investigating the role of these mechanisms, which have proven effective in addressing agency problems in many developed countries, is crucial. Therefore, the decision was made to explore the relationship between the business failure prediction model using accounting anomaly indices in companies listed on the stock exchange, emphasizing the necessity of establishing an appropriate and effective corporate governance system to prevent potential anomalies, improve accounting norms, and enhance shareholder trust. This study examines the disclosed information in auditors' reports regarding the probability of business failure. Given the importance of this issue for future decisions of financial statement users, particularly investors and lenders, no research has been conducted in this area so far. Corporate governance refers to a set of processes, customs, policies, and procedures, laws, and factors that influence how a company is directed and controlled, particularly under the separation of ownership and management. The main argument is that since a company is more than just a legal entity, its values should derive from the preferences and values of its stakeholders. In other words, a company's values are created when stakeholders' values become prominent, key, and intrinsic [10]. Therefore, the main research question is: How is the business failure prediction model using accounting anomaly indices structured?

2. Methodology

This study is quantitative, descriptive, analytical, and causal based on research methods and data collection, and is considered an applied research in terms of its objective. The statistical population of this research includes all companies listed on the Tehran Stock Exchange that meet the following conditions: 1) They are not investment and financial intermediation companies, financial institutions, or banks due to significant differences in operations. 2) Their financial statements and accompanying notes are available for the fiscal years 2019 to 2021. 3) Their fiscal year ends on March 20. 4) They do not have negative book value (negative shareholders' equity). 5) They do not have negative structural capital, as negative value creation or lack of value creation by the components of the model used in this research is meaningless. 6) Companies with outlier data (extremely high or low) were excluded. After applying these limitations, a sample of 148 companies was selected from the statistical population.

The required data for this research were obtained from the annual financial statements and accompanying explanatory notes of agricultural companies listed on the Tehran Stock Exchange, available on the Securities and Exchange Organization's website and Rahavard Novin and Tadbir Pardaz software, for the seven-year period from

2016 to 2023. To ensure the accuracy of the data available in the software, random comparisons with the companies' financial statements will be conducted.

A combined method was used to analyze the collected data to prove or reject the hypotheses, and the t-test was employed to test the significance of the regression model. The statistical software used in this research was EViews.

The research variables are as follows: Business failure prediction was measured based on the method of Cohen and Zarowin (2010) and Cheng et al. (2016), which includes cash flow from operations (CFO), defined as the net cash flow from operating activities of company i in year t. Discretionary expenses (DISX) and production costs (PROD) were estimated as follows:

$$CFO_{it} / Asset_{it-1} = \alpha 1 (1 / Asset_{it-1}) + \alpha 2 (SALE_{it} / Asset_{it-1}) + \alpha 3 (\Delta SALE_{it} / Asset_{it-1}) + \varepsilon it \quad (1)$$

$$DISX_{it} / Asset_{it-1} = \alpha 1 (1 / Asset_{it-1}) + \alpha 2 (SALE_{it} / Asset_{it-1}) + \alpha 3 (\Delta SALE_{it} / Asset_{it-1}) + \varepsilon it \quad (2)$$

$$PROD_{it} / Asset_{it-1} = \alpha 1 (1 / Asset_{it-1}) + \alpha 2 (SALE_{it} / Asset_{it-1}) + \alpha 3 (\Delta SALE_{it} / Asset_{it-1}) + \alpha 4 (\Delta SALE_{it-1} / Asset_{it-1}) + \varepsilon it \quad (3)$$

where CFO is cash flow from operations. DISX is the sum of research and development expenses, advertising expenses, and selling, general, and administrative expenses (SG&A) of a company. PROD is the sum of the cost of goods sold (COGS) and inventory changes.

The abnormal levels of CFO, DISX, and PROD (i.e., AB_CFO, AB_DISX, and AB_PROD) were then calculated by subtracting their normal levels from their actual levels. The RM1 and RM2 indices were used to measure business failure prediction, as presented below:

$$RM1 = AB\_CFO * (-1) + AB\_DISX * (-1) \quad (4)$$

$$RM2 = AB\_DISX * (-1) + AB\_PROD \quad (5)$$

Higher values of RM1 and RM2 indicate a higher level of REM and, consequently, lower business failure prediction.

3. Findings

In order to examine the general characteristics of the study variables and conduct a precise analysis of them, it is necessary to be familiar with the descriptive statistics related to these variables. Descriptive statistics allow us to have a comprehensive view of the data distribution, their centrality, and the extent of dispersion in various variables. These statistics form the starting point for any advanced statistical analysis and enable the researcher to become acquainted with the overall characteristics of the data. The table below shows the descriptive statistics of the data for 129 sample companies analyzed in this research. Key financial and operational variables, including abnormal operating cash flow, abnormal discretionary expenses, abnormal production expenses, and business failure prediction are among the main variables examined in this study.

