Predicting Bankruptcy with Univariate Discriminant Analysis. Case of Albania

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Abstract:

Enterprise bankruptcy is one of the main financial management's fields of study, whose importance is significantly increasing in nowadays. The purpose of this paper is to determine the key ratios that help to classify enterprises as bankrupt and non-bankrupt enterprises. The paper is focused on the private-sector enterprises operating in Albania. The sample comprises of 200 enterprises and 24 variables were calculated based on their financial statements. The results of this study show that the most important financial ratios that distinguish between bankrupt and non-bankrupt enterprises in Albania refer to profitability ratios, financial structure ratios, and activity management ratios. Net margin profit is the main ratio, which can accurately classify 70% of the enterprises. With regard to the bankrupt enterprises, the most accurate ratio which can better classify the enterprises one year before bankruptcy is the log of total sales (68%), while in the case of non-bankrupt enterprises, the most accurate ratio in the classification is the net profit margin, which accurately classify 95% of them one year before bankruptcy. In addition, the results of this paper show that liquidity ratios are the least important statistical ratios in this discriminant analysis.

Key words: bankruptcy, private enterprise, univariate analysis, liquidity, capital structure.

1. INTRODUCTION

Enterprise bankruptcy is one of the most important fields of study in financial management. Research on this field has shown a consistent growing interest for many reasons. First, the enterprise bankruptcy affects the economic development of a country as a whole, as a consequence of its negative impact on the economic welfare of shareholders, suppliers, creditors and employees. Second, the indirect and direct costs of bankruptcy are very high, and grow considerably when approaching the moment of bankruptcy. Third, scientific researchers nowadays have more availability in data and can use more advanced quantitative techniques. This has significantly increased the possibilities of researchers to build bankruptcy forecasting models.

In the second section of the paper are summarized the advantages and disadvantages of using the univariate discriminant analysis for bankruptcy prediction. The third section presents the results of applying this model to a sample of 200 enterprises operating in Albania. Finally, in the fourth section, some conclusions are drawn regarding the use of univariate model for bankruptcy prediction.

2. ADVANTAGES AND DISADVANTAGES

Univariate Discriminate Analysis has always played an important role in predicting the bankruptcy of enterprises. Although other quantitative techniques have been developed and are more advanced, these models have served as the basis of research for many scholars. Below are summarized some advantages of using these models in bankruptcy forecasting:

- Univariate Discriminate Analysis is simple to be used. They do not require any advanced statistical or mathematical knowledge. Each ratio in the study is

compared to the cut-off level and depending on its value, the enterprise is classified as bankrupt or not.

- These models indicate which ratios have a greater impact on the enterprise bankruptcy. The ratio of working capital to total assets has resulted the main influencing ratio according to Smith and Winakor (1935) and Merwin (1942), the quick ratio according to Jackendoff (1962) and cash flow ratios according to Casey and Bartczak (1984).

- These models serve as a basis for the use of more advanced quantitative models, helping to determine the factors that can be taken into account in developing Multivariate Discriminate Analysis.

Univariate Discriminate Analysis is the first model built by researchers in the field of bankruptcy. These models are rarely used in nowadays for some reasons:

- The number of non-bankrupt enterprises is many times higher than those of the bankrupt ones. Since using these models requires the same distribution of enterprises in the two classes (bankrupt and non-bankrupt), their use may have several problems.

- There are difficulties in determining the ratios that will be considered in the study. Researchers usually use subjectivity in this regard and are mostly based on the reviewed literature.

- These models consider only one ratio. However, financial failure can be caused by several ratios simultaneously and by a whole set of ratios, both financial and non-financial.

- Univariate Discriminate Analysis assumes that the relationship of each factor with the enterprise bankruptcy is linear. But, in practice, this relationship may not exist for all the factors (Keasey

and Watson, 1991), making these models often result
in inaccurate conclusions.

- The cut-off level for each ratio, which distinguishes
  bankrupt and non-bankrupt enterprises, may change
  over time and from one industry to another.

Despite of the disadvantages of the Univariate Discriminate
Analysis, they have played and still play an important role for
all groups of interest in this field and have served as a basis for
further studies that use more ratios in bankruptcy prediction.

3. UNIVARIATE DISCRIMINATE ANALYSIS FOR ALBANIAN PRIVATE ENTERPRISES

In the previous section we summarized the advantages and
disadvantages of using the Univariate Discriminate Analysis
for bankruptcy prediction. The overwhelming majority of the
models belong to the developed countries, because of the need
that has demonstrated the enterprises in these countries in
different periods. The only study in our country regarding the
bankruptcy prediction was carried out by Perri (2007), who was
focused on state-owned enterprises. Meanwhile, this is the first
study conducted in our country with aim on building a model
for bankruptcy prediction of private-sector enterprises.

