The Research of Influencing Factors that Possibly lead to Company Bankruptcy

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Abstract. Previous research has established correlations between corporate bankruptcy and internal factors such as financial ratios, cash reserves, company liquidity, and capital structure, as well as external factors, such as macroeconomic conditions, industry competition, and regulatory policies. However, several unidentified factors still warrant investigation. This study employs the Binary Probit Model to analyze data from Taiwan Economic Journal, encompassing 6,819 companies over the period from 1999 to 2009. The findings indicate that corporate bankruptcy is not significantly associated with 8 variables such as Operating Gross Margin, Cash flow rate, Operating Profit Growth Rate, Total Asset Growth Rate, Current Ratio, etc. However, it exhibits particularly strong correlations with 8 variables such as Pre-tax net Interest Rate, Operating Expense Rate, ROA(C) before interest and depreciation before interest, Non-industry income and expenditure/revenue, Net Value Per Share (B), Total Asset Turnover, etc. This research provides valuable insights into factors that may lead to corporate bankruptcy, which is instrumental in identifying warning signals, mitigating risks, and formulating effective preventive measures. Moreover, it points to the direction for further research in this field.

Keywords: Corporate bankruptcy; influence factors; binary probit model.

1. Introduction

Corporate bankruptcy is a significant issue that has important implications for employees, shareholders, creditors, and the overall economy. The closure of companies not only leads to financial losses but also has far-reaching effects on society and the economy. For example, corporate bankruptcy can impact industry structure and overall investment activities, thus exerting a substantial influence on the economy [1]. For a considerable duration, experts, investors, governmental bodies, and scholars have been extensively researching methods to recognize potential hazards of business insolvency with the aim of minimizing the financial repercussions stemming from bankruptcy [2, 3].Therefore, understanding the factors that may lead to company bankruptcy is crucial for identifying warning signals, reducing risks, and formulating effective preventive measures.

Over the years, researchers and scholars have been devoted to exploring the causes and prediction of corporate bankruptcy. Their research findings reveal that corporate bankruptcy is the result of both internal and external factors. It is not solely attributable to a single factor but rather the outcome of multiple influences and interactions. Scholars from both domestic and international contexts have found a certain correlation between corporate bankruptcy and internal factors such as financial ratios [4, 5], cash reserves [6], company liquidity [7], and capital structure [8]. Altman identified the significant impact of external factors, such as macroeconomic conditions, industry competition, and regulatory policies, on corporate bankruptcy [9]. Zhang specifically investigated the influence of macroeconomic factors, such as economic growth rate, inflation rate, and interest rate, on the likelihood of corporate bankruptcy [10].

However, there is a scarcity of literature focusing on the factors contributing to corporate bankruptcy, and there is a lack of systematic and comprehensive statistical data. Therefore, this study places emphasis on examining the influence of 16 internal factors on company bankruptcy and further selecting an appropriate model to study the degree of correlation between these factors and corporate bankruptcy.

In a similar research direction, Beaver proposed a model based on financial ratios to predict the likelihood of corporate bankruptcy [11]. However, this study's research sample primarily relied on US company data, which may limit its applicability to different regions and industries. Additionally, it did not consider other non-financial factors, such as market environment and managerial decision-making, which also have an impact on corporate bankruptcy. The study aimed to explore the influence of managerial decisions on corporate collapse in Argentina [12]. Nevertheless, it mainly relied on a case study approach and could not provide comprehensive quantitative analysis and universally applicable conclusions. Furthermore, due to the relatively short time span of the study, it could not capture the long-term effects of managerial decisions on corporate bankruptcy. Martínez-Sola and colleagues utilized a case study method to compare non-financial factors of bankrupt firms through in-depth analysis [13]. By comparing the differences between bankrupt and non-bankrupt firms, the researchers attempted to determine the relationship between non-financial factors and corporate financial distress. However, this study also has some limitations. Firstly, the research sample mainly relied on bankrupt firm cases, which may introduce sample selection bias and limit generalizability. Secondly, the adoption of a case study method restricts the provision of comprehensive quantitative analysis and universally applicable conclusions.

In summary, after consideration and optimization, this paper will use the Probit Regression model to study the effect of these 16 factors on corporate bankruptcy, i.e., whether they are factors that could lead to corporate bankruptcy.

2. Methods

2.1. Data Sources

The information utilized in this research is sourced from the Kaggle platform, where data was gathered from the Taiwan Economic Journal spanning the years 1999 to 2009, encompassing 6819 firms. The determination of corporate insolvency was established according to the regulations set forth by the Taiwan Stock Exchange.

