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Original scientific article

Financial ratio indicators as early predictors of business failure: evidence from Serbia

Финансијски рацио показатељи као рани предиктори пословног неуспеха: искуство из Србије

Denis Kušter
PhD student, University of Novi Sad, Faculty of Economics in Subotica, Subotica, Republic of Serbia,
kuschter@yahoo.com https://orcid.org/0000-0001-6697-6792

Abstract:
The problem of corporate bankruptcies has intrigued the scientific community for years due to its practical significance. There is no country whose economic well-being is not affected by business failures. The research problem stems from the lack of analyses related to the issue of business failures in the the Republic of Serbia. The main aim of this research paper is to determine whether ratio indicators are relevant in predicting business failure one, two and three years before bankruptcy proceedings start. The research was conducted on a sample of 100 companies from the teritorry of Serbia. The data for ratios calculation was taken from the official website of the Business Registers Agency. Statistical analysis is based on *Mann-Whitney* test, which is used to identify differences between two groups with respect to a variable (ratio). The test was conducted in IBM's SPSS v.26 tool. Results of the research indicate that financial ratios can be useful for business failure prediction even three years before bankruptcy proceedings start, since there are statistically significant differences in ratio values between bankrupt and solvent companies.
Keywords: business failure, bankruptcy, financial distress, Mann-Whitney, financial ratios
JEL classification: G33, M40

Сажетак: Проблем банкротства предузећа годинама интригира научну јавност због свог практичног значаја. Нема земље на чије економско благостање не утичу пословни неуспеси. Проблем истраживања произилази из недостатка анализа из Републике Србије које се односе на питање пословних неуспеха. Основни циљ овог истраживачког рада је да се утврди да ли су рацио показатељи релевантни за предвиђање пословног неуспеха једну, две и три године пре покретања стечајног поступка. Истраживање је спроведено на узорку од 100 предузећа са територије Републике Србије. Подаци за обрачун рациа преузети су са званичног сајта Агенције за привредне регистре. Статистичка анализа се заснива на *Mann-Whitney* тесту који се користи за идентификацију разлика између две групе у односу на неку варијаблу (рацио). Тест је спроведен у ИБМ-овом СПСС в.26 алату. Резултати истраживања указују на то да финансијски показатељи могу бити корисни за предвиђање пословног неуспеха чак и три године пре покретања стечајног поступка, јер постоје статистички значајне разлике у вредностима рациа између банкротиралих и солвентних предузећа.
Кључне речи: пословни неуспех, банкрот, финансијски притисак, Mann-Whitney, финансијска рациа
ЈЕЛ класификација: G33, M40

Introduction

Business failures can be identified in the literature by different terms, such as deteriorating corporate financial health, bankruptcy, financial difficulties, default, credit risk, ex-ante financial analysis, early warning systems, etc. (Svabova et al., 2018, p. 16–29). Bankruptcy prediction is a topic which affects the economic well-being of all countries (Gordini, 2014, p. 2). A company is said to be insolvent or under financial distress if it is unable to pay its debts as they become due, which is aggravated if the value of the firm's assets is lower than its liabilities (Bacerra, Galvao & Abou-Seada, 2005).

In terms of this research, *business failure* is considered to be a synonym for *bankruptcy*. According to Serbian Law[1] bankruptcy can be defined as procedure carried out against a legal entity that is experiencing difficulties in operating business. The main aim of bankruptcy proceedings is to enable the most favorable collective settlement of creditors' claims by selling the property of a bankrupt legal entity.

The problem that the paper focuses is creating segregation between two groups of companies, bankrupt and solvent, through financial analysis. The main aim of the research is to determine which of the most used financial ratios can signal business failure early (one, two and three years in advance). To test the financial performance of companies, ratio analysis is employed as a commonly used technique. Ratio analysis is defined as the systematic use of indicators to interpret financial statements (Mitrovic, Knezevic & Milasinovic, 2021). The ratios that will be used in the paper are of great importance in both traditional and modern analyses of business failures, judged by the results of previous research. However, a large number of analyses and models are focused on developed countries, while a small number of them are focused on developing countries such as Serbia. There are not many scientific papers in Serbia dealing with the issue of corporate bankruptcies, and even fewer papers deal with the issue of adequate selection of financial variables that could signal business troubles three years in advance, which emphasizes the importance of the research.

The first part of the research paper systematizes the existing literature related to bankruptcy prediction models. This part is important for understanding the choice of variables that will be used in the research. In the second part, the final selection of variables is performed, the research sample is presented, as well as the way in which the analysis will be performed. In the third part, the analysis is performed, as well as confirmed which variables are potentially good predictors of business failure. Final thoughts and conclusions are presented in the penultimate and last chapters.