Table 1. Descriptive Statistics of the Study Variables

Variable Name	Symbol	Number	Mean	Standard Deviation	Minimum	Maximum
Abnormal Operating Cash Flows	ABCFO	1161	0.156	0.150	0.00011	0.967
Abnormal Discretionary Expenses	ABDISX	1161	0.200	0.196	0.00017	0.989
Abnormal Production Expenses	ABPROD	1161	0.048	0.0577	0.00013	0.799

Business Failure Prediction	RM1	1161	-0.356	0.289	-1.696	-0.0081

Table 2. Qualitative Variables of the Study

Name	Symbol	Description	Percentage Frequency	Cumulative Percentage Frequency
Loss-Reporting Company	Loss	0	90.35%	90.35%
		1	9.65%	100%
Highly Influential Industries	EffectiveIndus	0	37.21%	37.21%
		1	62.79%	100%
High Product Market Competition	PMC	0	49.96%	49.96%
		1	50.04%	100%

One of the main statistical indices for describing a set of data is the mean. As a central index, the mean determines the point of equilibrium and the center of gravity in the data distribution, making it a suitable measure of data centrality. In fact, the mean is the value that, if all observations were the same, would be equal to that value. In a way, it can represent the overall distribution of the data. For example, the mean financial leverage in this study is 0.554. This figure shows that, on average, the companies in the sample financed about 55.4 percent of their resources through debt. This mean can indicate a moderate level of financial risk that companies have borne in financing their resources. Companies with higher debt ratios generally face greater risk, whereas companies with lower debt ratios carry less risk.

In this study, the standard deviation for the market-to-book ratio is 1.550, indicating considerable dispersion among the sample companies for this variable. This high value shows that companies differ greatly in terms of their market-to-book ratio; some companies have a very high market value compared to their book value, while others have a much lower ratio. In contrast, the standard deviation for abnormal production costs is 0.0577, indicating a closer concentration of data around the mean in this variable. This low standard deviation suggests that abnormal production costs vary less among companies and exhibit lower dispersion compared to other variables.

In addition to the mean and standard deviation, the minimum and maximum values are other measures of dispersion that show the lowest and highest values for the variables. The minimum and maximum help us understand the range of variation for each variable and the interval in which the variable's values lie. For instance, the maximum financial leverage is 1.824. This value shows that one of the companies in the sample has total debts exceeding its total assets, leading to a negative shareholders' equity. Such a company faces very high financial risk and likely experiences serious problems in repaying its debts. Conversely, the minimum financial leverage is 0.03, indicating that some companies finance only a small portion of their resources through debt and, thus, carry lower financial risk.

Below is the hypothesis:

H0: Business failure prediction (first criterion) has not decreased during accounting anomalies compared to previous periods.

H1: Business failure prediction (first criterion) has decreased during accounting anomalies compared to previous periods.

Subsequently, the table below provides descriptive statistics for business failure prediction for the two groups "before business failure" and "after business failure."

Table 3. Descriptive Statistics for Business Failure Prediction by Group

Variable Name	Group Name	Number	Mean	Standard Deviation
Business Failure Prediction	After Business Failure	387	-0.528	0.33
	Before Business Failure	774	-0.270	0.221

The mean business failure prediction for the "after business failure" group is -0.528, compared to -0.270 for the "before business failure" group. This comparison shows that the mean business failure prediction became significantly more negative after the occurrence of business failure. This finding indicates that the prediction model appropriately anticipates a worse condition after business failure and reports a higher level of failure.

On the other hand, the standard deviation for the "after business failure" group is 0.33, which is higher than the 0.221 standard deviation in the "before business failure" group. This difference in standard deviations implies that data dispersion is greater in the after-failure group, and the prediction model in this group may encounter more variation in forecasts. The increased standard deviation in the after-failure group may be due to uncertainty or more complex financial conditions of companies after failure. These differences highlight the importance of a more detailed analysis of changes in predictions and business conditions before and after failure.

Next, the table below examines the difference in means between different groups using the t-test and F-test.

Table 4. Comparison of Mean Business Failure Predictions

Variable Name	F-statistic	Significance Level	t-statistic	Degrees of Freedom	Difference	Significance Level
Business Failure Prediction	116.456	0.000	-15.828	1159	-0.258	0.000
	-	-	-13.938	565.289	-0.258	0.000

In the first column, the significance level for both the t-test and F-test is 0.000. This indicates that the significance level is less than 0.05, meaning the observed difference in the mean business failure prediction between the groups is statistically significant. In other words, the probability that this difference occurred randomly is very low, and the difference is real.

In the second column, the difference in means between the two groups is -0.258. This negative value shows that the mean business failure prediction in one group (most likely the "after business failure" group) is lower than in the other group. This difference may indicate a substantial decrease in business failure prediction.

