

WC-BEM 2012

Business failure risk analysis using financial ratios

Moscalu Maricica ^{a*}, Vintila Georgeta ^b^a*Academy of Economic Studies Bucharest, 6 Romana Square, Bucharest 010371, Romania*^b*Academy of Economic Studies Bucharest, 6 Romana Square, Bucharest 010371, Romania*

Abstract

Financial ratios have long been considered as good predictors of business failure and are proved to accurately discriminate between failed and non-failed companies several years prior to failure. The purpose of this paper is to investigate the predictive power of financial ratios for a sample of Romanian listed companies. The results of the t-test showed the existence of some significant differences between two groups of companies, performing and non-performing companies, especially with regard to profitability, financial position and leverage both in 2010 and 2009.

© 2012 Published by Elsevier Ltd. Selection and/or peer review under responsibility of Prof. Dr. Hüseyin Arasli

Open access under [CC BY-NC-ND license](#).

Keywords: Business failure, performing/non-performing companies, ratio analysis, t test;

1. Introduction

Business failure risk analysis using univariate ratio analysis has been moved in the background since the development of modern techniques starting with discriminant analysis by Altman (1968) and continuing with more advanced methods such as logistic regression or logit, probit, linear probability model (see, for example, Ginoglou et al. (2002) and Zavgren and Friedman (1988)) and even neural networks (Youn and Gu, 2010; Tang and Chi, 2005) and other modern techniques. In the literature, there are many definitions used for business failure but most often it has been seen as filing for bankruptcy law protection (Altman, 1968; Deakin, 1972; Wilcox, 1972; Altman et al., 1977; Ohlson, 1980; Boritz and Kennedy, 1995; McKee, 2003).

Classical univariate analysis of bankruptcy risk is based on financial ratios and consists of company's performance and risk analysis at the operating and financial levels of activity (Vintila, 2004) in a static as well as dynamic manner (Stancu, 2007). Ratios measuring profitability, liquidity, self-financing capacity, indebtedness and capacity to pay interest and repay loans are often used in this type of analysis. This method presents some limitations (Stancu, 2007; Vintila, 2004) that have lead to the development and application of some more advanced statistical methods for analyzing and predicting business failure. It is not our purpose here to detail these modern methods because there are many useful bibliographical resources that do this very well (Dimitras et al., 1996; Balcaen and Ooghe, 2006). On the contrary, our goal is to focus on the classic analysis because any statistical technique used for analyzing and predicting bankruptcy, no matter how advanced it is, is eventually based on the primary information provided by company's financial statements used for obtaining financial ratios and other measures because they reflect the most important aspects regarding company's economic and financial health and the perspectives for future evolution.

* Corresponding Author Moscalu Maricica. Tel.: +4-073-557-5501

E-mail address: mari.moscalu@yahoo.com

A previous stage before the introduction of the multivariate analysis for bankruptcy prediction issues is given by the univariate analysis of financial ratios. It is worth remembering in this context the work of Beaver (1966, 1968a, 1968b). He proposes a dichotomous classification model of companies (bankrupt/non-bankrupt) using a set of financial ratios and an individual cut-off value. The best predictor ratio in terms of error rate was found cash flow/total debt ratio that led to a classification accuracy of 78% five years before bankruptcy. The modern analysis of bankruptcy risk starts with Altman (1968) who applies multiple discriminant analysis (MDA) for corporate bankruptcy prediction. Since then, MDA was applied for large as well as for small companies (Moscalu, 2007), criticized and compared with more complex methods as those mentioned earlier. Although Beaver's research is based on the univariate analysis, his study has caused further comparisons. We are referring especially to those studies that compared the results of Beaver's 1966 model with those of Altman's 1968 model. Deakin (1972) makes such a comparative analysis and concludes that the Altman's model is better than Beaver's on the short term (1 year) while Beaver's is better on longer term (5 years) in terms of error classification rates. Holmen (1988) makes another comparative analysis and finds that the univariate Beaver's model using cash flow/total debt ratio has led to fewer prediction errors than the Altman's Z-score.

Bankruptcy prediction models, either classic or modern, are essentially based on financial ratios. Yet Mears (1966) finds that financial ratios do not possess the ability to predict bankruptcy in an absolute manner and that their utility is given by the power to signal about the company's financial health problems and their potential causes. The quality of the information provided by financial ratios is very important in bankruptcy prediction because it impacts on the accuracy of the bankruptcy prediction. Building on the hypothesis that the utility of the accounting information is a function of the predictive ability of the information and of the users' ability to interpret that information, Libby (1975) finds that a narrow set of financial ratios allowed a high degree of accuracy in prediction.