2.2. Variable Selection

The data used in this paper count a total of 6819 companies, including those who have gone and do not have gone bankrupt. There are 95 variables in the original data set, and 16 variables are selected in this paper. The data contains 16 variables.

Table 1 shows the logogram and description of the 16 variables. The sample of data is 6819, of which 220 have gone bankrupted.

Table 1. Logogram and description of the 16 variables

Logogram	Title	Min.	Max.	Mean	S.D.
y	Bankrupt?	0	1	0.032	0.177
x_1	ROA(C) before interest and depreciation before interest	0	1	0.505	0.061
x_2	Operating Gross Margin	0	1	0.608	0.017
x_3	Pre-tax net Interest Rate	0	1	0.797	0.013
x_4	Non-industry income and expenditure/revenue	0	1	0.304	0.011
x_5	Operating Expense Rate	0	9.99×10^9	2×10^9	3.24×10^9
x_6	Cash flow rate	0	1	0.467	0.017
x_7	Net Value Per Share (B)	0	1	0.191	0.033
x_8	Operating Profit Growth Rate	0	1	0.848	0.011
x_9	Total Asset Growth Rate	0	9.99×10^9	5.51×10^9	2.9×10^9
x_{10}	Current Ratio	0	2.75×10^9	403285	33302156
x_{11}	Borrowing dependency	0	1	0.375	0.016
x_{12}	Total Asset Turnover	0	1	0.142	0.101
x_{13}	Working Capital to Total Assets	0	1	0.814	0.059
x_{14}	Total income/Total expense	0	1	0.003	0.012
x_{15}	Current Liability to Current Assets	0	1	0.032	0.031
x_{16}	Liability to Equity	0	1	0.28	0.014

2.3. Method Introduction

This paper uses the Probit Regression model, whether or not to have gone bankrupted is the dependent variable(Y), and the 16 factors are the independent variables(X), where 0 represents no and 1 represents yes. Next, this paper uses SPSSAU and SPSSPRO to analyze the relationship between the effect of X on Y, i.e., the relationship between the 16 factors on company bankrupt.

2.4. Model Principle

Probit regression is used for statistical analysis of data whose dependent variable is a categorical variable, which is similar to Logistic regression. Deforming Logistic mode, it can be seen that:

$$P = \frac{e^{X\beta}}{1+e^{X\beta}} \tag{1}$$

The right-hand side of the above equation ($\frac{e^{X\beta}}{1+e^{X\beta}}$) happens to resemble the probability distribution function of the standard growth distribution, which is also commonly referred to as the Logistic distribution. The Probit model assumes that the probability distribution function on the right is similar to that of the standard normal distribution:

$$P = \int_{-\infty}^{X} \frac{1}{\sqrt{2\pi}} e^{-\frac{(X\beta)^2}{2}} \tag{2}$$

3. Results and Discussion

3.1. Model Testing

It can be seen from Table 2 that as model fitting quality is judged by model prediction accuracy, the overall prediction rate of this research model is 96.89%, indicating a satisfactory model fit. The forecast rates are 99.82% and 9.09% respectively for the true values of 0 and 1.

Table 2. Binary probit regression prediction accuracy summary

		predicted value		forecast accuracy	Prediction error rate
		0	1		
true value	0	6587	12	99.82%	0.18%
	1	200	20	9.09%	90.91%
Summary				96.89%	3.11%

3.2. Model Results

Based on the comparison chart (Figure 1), the differences between the mean values of going bankrupt and not going bankrupt on the factors $x_1, x_2, x_7, x_{11}, x_{12}, x_{13}, x_{14}, x_{15}$ and x_{16} are relatively large, leading to the greatest hidden risk of bankrupt, which is worth studying and analyzing.