1. Literature overview

The problem of bankruptcies or business failures has occupied researchers for a long time. The first beginnings of research on bankruptcies date back to early 30s, where Fitzpatrick (1932) analyzed distinction between successful and unsuccessful entities. The most popular

[1] Available at: https://www.paragraf.rs/propisi/zakon_o_stecaju.html (*date of access: 01.04.2022.*)

and traditional research papers on this topic were written in the mid 60's. Beaver (1966) used univariate discriminant (UDA) statistical method. He compared mean values for failed and non-failed companies and concluded that "Cash flow to Total debt", "Net income to Total assets", "Working Capital to Total Assets", "Current ratio" and "No-credit interval" have greater values for non-failed companies, while "Total debt to Total Assets" ratio has greater values in case of failed companies. Altman (1968) used multivariate (MDA) discriminant analysis on a sample of 66 entities. He developed well-known Z–score model with bankruptcy prediction accuracy of 79%. The model includes five variables: X1 (ratio of net working capital to operating assets), X2 (ratio of retained earnings and total assets), X3 (ratio of profit before interest and taxation and total assets), X4 (ratio of market value of capital and total liabilities) and X5 (ratio of operating income to total assets). Ohlson (1980) was the first to point out the shortcomings of MDA analysis, and used logistic regression in his work. 105 businesses were included in the research and a model of 96% accuracy was developed. Nine variables were used in Ohlson's models: X1 (logarithm of total assets to gross domestic product index), X2 (ratio of total liabilities to assets), X3 (share of net working capital in total assets), X4 (ratio of current liabilities and current assets), X5 ("dummy" variable that takes the value 0 if total liabilities are less than total assets and the value 1 in the opposite case), X6 (share of profit in total assets), X7 (ratio of cash flow from operating activities and total liabilities), X8 ("dummy" variable which takes the value 1 when there is a loss in the last two years, and 0 in other cases) and X9 [(NIt - NIt-1) / (| NIt | + | NIt-1 | , *and the label "Nit" is the net profit in the last observed period*]. Deakin (1972) used the MDA statistical technique and developed a model that could predict bankruptcy with 96% accuracy two years before initiating bankruptcy proceedings. He used 14 variables in the analysis: cash flow / total liabilities; net result / total assets; total liabilities / total assets; current assets / total assets; cash and cash equivalents / total assets; working capital / total assets; cash / total assets; current assets / current liabilities; cash and cash equivalents / current liabilities; cash / short-term liabilities; working capital / sales revenue; cash and cash equivalents / sales revenue; working capital / sales revenue; cash / sales revenue. Zmijewski (1984) opted for a probit approach which, like the models of his predecessors, was based on accounting data. However, it uses a different set of independent variables. The variables included in the model are: NITL (Net result divided by total liabilities), TLTA (total liabilities divided by total assets), and CACL (Current assets divided by current liabilities). McKee (1995) applied the method of inductive reasoning where he predicted the bankruptcy of 60 public companies from the territory of the United States. As with most authors, the sample is balanced (50:50 = solvent companies: bankrupt companies). The research is focused on the period from 1986 to 1989, and the following variables are included in the analysis: net profit / assets; working capital / assets; working capital / current liabilities; cash / assets; current assets / sales; long-term debt / assets; receivables / sales.

Many researchers have tested the significance and predictive power of these models to date (Milic, et al, 2021; Mizdrakovic & Bokic, 2017; etc.), but also many bankruptcy prediction models have been developed after those ground-breaking ones (Ciampi & Gordini, 2008; Pervan, Pervan & Vukoja, 2011; Zenzerovic, 2011; Cultrera & Bredart, 2016; Obradovic, et. al, 2018; Svabova, et al.,2020; etc.). What is specific to a large number of

predictions of business failures is that they are based on financial ratio indicators, but in order to strengthen the predictive power of analysis and models, it is desirable to include non-financial and even external variables as well.

Table 1: Variables selection in bankruptcy prediction models

Variables	Frequency of use in the 190 studies
Financial ratio (ratio of two financial variables)	93%
Statistical variable (mean, standard deviation, variance, logarithm, factor analysis scores… calculated with ratios or financial variables	28%
Variation variable (evolution over time of a ratio or a financial variable	14%
Non-financial variable (any characteristic of a company or its environment other that those related to financial situation	13%
Market variable (ratio or variable related to stock price, stock return)	6%
Financial market variable (data coming from a balance sheet, an income statement or any financial documents	5%

Source: Jardin, 2009

2. Data, variables and methods

The research idea and scientific problem lie in the fact that in Serbia, there are not many scientific papers dealing with analysis of financial (ratio) variables, in order to identify those that are relevant for business failure prediction. Before the research, it is mandatory to define several aspects: hypothesis, research sample, variables and methodology that will be applied.