Using data for a sample of Romanian companies listed on Bucharest Stock Exchange (BSE), we intend to explore in this paper the financial ratios' ability to signal about the evolution of the companies' health and potential risks which if inadequately managed can lead to bankruptcy. The paper is organized as follows: section 2 presents the research methodology, section 3 discusses the results and section 4 gives the conclusion.

2. Research methodology

2.1. Data

The sample being analyzed in this study consists of 63 companies listed on BSE. The companies come from different economic sectors. For a greater homogeneity of the sample were excluded companies in the financial sector. For these companies, financial information was collected from financial statements for the years 2009-2010. This information, including market capitalization, was collected from the web sites of BSE and Romanian National Securities Commission. Based on it, we determined a series of financial ratios and other measures.

One of the many definitions used for business failure, from an economic as opposed to a legal perspective, is based on the net profit criterion. It was used in the study of Youn and Gu (2010) and refers to having negative net profit for two years consecutively. A similar definition of business failure was adopted in this paper but because of the lack of data, the negative net profit criterion was applied only for a one year period, although the majority (60%) of the companies in the sample that were considered as failed according to the above criterion had negative net profit for at least two years. We need yet to clarify that, in the context of this paper the two categories of companies are performing and non-performing companies. The reason is that we adopted an economic not legal definition of failure and consequently the analysis performed here has the purpose to provide indications about the causes of the poor performance for the non-performing companies as opposed to the performing ones. Thus, we are building on the hypothesis that poor performance is a signal of failure. Based on this approach and using the information from profit and loss account for the year 2010, the sampled companies were grouped in the two categories as follows: (1) companies with positive net profit in 2010 were considered to be performing companies (P) while (2) companies with negative net profit in 2010 were considered as non-performing (NP). Of the 63 companies, 43 were included in the first category and the remaining 20 were included in the second one. It is worth mentioning that 12 of these 20 NP companies had negative net income in 2009 also, thus for two consecutive years, which gives a greater legitimacy to our approach and research design.

2.2. Financial ratios

We have used an extensive set of ratios according to the recommendations in the literature (Stancu, 2007; Vintila, 2004), both as absolute as well as relative measures. Due to the lack of information, some of the measures were determined only for 2010. The great majority of indicators were yet determined both for 2010 and 2009. In the cases where certain ratios couldn't be calculated (denominator was zero), the result was replaced by zero in order not to affect the length of the data series. The ratio set consists of the following categories: (1) *Size measures*: Total assets (TA); Sales (S); Market capitalization (MC); (2) *Return and margin ratios*: Return on assets (ROA); Return on equity (ROE); Self-financing capacity (SFC) gross margin (SFC)/S); (3) *Liquidity ratios*: Current ratio (CR); Quick ratio (QR); Immediate ratio (IR); (4) *Financial position indicators*: Net worth (NW); Working capital (WC); Need for working capital (NWC); Net treasure (NT); Variation in working capital (ΔWC); Variation in need for working capital (ΔNWC); Variation in net treasure (ΔNT); (5) *Cash-flow measures*: Operating treasure surplus (OTS); Self-financing capacity (SFC); Total cash-flow (CF); (6) *Earnings measures*: Earnings before interest, taxes, depreciation and amortization (EBITDA); Earnings before interest and taxes (EBIT); Earnings before taxes (EBT); Net income (NI); (7) *Indebtedness and capital structure indicators*: Economic assets (EA); Long-term debt (LTD); Total debt (TD); Shareholders' equity (EQ); Leverage (LTD/EQ, TD/EQ); Indebtedness ratios (LTD/EA, TD/TA); Solvency ratios (EQ/EA; EQ/LTD, (EQ+TD)/TD); (8) *Ratios measuring loan repayment and interest payment capacity*: SFC/Repayments; EBITDA/Interests; TD/SFC; LTD/SFC; CF/TD; Interest rate (Interests/TD); (9) *Ratios used in Altman' 1968 model*; Current assets (CA)/TA; Retained earnings /TA; Gross income (EBT)/TA; MC/TA; S/TA.