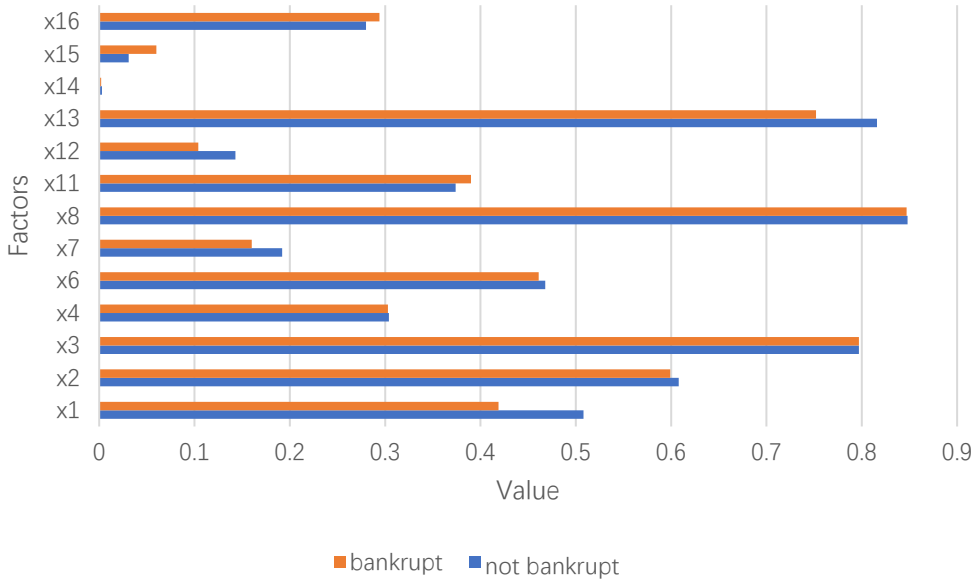

Fig. 1 Comparison of mean values for bankrupt and non-bankrupt companies under different factors.

From Figure 2, it can be observed that the use of correlation analysis to examine the relationships between the dependent variable y and the 16 independent variables is represented by the Pearson correlation coefficient, indicating the strength of these relationships. Specific analyses reveal the following:

There is a significant negative correlation between y and x_1, x_6, x_7, x_9, x_{12}, and x_{13}. Conversely, notable positive correlations are observed between y and x_{11}, x_{15} and x_{16}.Furthermore, no substantial correlations exist between y and x_3, x_4, x_5, x_8, x_{10}, and x_{14}.

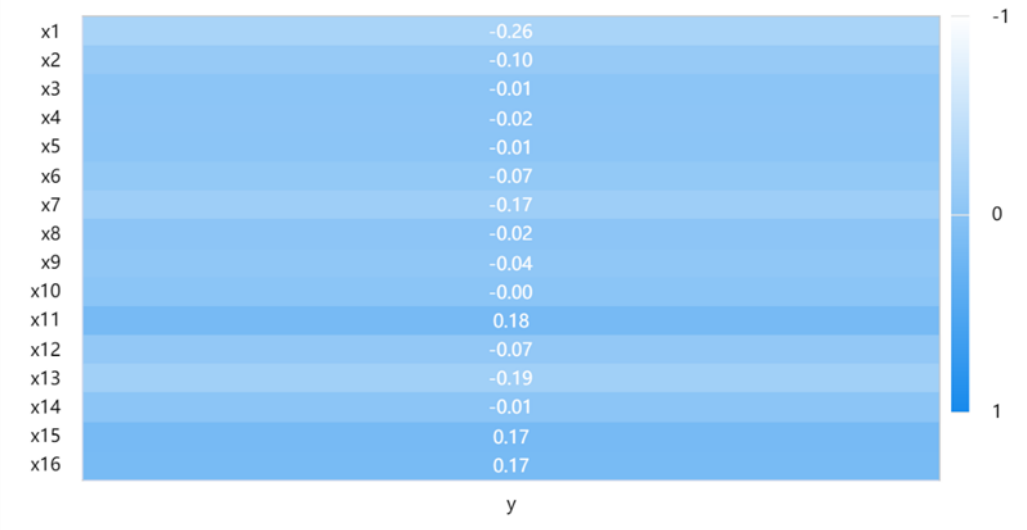

Fig. 2 Visualization of Pearson Correlation between Independent and Dependent Variables

From Figure 3, it is evident that correlation analysis was employed to investigate the relationships between variable x_1 and a set of fifteen variables denoted as x_2 - x_{16}. The Pearson correlation coefficient was utilized to quantify the strength of these associations. Specific examination reveals the following outcomes:

There exists a statistically significant positive correlation between x_1 and variables x_2, x_3, x_5, x_6, x_7, x_8, x_{12}, and x_{13}. Conversely, x_1 exhibits a statistically significant negative correlation with variables x_{11}, x_{15}, and x_{16}.

Additionally, it is noteworthy that the correlation coefficients between x_1 and variables x_4, x_9, x_{10}, and x_{14} do not attain statistical significance ($p > 0.05$). This implies that there is no significant correlation between x_1 and the aforementioned four variables, namely x_4, x_9, x_{10}, and x_{14}.