Research hypothesis is defined as follows: *financial ratio indicators can be used as early predictors of business failure in Serbia one (Y-1), two (Y-2) and three (Y-3) years before bankruptcy proceedings occur.* The research sample consists of 100 Serbian large, medium and small companies from various industries. A bankrupted company is considered to be one that initiated bankruptcy proceedings, while those that did not initiate bankruptcy proceedings are considered "healthy" ones (solvent). Business years 2019-2021 were considered. The number of companies that initiated bankruptcy proceedings is equal to the number of companies that did not (50:50) which is the case in most bankruptcy analysis and prediction models (Altman, 1968; Deakin 1972; McKee 1995; Ciampi & Gordini, 2008; Zenzerovic, 2011; Obradovic, et. al, 2018; etc.). Bankrupt companies were selected based on the list of active bankruptcy proceedings that is available on the "Agency for Licensing of Bankruptcy Trustees"[2] web page.

Such an analysis requires a sample that is well structured, and it is important to note that the sample is also balanced by company size, as well as by business activity. The average turnover of companies that started bankruptcy proceedings is 777,375,000 RSD, while the average turnover of "healthy" companies is 781,095,000 RSD. According to the Statistical

[2] Available at: https://alsu.gov.rs/stecaj/statistika-stecajnih-postupaka/ (*date of access: 01.04.2022.*)

Office of the Republic of Serbia[3], the characteristic of the Serbian economy is that small companies dominate, with an average share of 79% in the total number of companies (excluding micro entities) for the period 2018-2020. Accordingly, the research sample is dominated by small businesses with a share of 72%. Also, the research sample is dominated by trading and manufacturing companies with the share of 66% in total number of observations.

The research is based on a combination of statistical and financial analysis methods. The financial data (balance sheets) were taken from the Serbian Business Registers Agency[4] webpage. Financial part of the analysis is related to calculation of research variables – financial ratio indicators that are presented in the Table 2. They were calculated for one (Y-1), two (Y-2) and three (Y-3) years before bankruptcy proceedings started, in order to test the hypothesis. Financial statements used in the research cover the period from 2016 to 2021.

Table 2: Variables selection

Label	Calculation	Author sources
V1	Working capital / Total Assets	Altman (1968); Deakin (1972); Ohlson (1980); Keasey and McGuinness (1990); Theodossiou (1991); Obradovic, et. al. (2018); Becerra, Galvao and Abou-Seada (2005); Tserng, et al. (2014); Alaminos and Ferna´ndez (2016)
V2	Retained earnings / Total Assets	Altman (1968); Theodossiou (1991); Becerra, Galvao and Abou-Seada (2005);
V3	Gross result / Total Assets	Altman (1968); Chesser (1974); Hillegeist, et al. (2004) Alaminos and Fernández (2016); Papana & Spyridou (2020)
V4	Net result / Total Assets	Deakin (1972); Ohlson (1980); Frydman, Newblod and Whiteford (1985) Zmijewski, M. E. (1984); Theodossiou (1991); McKee (1995); Zenzerović (2011); Tserng, et al. (2014); Papana and Spyridou (2020)
V5	Equity / Total Assets	Altman (1968); Keasey and McGuinness (1990); Papana and Spyridou (2020)
V6	Sales / Total Assets	Altman (1968); Bilderbeek (1979); Zavgren (1983); Keasey and McGuinness (1990); Shah and Murtaza (2000); Dewaelheyns and Van Hulle (2004); Becerra, Galvao and Abou-Seada (2005); Tserng, et al. (2014); Alaminos and Ferna´ndez (2016); Korol (2019)
V7	Net cash flow / Total Assets	Beaver (1966); Van Wymeersch, Declerc and Heins (1992)
V8	Net cash flow / Total Liabilities	Beaver (1966); Deakin (1972); Frydman, Newblod and Whiteford (1985); Cultera and Brédart (2016)
V9	Net result / Total Liabilities	Beaver (1966); Shumway (2001)

[3] Available at: https://www.stat.gov.rs/ (*date of access: 05.04.2022.*)

[4] Available at: https://pretraga2.apr.gov.rs/unifiedentitysearch (*date of access: 10.04.2022.*)