2.3. Analysis methods

In order to investigate the discriminating power of financial ratios we will use the *test t*. It allows us to test weather the two groups of companies come from different populations. More precisely, this test allows us to check for the existence of statistically significant differences in the mean values of each ratio between the two groups. The null hypothesis states that the mean values of the two groups are equal ($M_1=M_2$) which means that the two samples come from the same population. If the null hypothesis cannot be accepted then we say that the samples are coming from different populations and they significantly differ with respect to that ratio. The statistic *t* represents the ratio between the difference of the means for the two groups ($M_1 - M_2$) and the standard deviation of this difference ($S_{M_1-M_2}$). In our analysis, we have to be careful when applying this test because our two sub-samples are of different sizes and are heteroscedastic. This has implications on the way the standard deviation of the mean difference is calculated. Thus, the average size of the sample was determined as harmonic mean and the variance of the difference in means is calculated based on the total sum (of the two sub-samples) of the squared deviations about the mean, for each group, and the number of the degrees of freedom. The *t* statistic is given in equation (1).

$$t = \frac{|M_1 - M_2|}{S_{M_1-M_2}} \quad (1)$$

$M_1 - M_2$ = the difference in means of the two groups; $S_{M_1-M_2}$ = the standard deviation of the difference in means;

The standard deviation ($S_{M_1-M_2}$) is determined from the variance of the statistic ($S^2_{M_1-M_2}$) and from the average dimension of the sub-samples determined as harmonic mean (n_h) as in equation (2).

$$S_{M_1-M_2} = \sqrt{\frac{2 * S^2_{M_1-M_2}}{n_h}} \quad (2)$$

This empirical value of the statistic is compared with the theoretical value for the number of the degrees of freedom ($df = (n_1-1) - (n_2-1)$, where n_1 and n_2 represent the dimensions of the two sub-samples) and the significance level (usually 5% but also 1% or even 10%).

3. Results and discussion

In this section we will present the results of the t test for the two categories of companies. Due to the limited size of the paper, we cannot present here the results. We will just comment on them.

The sample used included companies of different size and from different sectors but, as regards the *size measures*, expressed as total assets and sales, we cannot say that there are significant differences. Therefore, the companies included in the two categories are comparable from the size point of view which can strengthen the comparison of other ratios. The situation is the same in both years. There are not significant size differences regarding the book value, given by total assets, as well as the market value, expressed by the market capitalization.

A first difference is found for the *return ratios*. Return on assets and return on equity (in 2010) as well as the self-financing capacity (SFC) gross margin (in 2010 and 2009) are significantly different for 1% level of significance. Moreover, the means for ROA and ROE (in 2010) and for SFC/S (in 2010 and 2009) are positive for the P companies and negative for the NP ones. This was quite probable because they are obtained using net income. The SFC margin increases in 2010 for the P companies and lowers for the NP ones.

Financial position indicators provided mixed results. Thus, the best discriminator is net treasure, the difference being significant at 1% in 2010 and 5% in 2009. For both years, the average value of net treasure is positive for the P group of companies and is negative for the NP one. The result has a strong meaning because this measure of company's general financial position essentially reflects the manner in which the company balances the financing sources and needs on both long and short term. A great discriminating power also has working capital, the differences being significant at 5%. It has positive average values for P companies and negative average values for the NP in both years. Thus, it seems that NP companies have problems in financing current assets with current liabilities which means that the liquidity of the current assets is not correlated enough with the maturity of current assets. Moreover, the variation in working capital is significant at 5% which means that working capital stays positive and increases for P companies while it remains negative and lowers for NP companies.

Cash-flow indicators have not led to the expected results. Neither the total cash-flow (CF) nor the operating treasure surplus (OTS) presents significant differences. Only self-financing capacity (SFC), as potential cash-flow, is significantly different at 5% for 2009 and at 1% for 2010 but it is strongly related to net income.

The *earnings measures* have a strong discriminating power (at 1% level) in both years except for the earnings before interest, taxes, depreciation and amortization (EBITDA) (10% or 5%). This means that there are important differences in profitability at all activity levels of the company. Much more, all the mean values are positive for the P companies and negative for the NP ones.

A mixed picture again is outlined by the *indebtedness and capital structure indicators*. Some of them are not significantly different while others are significant at different significance levels. Thus, leverage and financial autonomy' measures exhibit the greatest discriminating power, especially in 2010. For example, total indebtedness ratio (TD/TA) is significant at 1% in both years and shows that the NP companies are more indebted. Their total indebtedness degree surpasses 50% and is on increase (from 53.79% in 2009 to 62.15% in 2010) while it is below 50% and on a slight decrease (from 31.31% in 2009 to 30.18% in 2010) for the P ones. The same trend is witnessed by the long-term indebtedness ratio while for the equity financing the opposite is true – lower and decreasing for NP companies and superior and slightly increasing for the P companies. Despite the higher reliance on debt for the NP companies, the total solvency ratio ((EQ+TD)/TD) has a low significance and only in 2010 (probability = 0.0873).