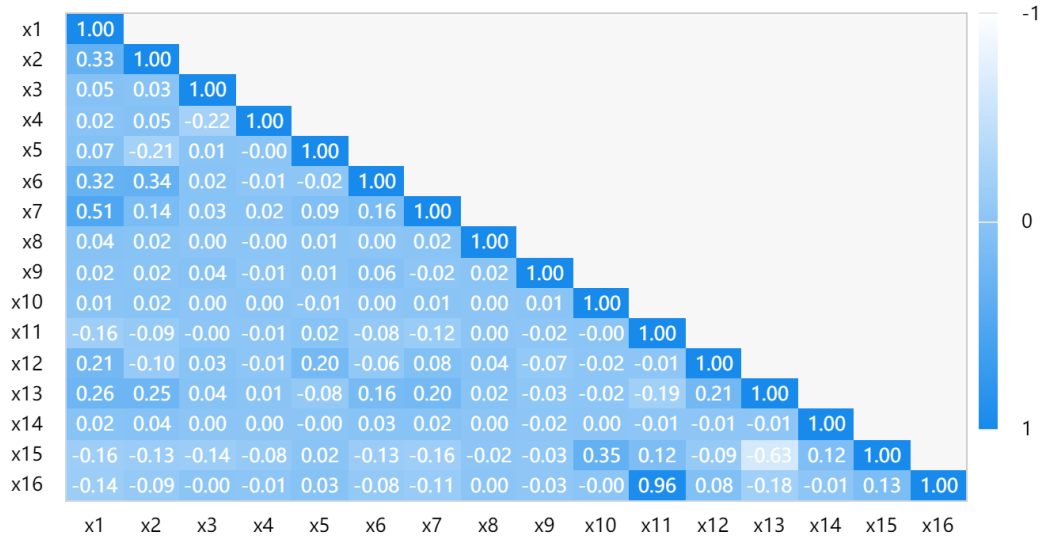

Fig. 3 Pearson Correlation Visualization Chart Among 16 Independent Variables

As shown in Figure 4, the research introduced various factors that might be related to company bankrupt into the model, including 16 various factors.

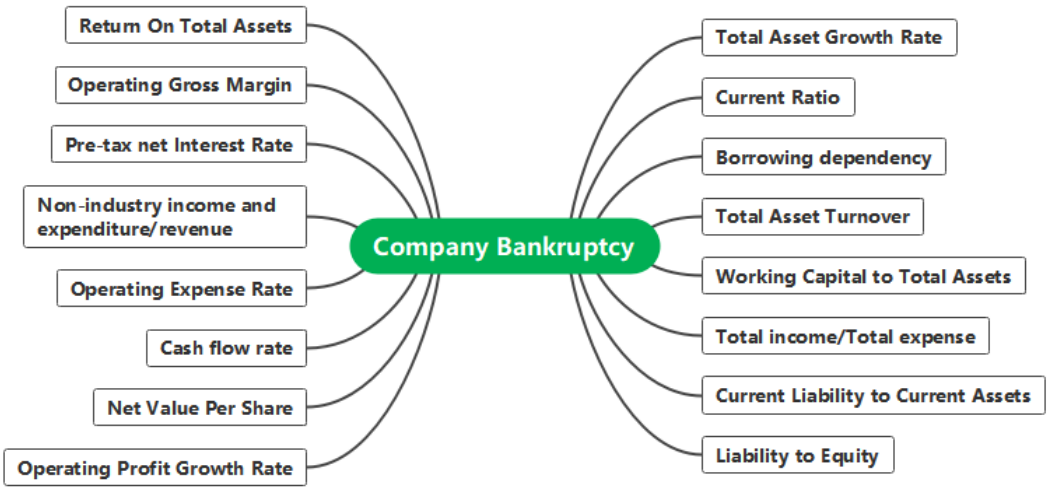

Fig. 4 Variable-related schematic

3.3. Main Results

Through calculations, this study yields the final linear regression equation:

$$\text{Probit}(p) = -139.180 - 6.028 * \text{X1} - 0.734 * \text{X2} + \ldots + -3.668 * \text{X16} \quad (3)$$

Where p represents the probability of Bankrupt being 1. It is manifest from Table 3 that the model gets the conclusion that by judging whether the p-value is greater than 0.05, this study can further infer what factors may be associated with bankrupt.