V10	Total Liabilities / Total Assets	Deakin (1972); Chesser (1974); Ohlson (1980); Zmijewski (1984); Frydman, Newblod and Whiteford (1985); Theodossiou (1991); Van Wymeersch, Declerc, and Heins (1992) Platt, Platt and Pedersen (1994); Shah and Murtaza (2000); Shumway (2001); Dewaelheyns and Van Hulle (2004); Tserng, et al. (2014); Alaminos and Ferna´ndez (2016); Slefendorfas G (2016);
V11	Current Assets / Current Liabilities	Ohlson (1980); Altman & Levallee (1980); Zmijewski (1984); Frydman, Newblod and Whiteford (1985); McKee (1995); Pervan, Pervan and Vukoja (2011); Korol (2019); Cultera and Brédart (2016); Svabova, et. al. (2020); Vukovic, et. al. (2020); Papana and Spyridou (2020); Sfakianakis (2021); Mirovic, et. al (2022)
V12	Current Liabilities / Total Assets	Deakin (1972); Taffler (1983)
V13	Current Assets / Total Assets	Deakin (1972); Frydman, Newblod and Whiteford (1985); Alaminos and Ferna´ndez (2016); Vukovic, et. al (2020)

Source: the author

Focusing on the statistical method, it requires a good analysis of data, so that the research would not be conducted by wrong statistical method, which can further lead to wrong conclusions. The main aim of the research is to determine whether there are statistically significant differences in variables levels for two groups of entities: bankrupt VS solvent. Therefore, the hypothesis testing will be performed through variables mean comparison. A parametric t-test and a nonparametric Mann-Whitney test are available for such testing. Through the analysis of data distribution normality for all three years, a decision will be made on which of the two above-mentioned statistical methods will be applied. According to Rosenthal (1991) SPSS z-score can be converted into the effect size estimation (*r*) as it follows:

$$r = \frac{Z}{\sqrt{N}}$$

Where z is score produced by SPSS program, and N is the sample size from the research (50 bankrupted + 50 solvent = 100 total). Effect size will be calculated for every variable and every case (Y-1, Y-2 and Y-3).

3. Analysis and research results

In order to analyze if distribution deviates from normal distribution, Kolmogorov-Smirnov (K-S) and Shapiro-Wilk (S-W) tests will be used. These tests compare the scores in the sample to a normally distributed set of scores with the same mean and standard deviation. If the test is non-significant ($p > .05$) it tells us that the distribution of the sample is not significantly different from a normal distribution (i.e. it is normal). If, however, the test is significant ($p < .05$) then the distribution in question is significantly different from a normal distribution (Field, 2009, p.144)

Table 3: Normality tests

Tests of Normality – one year before bankruptcy proceedings						
Var.	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
V1 (Y-1)	0.313	100	0.000	0.310	100	0.000
V2 (Y-1)	0.176	100	0.000	0.843	100	0.000
V3 (Y-1)	0.222	100	0.000	0.699	100	0.000
V4 (Y-1)	0.233	100	0.000	0.673	100	0.000
V5 (Y-1)	0.314	100	0.000	0.525	100	0.000
V6 (Y-1)	0.252	100	0.000	0.621	100	0.000
V7 (Y-1)	0.283	100	0.000	0.561	100	0.000
V8 (Y-1)	0.319	100	0.000	0.519	100	0.000
V9 (Y-1)	0.305	100	0.000	0.508	100	0.000
V10 (Y-1)	0.345	100	0.000	0.278	100	0.000
V11 (Y-1)	0.241	100	0.000	0.728	100	0.000
V12 (Y-1)	0.326	100	0.000	0.297	100	0.000
V13 (Y-1)	0.098	100	0.019	0.941	100	0.000
Tests of Normality – two years before bankruptcy proceedings						
Var.	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
V1 (Y-2)	0.330	100	0.000	0.270	100	0.000
V2 (Y-2)	0.163	100	0.000	0.849	100	0.000
V3 (Y-2)	0.285	100	0.000	0.682	100	0.000
V4 (Y-2)	0.299	100	0.000	0.669	100	0.000
V5 (Y-2)	0.374	100	0.000	0.297	100	0.000
V6 (Y-2)	0.217	100	0.000	0.663	100	0.000
V7 (Y-2)	0.319	100	0.000	0.447	100	0.000
V8 (Y-2)	0.232	100	0.000	0.694	100	0.000
V9 (Y-2)	0.257	100	0.000	0.718	100	0.000
V10 (Y-2)	0.358	100	0.000	0.237	100	0.000
V11 (Y-2)	0.303	100	0.000	0.458	100	0.000
V12 (Y-2)	0.343	100	0.000	0.252	100	0.000
V13 (Y-2)	0.087	100	0.061	0.946	100	0.000

Tests of Normality – three years before bankruptcy proceedings						
Var.	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
V1 (Y-3)	0.281	100	0.000	0.537	100	0.000
V2 (Y-3)	0.169	100	0.000	0.839	100	0.000
V3 (Y-3)	0.352	100	0.000	0.347	100	0.000
V4 (Y-3)	0.358	100	0.000	0.331	100	0.000
V5 (Y-3)	0.468	100	0.000	0.093	100	0.000
V6 (Y-3)	0.232	100	0.000	0.612	100	0.000
V7 (Y-3)	0.392	100	0.000	0.217	100	0.000
V8 (Y-3)	0.409	100	0.000	0.207	100	0.000
V9 (Y-3)	0.275	100	0.000	0.446	100	0.000
V10 (Y-3)	0.296	100	0.000	0.493	100	0.000
V11 (Y-3)	0.474	100	0.000	0.091	100	0.000
V12 (Y-3)	0.256	100	0.000	0.511	100	0.000
V13 (Y-3)	0.077	100	0.145	0.955	100	0.002