3.1 Database

This study refers to enterprises with an annual turnover over
20 million Lek. This selection is done to ensure the reliability of
data on the financial statements (as the majority of smaller
businesses have no audited financial statements). The study is
carried out in two steps. Initially, the study is focused on
providing information regarding bankrupt enterprises. Out of
checking over 10,000 historical extracts from the database of
National Business Center, only 130 bankrupt enterprises have

been identified. In this study, bankrupt enterprises are considered the followings:

- Enterprises for which the liquidation procedure has been opened;
- Enterprises that have not settled liabilities to the banking institution yet, although at least one year has elapsed since the maturity date;
- Enterprises with negative profit before amortization, interest and tax for at least two consecutive years.

Then, as suggested by most of other authors, the study is focused on providing financial data for the same number of non-bankrupt enterprises. Selection is performed based on the "match" process. This means that, for each bankrupt enterprise, a non-bankrupt enterprise has been selected which belongs to the same sector and has more or less the same volume of sales or total assets. This method ensures the comparisons between similar enterprises in the same sector and leads to more accurate results.

In this paper are used financial data from 2008 to 2015. Due to deficiencies of some financial statements, for discriminant analysis is used only data of 100 bankrupt enterprises and 100 non – bankrupt enterprises. In the following table (Table 1) is given the distribution of enterprises by district.

Table 1: Distribution of enterprises by district

District	Bankrupt	Non - Bankrupt
Berat	2	2
Dibër	0	5
Durrës	8	13
Elbasan	8	6
Fier	5	10
Gjirokastër	2	3
Korcë	5	4
Kukës	0	0
Lezhë	2	4

Shkodër	3	7
Tiranë	57	42
Vlorë	8	4
In total	**100**	**100**

Source: Author's calculations

As we see above, most of the bankrupt enterprises belong to the district of Tirana, while in other districts the number of bankrupt enterprises is at low or zero levels (District of Dibër and Kukës). If we refer to the sector where enterprises operate, it results that 50 of them belong to the trade sector. The full distribution of enterprises by sector of activity is given in the following table (Table 2):

Table 2: Distribution of enterprises by sector of activity

Sector	Frequency	Percentage	Cumulative percentage
Industry	6	6.0	6.0
Construction	18	18.0	24.0
Production	13	13.0	37.0
Services	13	13.0	50.0
Trade	50	50.0	100.0
In total	**100**	**100.0**	

Source: Author's calculations

3.2 The descriptive statistics of the database

Before we start with the univariate discriminant analysis, in this section are provided the descriptive statistics of the database. In total in this study were calculated 24 financial ratios, which are summarized in the following table (Table 3):

Table 3: Ratios used for univariate discriminant analysis

RATIO	CALCULATION
RK	Current Assets / Current Liabilities
RSH	(Current Assets – Inventory) / Current Liabilities
RL	Liquid Assets / Current Liabilities
AASH_DET	Current Assets / Total Liabilities
KQN_AASH	Working Capital / Current Assets
KQN_DET	Working Capital / Total Liabilities
PMA	Receivable Accounts / Daily Sales

QARK_AASH	Total Sales / Current Assets
QARK_AKTIVE	Total Sales / Total Assets
QARK_PUNUES	Total Sales / Working Capital
QARK_KAP	Total Sales / Equity
RB	Total Liabilities / Total Assets
KAPVET	Equity / Total Assets
DET_KAP	Total Assets / Equity
KAPEKON_AKTIVE	Economic Capital / Total Assets
FMB	Gross Profit / Total Sales
FMO	Operating Profit / Total Sales
FMN	Net Profit / Total Sales
BEP	Profit before Interest and Taxes / Total Assets
ROA	Net Profit / Total Assets
ROE	Net Profit / Equity
ILF	ROE / ROA
LOG_AKT	Log of Total Assets
LOG_SH	Log of Total Sales

Source: Author's calculations

As we see in the table 3, the number of financial ratios used in this study is only 24 for several reasons, which are given below:

- As a result of the lack of cash flow statement for some enterprises;
- As a result of the lack of long – term assets for some enterprises;
- As a result of the lack of inventory for some enterprises.