In the third column, two values for degrees of freedom are reported: 1159 and 565.289. Degrees of freedom depend on the sample size and the type of test used. Here, they are employed for comparing means of two groups. The higher degree of freedom (1159) represents a larger number of data points in the analysis, increasing the statistical power to more accurately detect differences.

The t-statistic is -15.828 and -13.938. These values indicate how much the difference in means deviates relative to the standard deviation. The negative t-statistics suggest that the mean for the "after failure" group is lower than the mean for the "before failure" group. The large magnitude of the t-statistics (here, very large) shows a highly significant difference between the means.

The significance level for the F-test is also reported as 0.000, which, similar to the t-test, indicates statistical significance. The F-test here examines the homogeneity of variances (or the equality of data dispersion) between the two groups. An F-test significance level of 0.000 suggests that the variances between the two groups are not equal; thus, the assumption of equal variances is rejected. The F-statistic is 116.456, indicating a very large variance difference between the groups. Such a high F-statistic value usually signifies a marked disparity in variances between the two groups, necessitating the use of corrective methods in data analysis (such as using adjusted t-test values when variances are unequal).

As can be seen, two significance values are reported for each criterion. If the equality of variances assumption is accepted, the first value is used; otherwise, the second value is used to confirm or reject the hypothesis. Given that 0.000 and 0.000 in the fourth column are both less than 5 percent, Levene's test indicates that the assumption of equal variances is rejected. Therefore, the second reported value in the last column is used, and since this value for business failure prediction is less than 5 percent, the assumption of equal means is rejected. Considering the positive coefficient of the t-statistic, it can be concluded that in the after business failure group, the business failure prediction has decreased.

4. Discussion and Conclusion

This study examined the business failure prediction model using anomaly indices based on methods presented by Cohen and Zarowin (2010) and Cheng et al. (2016). The main objective of this research was to identify and analyze the relationships between accounting anomalies and the prediction of business failure probability in companies listed on the Tehran Stock Exchange.

The statistical test results showed a significant relationship between business failure and accounting anomalies. In general, accounting anomalies refer to events or conditions that cause financial information to deviate from reality, ultimately weakening the transparency and accuracy of financial information. The results are consistent with prior findings [6-9, 11, 12].

It should be noted that accounting literature lacks a clear and comprehensive definition of accounting anomalies that can be universally applied. However, researchers and theorists strive to provide definitions of accounting anomalies that prove practical. For instance, the Financial Accounting Standards Board (FASB), in its Conceptual Statement No. 2, states that the quality of financial reporting is determined by its overall objectives, which include providing useful information for users in investment and credit decisions. The board also defines the qualitative characteristics necessary to achieve financial reporting objectives. In essence, accounting anomalies signify a reduction in the usefulness of financial information for users, including investors, creditors, and managers. Accounting anomalies can be defined as the ability of financial statements to convey information about a company's operations and, specifically, to forecast its expected cash flows to investors. This perspective is based on the argument that accruals can enhance the informational value of earnings by mitigating the impact of unpredictable fluctuations in cash flows.

Additionally, accounting anomalies can negatively affect investors' decision-making because they result in inaccurate and misleading information. This situation increases investment risks and may lead to business failure. Therefore, accounting anomalies play a crucial role in predicting and identifying potential business failures, and based on the results obtained from this study, there is a significant relationship between the two. These findings are also consistent with previous research that has addressed the impact of accounting anomalies on financial outcomes and company performance. Specifically, when the quality of financial information is low, the likelihood of financial problems and, consequently, business failure increases. Ultimately, this conclusion can help financial decision-makers and policymakers recognize the importance of monitoring financial reporting quality and accounting anomalies, thereby preventing potential business failures.

1. The stock exchange must implement a cohesive system for evaluating the quality of corporate governance and take more stringent measures to mandate companies to implement efficient and effective corporate governance systems. In addition, by expanding studies and theoretical literature on corporate governance, stock market participants, board members, shareholders, auditing institutions, and researchers should

become more familiar with corporate governance issues to play an appropriate role in corporate governance and consequently in reducing accounting anomalies in companies.

2. The market and potential investors should consider that an unqualified audit opinion on financial statements is not sufficient to reduce accounting anomalies, and simultaneous attention to other mechanisms of suitable corporate governance is necessary.

3. Analysts are advised to consider the impact of corporate governance mechanisms on accounting anomalies during the COVID-19 period in their analyses and forecasts. Corporate governance mechanisms enhance accounting anomalies, provide more realistic financial information, lead to better investment decisions, and consequently improve the efficiency of the capital market.

Authors' Contributions

Authors equally contributed to this article.

Ethical Considerations

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

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Conflict of Interest

The authors report no conflict of interest.

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