Source: the author's calculation, SPSS output

The results of K-S and S-W tests for Y-1, Y-2 and Y-3 period (one, two, and three years before bankruptcy proceedings) are present in the Table 3. It can be concluded that normal distribution is *not present* for Y-1 taking into account that the test is significant ($p<0.05$) in case of every variable. The results of K-S and S-W tests for Y-2 indicate that normal distribution is *not present* taking into account that the test is significant ($p<0.05$). It is important to point out that according to Kolmogorov-Smirnov test, Variable 13 (V13) is not significantly different from a normal distribution in Y-2. According to Field (2009), Sharpo-Wilk test has more power to detect differences from normality, and considering its p value < 0.05 it can be concluded that V13 is not normally distributed. The results of K-S and S-W tests for Y-3 period also indicate that normal distribution is not present taking into account that the test is significant. Like in previous case for Y-2 variables, Kolmogorov-Smirnov test for Variable 13 (V13) is not significantly different from a normal distribution, but Sharpo-Wilk test, that has more power to detect differences from normality, has p value < 0.05. Therefore, it be concluded that V13 is not normally distributed.

In accordance with the analysis of distribution normality, the hypothesis testing was performed using the *Mann-Whitney* test for all three periods: one year (Y-1), two years (Y-2) and three years (Y-3) before bankruptcy proceedings. The *Mann-Whitney* test is used to identify differences between two groups with respect to a variable. It is a nonparametric version of the statistical t-test (Mann & Whitney, 1947).

Table 4: Descriptive statistics and Test statistics for two groups (one year before bankruptcy proceedings)

Descriptive Statistics								
Variable	0				1			
	N		Mean	Median	N		Mean	Median
	Valid	Missing			Valid	Missing		
V1 (Y-1)	50	0	-0.71	-0.18	50	0	0.12	0.16

V2 (Y-1)	50	0	0.14	0.08	50	0	0.33	0.26
V3 (Y-1)	50	0	-0.24	-0.10	50	0	0.08	0.04
V4 (Y-1)	50	0	-0.24	-0.10	50	0	0.06	0.03
V5 (Y-1)	50	0	0.30	0.01	50	0	1.55	0.59
V6 (Y-1)	50	0	1.19	0.96	50	0	2.11	1.12
V7 (Y-1)	50	0	-0.11	-0.04	50	0	0.18	0.04
V8 (Y-1)	50	0	-0.11	-0.03	50	0	0.39	0.06
V9 (Y-1)	50	0	-0.15	-0.10	50	0	0.31	0.06
V10 (Y-1)	50	0	1.63	1.01	50	0	0.68	0.63
V11 (Y-1)	50	0	0.90	0.78	50	0	2.25	1.41
V12 (Y-1)	50	0	1.30	0.76	50	0	0.51	0.33
V13 (Y-1)	50	0	0.59	0.64	50	0	0.63	0.66

Test Statistics				
Variable	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig.(2-tailed)
V1 (Y-1)	594.000	1869.000	-4.522	0.0000
V2 (Y-1)	688.000	1963.000	-3.881	0.0001
V3 (Y-1)	350.000	1625.000	-6.204	0.0000
V4 (Y-1)	346.000	1621.000	-6.232	0.0000
V5 (Y-1)	537.000	1812.000	-4.983	0.0000
V6 (Y-1)	1060.000	2335.000	-1.310	0.1903
V7 (Y-1)	627.000	1902.000	-4.295	0.0000
V8 (Y-1)	673.000	1948.000	-3.978	0.0001
V9 (Y-1)	389.000	1664.000	-5.936	0.0000
V10 (Y-1)	513.000	1788.000	-5.081	0.0000
V11 (Y-1)	591.000	1866.000	-4.543	0.0000
V12 (Y-1)	584.000	1859.000	-4.591	0.0000
V13 (Y-1)	1165.000	2440.000	-0.586	0.5579

Source: the author's calculation, SPSS output

First part of the Table 4 shows descriptive statistics with mean and median for every variable. Due to fact that the data is not normally distributed and thus non-parametric test was used, median should be focused. Label "1" stands for entities that are solvent, while label "0" stands for entities that went bankrupt. Second part of the table shows results for Mann-Whitney test. This pattern is present in all 3 cases (1 year, 2 years and 3 years before bankruptcy). Test results for time period one year before bankruptcy that is presented in the Table 4 indicate following:

- **$V1_{(Y-1)}$**, **$V2_{(Y-1)}$**, **$V3_{(Y-1)}$**, **$V4_{(Y-1)}$**, **$V5_{(Y-1)}$**, **$V7_{(Y-1)}$**, **$V8_{(Y-1)}$**, **$V9_{(Y-1)}$**, **$V10_{(Y-1)}$**, **$V11_{(Y-1)}$** and **$V12_{(Y-1)}$** values for bankrupted companies **differ significantly** from the same variables values for entities that are solvent (**$p < 0.05$**), meaning further that these ratios can potentially be used for prediction of business failure *one year* before bankruptcy proceedings start.
- **$V6_{(Y-1)}$** and **$V13_{(Y-1)}$** values for bankrupted companies **do not differ significantly** from the same variables values for entities that are solvent (**$p > 0.05$**), meaning

further that these ratios are not recommended to be used for prediction of business failure *one year* before bankruptcy proceedings start.

Effect size (*r*) results for Y-1 follow:

- $r_{V1(Y-1)} = -0.45$; $r_{V2(Y-1)} = -0.39$; $r_{V3(Y-1)} = -0.62$; $r_{V4(Y-1)} = -0.62$;
- $r_{V5(Y-1)} = -0.50$; $r_{V6(Y-1)} = -0.13$; $r_{V7(Y-1)} = -0.43$; $r_{V8(Y-1)} = -0.40$;
- $r_{V9(Y-1)} = -0.59$; $r_{V10(Y-1)} = -0.51$; $r_{V11(Y-1)} = -0.45$; $r_{V12(Y-1)} = -0.46$;
- $r_{V13(Y-1)} = -0.06$

Taking into account the above stated *r* results, it can be concluded that V3 (Gross result / Total Assets) and V4 (Net Result / Total Assets) have largest effect size, while V13 (Current Assets / Total Assets) has lowest effect size one year before bankruptcy.

Table 5: Descriptive statistics and Test statistics for two groups (two years before bankruptcy proceedings)

Descriptive Statistics								
Variable	0				1			
	N		Mean	Median	N		Mean	Median
	Valid	Missing			Valid	Missing		
V1 (Y-2)	50	0	-0.49	0.03	50	0	0.06	0.13
V2 (Y-2)	50	0	0.13	0.09	50	0	0.31	0.26
V3 (Y-2)	50	0	-0.03	0.01	50	0	0.06	0.05
V4 (Y-2)	50	0	-0.03	0.01	50	0	0.05	0.04
V5 (Y-2)	50	0	0.76	0.22	50	0	1.52	0.54
V6 (Y-2)	50	0	1.49	1.08	50	0	1.74	1.14
V7 (Y-2)	50	0	-0.02	0.01	50	0	-0.01	0.03
V8 (Y-2)	50	0	-0.01	0.01	50	0	0.07	0.03
V9 (Y-2)	50	0	-0.01	0.01	50	0	0.16	0.07
V10 (Y-2)	50	0	1.37	0.82	50	0	0.69	0.65
V11 (Y-2)	50	0	1.00	1.04	50	0	2.12	1.28
V12 (Y-2)	50	0	1.10	0.67	50	0	0.56	0.43
V13 (Y-2)	50	0	0.61	0.65	50	0	0.62	0.61

Test Statistics				
Var.	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
V1 (Y-2)	885.000	2160.000	-2.516	0.0119
V2 (Y-2)	615.500	1890.500	-4.376	0.0000
V3 (Y-2)	662.000	1937.000	-4.054	0.0001
V4 (Y-2)	678.000	1953.000	-3.943	0.0001
V5 (Y-2)	744.000	2019.000	-3.500	0.0005
V6 (Y-2)	1158.000	2433.000	-0.634	0.5259
V7 (Y-2)	965.000	2240.000	-1.965	0.0494
V8 (Y-2)	915.000	2190.000	-2.309	0.0209
V9 (Y-2)	595.000	1870.000	-4.515	0.0000
V10 (Y-2)	748.000	2023.000	-3.461	0.0005

V11 (Y-2)	831.000	2106.000	-2.889	0.0039
V12 (Y-2)	825.000	2100.000	-2.930	0.0034
V13 (Y-2)	1234.000	2509.000	-0.110	0.9122

Source: the author's calculation, SPSS output

Test results for two years before bankruptcy that are presented in the Table 5 indicate the following:

- **V1(Y-2), V2(Y-2), V3(Y-2), V4(Y-2), V5(Y-2), V8(Y-2), V9(Y-2), V10(Y-2), V11(Y-2), V12(Y-2)** values for bankrupted companies **differ significantly** from the same variables values for entities that are solvent (**p < 0.05)**, meaning further that these ratios can potentially be used for prediction of business failure *two years* before bankruptcy proceedings start.
- **V6(Y-2), V7(Y-2)** and **V13(Y-2)** values for bankrupt companies **do not differ significantly** from the same variables values for entities that are solvent (**p > 0.05**), meaning further that these ratios are not recommended to be used for prediction of business failure *two years* before bankruptcy proceedings start.