After we have defined the financial ratios for univariate discriminant analysis, in the following table (Table 4) is given the description of the data for bankrupt enterprises, where it is given the average value, the minimum and maximum value and the standard deviation for each financial ratio.

Table 4: Descriptive Statistics for Bankrupt Enterprises

Ratio	Min.	Max.	Average	Standard Deviation
RK	.04	910.80	13.5198	93.01803
RSH	.01	910.80	13.0694	92.95601
RL	.00	184.80	2.1094	18.47394
AASH_DET	.04	116.30	2.8600	11.89513
KQN_AASH	-.96	909.80	12.5198	93.01803
KQN_DET	-.96	116.17	2.1110	11.94224
PMA	.19	21548.74	1421.3700	3218.52211
QARK_AASH	.00	81.27	2.7740	9.32702

QARK_AKTIVE	.00	33.72	1.4371	3.86942
QARK_PUNUES	-19.62	46.60	1.7217	9.03443
QARK_KAP	-41.56	200.79	4.9332	24.86084
RB	.01	10.04	1.0165	1.12660
KAPVET	-9.04	.99	-.0165	1.12660
DET_KAP	-49.83	257.88	8.2235	38.56320
KAPEKON_AKTIVE	-9.04	1.00	.2538	1.07495
FMB	-.93	1.64	.2018	.38867
FMO	-4.37	1.44	-.1700	.64971
FMN	-4.37	3.89	-.1269	.85337
BEP	-5.45	11.80	.0083	1.34113
ROA	-5.49	10.64	-.0157	1.24279
ROE	-12.55	13.25	.1796	2.62638
ILF	-48.83	258.88	9.2229	38.56333
LOG_AKT	12.49	24.48	18.5439	2.08901
LOG_SH	14.72	23.79	17.6488	1.77304

Source: Author's calculations

In the following table (Table 5) is given the description of the data for non - bankrupt enterprises, where it is given the same information given above for the bankrupt enterprises, the average value, the minimum and maximum value and the standard deviation for each financial ratio.

Table 5: Descriptive Statistics for Non – Bankrupt Enterprises

Ratio	Min.	Max.	Average	Standard Deviation
RK	.13	298.49	10.3913	40.27066
RSH	.00	136.36	5.5925	18.05489
RL	-.10	84.04	2.4246	10.15109
AASH_DET	.03	298.49	6.6913	31.58329
KQN_AASH	-.87	297.49	9.3913	40.27066
KQN_DET	-.81	297.49	5.8921	31.54825
PMA	.28	2088.31	194.1926	350.58551
QARK_AASH	.05	13.89	2.1835	2.48297
QARK_AKTIVE	.05	11.64	1.4061	1.54102
QARK_PUNUES	-2867.80	77.78	-30.4293	292.34098
QARK_KAP	-6.53	414.50	10.1994	42.47458
RB	.00	1.30	.6227	.26879
KAPVET	-.30	1.00	.3796	.26694
DET_KAP	-61.89	150.05	3.8119	16.89435
KAPEKON_AKTIVE	-.30	1.00	.5219	.27915
FMB	-.03	1.00	.2569	.23392
FMO	-.25	.87	.1083	.14753
FMN	-.37	.48	.0742	.11800
BEP	-.19	.81	.1130	.14068
ROA	-.19	.73	.0892	.12752

ROE	-.64	34.34	.5723	3.42284
ILF	-60.89	151.31	4.8064	16.91750
LOG_AKT	15.27	23.32	18.5278	1.80052
LOG_SH	15.62	24.88	18.3855	1.78520

Source: Author's calculations

From the comparison of the data we see that the bankrupt enterprises have a higher current ratio and a higher quick ratio than the non – bankrupt enterprises, but on the other hand they have a lower liquid ratio. This is because the bankrupt enterprises have a high level of short – term assets less liquid, which increases the risk of the activity. Risk growth is also supported by the fact that bankrupt enterprises have a much higher level of debt than non – bankrupt enterprises. Consequently they result in loss, which has made their overall profitability to be negative.