On the one hand, the p values of x_2, x_6, x_8, x_9, x_{10}, x_{11}, x_{15}, and x_{16}, are all greater than 0.05, meaning they do not affect Bankrupt. On the other hand, the p values of x_1, x_3, x_4, x_5, x_7, x_{12}, x_{13} and x_{14} are all smaller than 0.05, which shows that these factors have relatively strong affection on

bankrupt. More specifically, Bankruptcy will be significantly positively influenced by x_3 and x_5, and x_1, x_4, x_7, x_{12}, x_{13} and x_{14} will have a significant negative impact on Bankrupt.

When it comes to the influence relations, regression coefficient value combined with Marginal effect value show the specific influence factors: the increasing (decreasing) in bankrupt will be 352.41%, 204.48% with one unit increase of Pre-tax net Interest Rate, Operating Expense Rate separately, while the decreasing in bankrupt will be -712.36%, -350.08%, -329.44%, -292.96%, -499.68%, -317.90% with one unit increase of ROA(C) before interest and depreciation before interest, Non-industry income and expenditure/revenue, Net Value Per Share (B), Total Asset Turnover, Working Capital to Total Assets, Total income/Total expense separately. There is no denying that these factors have a significant impact on the likelihood of being bankrupt, as these data are all large comparably, which means they have some reference and research value.

Table 3. Model results

Variable	Coefficient	S. E.	Z-value	p-value	CI
x_1	-6.028	0.828	-7.285	0.000	-7.650 ~ -4.406
x_2	-0.734	2.551	-0.288	0.773	-5.734 ~ 4.266
x_3	260.098	73.038	3.561	0.000	116.946 ~ 403.250
x_4	-192.615	54.465	-3.536	0.000	-299.365 ~ -85.864
x_5	0.000	0.000	2.053	0.040	0.000 ~ 0.000
x_6	-4.217	2.822	-1.495	0.135	-9.748 ~ 1.313
x_7	-8.529	2.562	-3.328	0.001	-13.551 ~ -3.507
x_8	-1.291	2.978	-0.433	0.665	-7.128 ~ 4.546
x_9	-0.000	0.000	-0.630	0.529	-0.000 ~ 0.000
x_{10}	-0.000	0.000	-0.000	1.000	-0.000 ~ 0.000
x_{11}	7.040	5.300	1.328	0.184	-3.347 ~ 17.427
x_{12}	-1.499	0.507	-2.958	0.003	-2.492 ~ -0.506
x_{13}	-4.161	0.814	-5.115	0.000	-5.756 ~ -2.567
x_{14}	-864.976	269.070	-3.215	0.001	-1392.344 ~ -337.609
x_{15}	0.555	0.974	0.570	0.569	-1.354 ~ 2.465
x_{16}	-3.668	6.476	-0.566	0.571	-16.360 ~ 9.024
Constant	-139.180	40.750	-3.415	0.001	-219.048 ~ -59.312

*Dependent variable: Bankrupt.

4. Conclusion

This research employs a diverse dataset to investigate factors potentially associated with corporate bankruptcy. The study reveals that corporate bankruptcy may be correlated with Pre-tax net Interest Rate, Operating Expense Rate, ROA(C) before interest and depreciation before interest, Non-industry income and expenditure/revenue, Net Value Per Share (B), Total Asset Turnover, Working Capital to Total Assets, Total income/Total expense.

Acknowledging the limited data available for bankrupt companies, the prediction accuracy rate of the bankruptcy for bankruptcy companies in this model is comparatively low. Nevertheless, this study holds significant value and merits.

Firstly, the approach adopted in this research is innovative. On one hand, graphical analysis is employed to visually analyze the discrepancies in the numerical values of each factor between the bankrupt and non-bankrupt company groups, rendering experimental results more clear and intuitive. On the other hand, unlike many prior single-factor analysis methods, this study utilizes multivariate linear regression, which contributes to a more comprehensive investigation.

Secondly, this research has positive implications for corporate bankruptcy prediction. It identifies potential factors that might lead to corporate bankruptcy, which is highly significant in recognizing warning signals, mitigating risks, and formulating effective preventive measures.

Future research could further explore other external factors that may contribute to corporate bankruptcy, such as macroeconomic conditions, industry competition, and regulatory policies, in order to achieve a more comprehensive and accurate prediction of corporate bankruptcy. Additionally, investigating the reason why those internal factors could lead to corporate bankruptcy could also prove beneficial. Furthermore, this paper does not provide specific recommendations on improving policies regarding corporate financial data disclosure for predicting bankruptcy risks through financial data. Therefore, further research and discussion might be necessary to develop and refine disclosure policies and measures.

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