Effect size results for Y-2 follow:

- $r_{V1(Y-2)} = -0.25$; $r_{V2(Y-2)} = -0.44$; $r_{V3(Y-2)} = -0.41$; $r_{V4(Y-2)} = -0.39$;
- $r_{V5(Y-2)} = -0.35$; $r_{V6(Y-2)} = -0.06$; $r_{V7(Y-2)} = -0.20$; $r_{V8(Y-2)} = -0.23$;
- $r_{V9(Y-2)} = -0.45$; $r_{V10(Y-2)} = -0.35$; $r_{V11(Y-2)} = -0.29$; $r_{V12(Y-2)} = -0.29$;
- $r_{V13(Y-2)} = -0.01$

Taking into account the above stated *r* results, it can be concluded that V3 (Gross result / Total Assets) and V4 (Net Result / Total Assets) still have important effect size, but largest effect size is present for variables V9 (Net Result / Total Liabilities) and V2 (Retained earnings / Total Assets). On the other hand, V13 (Current Assets / Total Assets), together with V6 (Sales / Total Assets), has lowest effect size two years before bankruptcy.

Table 6: Descriptive statistics and Test statistics for two groups (three years before bankruptcy proceedings)

Descriptive Statistics								
Status	0				1			
	N		Mean	Median	N		Mean	Median
	Valid	Missing			Valid	Missing		
V1 (Y-3)	50	0	-0.23	0.07	50	0	0.03	0.09
V2 (Y-3)	50	0	0.13	0.08	50	0	0.28	0.20
V3 (Y-3)	50	0	-0.08	0.01	50	0	0.06	0.04
V4 (Y-3)	50	0	-0.09	0.01	50	0	0.05	0.04
V5 (Y-3)	50	0	10.85	0.22	50	0	1.28	0.42
V6 (Y-3)	50	0	1.74	1.41	50	0	1.61	1.10

V7 (Y-3)	50	0	-0.08	0.02	50	0	0.01	0.02
V8 (Y-3)	50	0	-0.34	0.02	50	0	-0.01	0.03
V9 (Y-3)	50	0	0.04	0.02	50	0	0.13	0.06
V10 (Y-3)	50	0	1.07	0.83	50	0	0.71	0.71
V11 (Y-3)	50	0	11.08	1.15	50	0	2.12	1.24
V12 (Y-3)	50	0	0.83	0.63	50	0	0.59	0.53
V13 (Y-3)	50	0	0.61	0.63	50	0	0.61	0.60

Test Statistics				
Var.	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
V1 (Y-3)	1080.500	2355.500	-1.169	0.2426
V2 (Y-3)	758.500	2033.500	-3.391	0.0007
V3 (Y-3)	637.500	1912.500	-4.222	0.0000
V4 (Y-3)	627.500	1902.500	-4.291	0.0000
V5 (Y-3)	916.500	2191.500	-2.304	0.0212
V6 (Y-3)	1228.500	2503.500	-0.148	0.8822
V7 (Y-3)	1244.000	2519.000	-0.041	0.9670
V8 (Y-3)	1184.500	2459.500	-0.452	0.6516
V9 (Y-3)	613.500	1888.500	-4.388	0.0000
V10 (Y-3)	921.500	2196.500	-2.265	0.0235
V11 (Y-3)	1003.500	2278.500	-1.699	0.0893
V12 (Y-3)	1034.500	2309.500	-1.486	0.1374
V13 (Y-3)	1242.500	2517.500	-0.052	0.9588

Source: the author's calculation, SPSS output

Test results for period of three years before bankruptcy that are presented in the Table 6 indicate the following:

- **V2(Y-3), V3(Y-3), V4(Y-3), V5(Y-3), V9(Y-3), V10(Y-3)** values for bankrupted companies **differ significantly** from the same variables values for entities that are solvent (**p < 0.05)**, meaning further that these ratios can potentially be used for prediction of business failure *three years* before bankruptcy proceedings start.
- **V1(Y-3), V6(Y-3), V7(Y-3), V8(Y-3), V11(Y-3), V12(Y-3)** and **V13(Y-3)** values for bankrupted companies **do not differ significantly** from the same variables values for entities that are solvent (**p > 0.05**), meaning further that these ratios are not recommended to be used for prediction of business failure *three years* before bankruptcy proceedings start.