3.3 Univariate Discriminant Analysis

Univariate discriminant analysis aims to identify the best ratio to distinguish between two classes of enterprises, bankrupt and non – bankrupt. For this, at first it is made a comparison between the average values of each ratio and then it is tested if this change is statistically significant. The results of this analysis are summarized in the following table (Table 6):

Table 6: Results of univariate discriminant analysis

Ratio	Wilks' Lambda	F	df1	df2	Sig.
RK	1.000	.095	1	198	.758
RSH	.997	.623	1	198	.431
RL	1.000	.022	1	198	.881
AASH_DET	.994	1.289	1	198	.258
KQN_AASH	1.000	.095	1	198	.758
KQN_DET	.994	1.256	1	198	.264
PMA	.932	14.367	1	198	.000
QARK_AASH	.998	.374	1	198	.541
QARK_AKTIVE	1.000	.006	1	198	.941
QARK_PUNUES	.994	1.208	1	198	.273
QARK_KAP	.994	1.145	1	198	.286
RB	.945	11.560	1	198	.001
KAPVET	.944	11.704	1	198	.001

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DET_KAP	.994	1.098	1	198	.296
KAPEKON_AKTIVE	.971	5.827	1	198	.017
FMB	.993	1.475	1	198	.226
FMO	.919	17.448	1	198	.000
FMN	.973	5.449	1	198	.021
BEP	.997	.603	1	198	.438
ROA	.996	.705	1	198	.402
ROE	.996	.828	1	198	.364
ILF	.994	1.100	1	198	.296
LOG_AKT	1.000	.003	1	198	.954
LOG_SH	.958	8.573	1	198	.004

Source: Author's calculations with SPSS

The table above gives the results of the ANOVA for each of the selected ratios. If the significance level is below 0.05, it means that the corresponding ratio helps to differentiate between the two classes of enterprises. As seen above, there are 7 statistically significant ratios in the discriminant analysis performed. Another indicator that helps to determine the ratios that best make the difference between the two classes of enterprises is the "Wilks' Lambda". The lower the value of this indicator, the higher is the contribution of the relevant ratio in the discriminant analysis. Referring to this analysis, the ratios that best manage to classify bankrupt and non-bankrupt enterprises one year before bankruptcy are presented below (starting with the largest contributing ratio):

- Operating Profit Margin Ratio;
- Average Collection Period;
- Equity Ratio;
- Debt Ratio;
- Log of Total Sales;
- Economic Capital to Total Assets Ratio;
- Net Profit Margin Ratio.

As seen above, the most important financial ratios that distinguish between bankrupt and non-bankrupt enterprises belong to the profitability ratios group (Operating profit margin, Net profit margin); capital structure ratios (Equity

ratio, Debt ratio, Economic capital to total assets ratio) and activity ratios (Average collection period, Log of total sales). Meanwhile, the most impressive result is that liquidity ratios are the least statistically important ratios in this discriminant analysis.

Regarding the accuracy of ratios in forecasting the bankruptcy of enterprises one year before bankruptcy, the results are given in the following table (Table 7):

Table 7: Accuracy of ratios in the classification of enterprises

	Accuracy of enterprise classification		
Ratio	Bankrupt	Non-Bankrupt	In total
Operating Profit Margin Ratio	42	95	68.5
Average Collection Period	27	95	61
Equity Ratio	57	75	66
Debt Ratio	57	74	65.5
Log of Total Sales	68	53	60.5
Economic Capital to Total Assets Ratio	48	68	58
Net Profit Margin Ratio	45	95	70

Source: Author's calculations with SPSS

Furthermore, the ratios that are the most accurate to classify the enterprises are the two profitability ratios: the net profit margin, which can accurately classify 70% of the enterprises and the operating profit margin, which can accurately classify 68.5% of the enterprises. In addition, the table above gives the accuracy of each variable for each class of enterprises. As referred to bankrupt enterprises, the most accurate variables in the classification one year before bankruptcy are the log of total sales (68%), the debt ratio (57%) and the equity ratio (57%). While referring to non-bankrupt enterprises, the most accurate ratios in the classification are the net profit margin, the operating profit margin and the average collection period, which are able to accurately classify 95% of enterprises one year before bankruptcy.

4. CONCLUSIONS

Although advanced quantitative techniques have been developed and have increased in number, Univariate Discriminate Analysis still play an important role in forecasting bankruptcy of enterprises and serve as a basis for many researchers work in this field. Univariate Discriminate Analysis is simple to be used and it does not require advanced statistical or mathematical knowledge. Each variable (financial ratio) is compared to the cut-off level and depending on its value, the enterprise is classified as bankrupt or not. This model is used to determine variables that better classify Albanian private equity enterprises into bankrupt or non-bankrupt enterprises. The results of this study show that the variables that more accurately classify enterprises as bankrupt or not are the two profitability ratios: the net profit margin ratio, which can accurately classify 70% of enterprises and the operating profit margin ratio, which can accurately classify 68.5% of enterprises.

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