Effect size results for Y-3 follow:

- $r_{V1(Y-3)} = -0.12$; $r_{V2(Y-3)} = -0.34$; $r_{V3(Y-3)} = -0.42$; $r_{V4(Y-3)} = -0.43$;
- $r_{V5(Y-3)} = -0.23$; $r_{V6(Y-3)} = -0.01$; $r_{V7(Y-3)} = -0.00$; $r_{V8(Y-3)} = -0.05$;
- $r_{V9(Y-3)} = -0.44$; $r_{V10(Y-3)} = -0.23$; $r_{V11(Y-3)} = -0.17$; $r_{V12(Y-3)} = -0.15$;
- $r_{V13(Y-3)} = -0.01$.

Taking into account the above stated *r* results, it can be concluded that V9 (Net Result / Total Liabilities) has largest effect size, together with V4 (Net result / Total

Assets) and V3 (Gross result / Total Assets). On the other hand, V7 (Net Cash Flow/ Total Assets), together with V6 (Sales / Total Assets) and V13 (Current Assets / Total Assets), has the lowest effect size for business failure prediction three years before bankruptcy.

4. Discussion

Based on previous research by other authors, but also based on the results of this research, there is no doubt that financial ratios can be useful inputs in diagnosing financial health of a company, combined with statistical techniques. The issue of bankruptcies is extremely important for every country, especially for developing countries such as Serbia.

The focus of this research was on isolated analysis of individual variables, i.e. financial ratios, in order to identify ratios that may be relevant in the classification of companies into two categories: those that have gone bankrupt and those that are solvent (healthy). The research results are important both for business owners and future researchers. On the one hand, business owners can calculate these critical ratio indicators to examine whether results for their companies are closer to means and medians of bankrupt entities or closer to values of solvent (healthy) entities. On the other hand, research results can be useful for future researchers who will develop models for predicting business failure, because results indicate which variables of all the popular ones can be useful for statistical modelling in developing countries like Serbia. It is important to note that this research has several shortcomings. To begin with, Serbian economy is dominated by small and medium enterprises, and therefore those enterprises are dominant in the research sample (share of 72%). This indicates that variables from this research may not give perfect results if used in modeling only for large companies. In addition, the sample is dominated by processing and trading companies (share of 66%), which may also indicate that variables used in this research may not be a perfect fit for other economic activities such as IT or administration, for example. Furthermore, research focuses on financial ratio data, but in order to better understand differences between bankrupt and solvent entities, it is necessary to include some non-financial or even global (macroeconomic) indicators in analysis. An avenue of future research is to include these relevant ratio indicators in some statistical or machine learning models, to investigate how these relevant variables, combined together, classify businesses into group of solvent or bankrupt ones several years in advance. Additionally, it is important to mention that correctly presented financial statements are mandatory for any analysis including bankruptcy prediction. If it is based on erroneous information, then a correctly performed analysis of financial and accounting reports will, in fact, not be valid (Parnicki, Zivkovic Petrovic & Tucakovic, 2021).

Conclusion

The results demonstrate importance of financial ratios in business failure prediction. Also, results indicate that, as we move backwards from the moment of initiating the bankruptcy proceedings, the power of financial ratios to give a signal of financial difficulties decreases.

One year before bankruptcy (Y-1), all the variables except for V6 (Sales / Total Assets) and V13 (Current Assets / Total Assets) showed statistically significant differences in values for the two groups of companies: bankrupt vs. solvent. This means that all variables except for two above mentioned can potentially be used for prediction of business failure one year before bankruptcy proceedings start. *Two years before bankruptcy (Y-2)* all the variables except for V6 (Sales / Total Assets), V13 (Current Assets / Total Assets) and V7 (Net Cash Flow / Total Assets) showed statistically significant differences for the two groups of companies. This means that all variables except for three above mentioned can potentially be used for prediction of business failure two years before bankruptcy proceedings start. When it comes to the period of *three years before the initiation of bankruptcy proceedings (Y-3)*, 6 out of 13 variables showed statistically significant differences in value for these two groups of companies. Variables V1 (Working Capital / Total Assets), V6 (Sales / Total Assets), V7 (Net Cash Flow / Total Assets), V8 (Net Cash Flow / Total Liabilities), V11 (Current Assets / Current Liabilities), V12 (Current Liabilities / Total Assets) and V13 (Current Assets / Total Assets) are not recommended as good predictors of business failure three years in advance according to research results. Considering the fact that ≈85% of variable values showed statistically significant differences between groups for Y-1 period, ≈77% of variable values showed statistically significant differences between groups for Y-2 period, and ≈46% of variable values showed statistically significant differences between groups even for Y-3 period, it can be concluded that commonly used financial ratios can be solid base for business failure prediction in Serbia, thus hypothesis of the research is accepted.

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