Contrary to our expectations, and despite the differences in profitability, return and leverage, there are not significant differences with regard to the *loan repayment and interest payment capacity ratios* and *liquidity ratios*. Only the TD/SFC and quick ratios revealed some significant differences but at 10% and not in both years. Thus, companies are not significantly different regarding their capacity to fulfill their debt engagements (repayments and interests) and regarding their liquidity as solvency ratios also revealed. Moreover, interest rate does not differ significantly. It is the indebtedness ratio that differs significantly and this affects significantly their profitability. Although not strongly significant, liquidity ratios are generally greater for P companies, as expected.

Not lastly, we intended to see to what extent companies are different in regard to the financial ratios used in Altman' 1968 Z score model for bankruptcy prediction. The results are not strongly significant with the exception of the ratio of gross profit to total assets (EBT/TA) that is significant at 1% (probability = 0.0000) but this difference can be easily explained by the approach we took for defining P and NP companies.

4. Conclusion

The purpose of this study was to investigate the power of financial ratios to give early warning signals about the foreseeable negative evolution of the company's financial health and to discriminate between performing and non-performing companies. These signals point to the potential risks that the companies may face and that can lead to bankruptcy if they are not adequately managed. Using the t test, the significance of the difference in means was tested for the two groups of companies for a series of financial measures. The study revealed the existence of some differences between companies with respect to profitability and return, financial position, indebtedness and capital structure even with two years in advance. Nevertheless, there weren't noticed important differences with respect to cash-flow, liquidity and capacity to repay debt and pay interest. Among the major limits of the study we can mention the loose definition of failure and the short time period used for analysis. Thus, future research should consider a more rigorous definition and selection of the failed and non-failed companies and the extension of the time horizon for analyzing financial ratios trends.

References

- Altman, E. (1968). Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy. *The Journal of Finance*, 23, 4, 586-609.
- Altman, E., Haldeman, R. & Narayanan, P. (1977). ZETA™ Analysis - A new model to identify bankruptcy risk of corporations. *Journal of Banking and Finance*, 1, 29-54.
- Balcaen, S. & Ooghe, H. (2006). "35 years of studies on business failure: an overview of the classic statistical methodologies and their related problems", *The British Accounting Review*, 38, 63-93.
- Beaver, W. (1966). Financial Ratios as Predictors of Failure. *Journal of Accounting Research*, 4, 71-111.
- Beaver, W. (1968a). Alternative Accounting Measures as Predictors of Failure. *The Accounting Review*, 43, 1, 113-122.
- Beaver, W. (1968b). Market Prices, Financial Ratios, and the Prediction of Failure. *Journal of Accounting Research*, 6, 2, 179-192.
- Boritz, E. & Kennedy, D. (1995). Effectiveness of Neural Network Types for Prediction Business Failure. *Expert Systems With Application*, 9, 4, 503-512.
- Deakin, E. (1972). A Discriminant Analysis of Predictors of Business Failure. *Journal of Accounting Research*, 10, 1, 167-179.
- Dimitras, A., Zanakis, S. & Zopounidis, C. (1996). A survey of business failure with an emphasis on prediction methods and industrial application. *European Journal of Operational Research*, 90, 487-513.
- Ginoglou, D., Agorastos, K. & Hatzigagios, T. (2002). Predicting Corporate Failure of Problematic Firms in Greece with LPM Logit Probit and Discriminant Analysis Models. *Journal of Financial Management & Analysis*, 15, 1, 1.
- Holmen, J. (1988). Using Financial Ratios to Predict Bankruptcy: an Evaluation of Classic Models Using Recent Evidence. *Akron Business and Economic Review*, 19, 1, 52-63.
- Libby, R. (1975). Accounting Ratios and the Prediction of Failure: Some Behavioral Evidence. *Journal of Accounting Research*, 13, 1, 150-161.
- Mears, P. (1966). Discussion of Financial Ratios as Predictors of Failure. *Journal of Accounting Research*, 4, 119-122.
- McKee, T. (2003). Rough Sets Bankruptcy Prediction Models versus Auditor Signalling Rates. *Journal of Forecasting*, 22, 8, 569-586.
- Moscalu, M. (2007). The state of SMEs in the European Union and Romania. *Sustainable Development. Pros and Cons. Dissertations of the Financial Management and Capital Markets Master Program – DAFI*, Academia de Studii Economice Publishing House, Bucharest, 9-30.
- Ohlson, J. (1980). Financial Ratios and the Probabilistic Prediction of Bankruptcy. *Journal of Accounting Research*, 18, 1, 109-131.
- Stancu, I. (2007). Finance, *Economica Publishing House*, Bucharest, fourth edition.
- Tang, T. & Chi, L. (2005). Neural network analysis in business failure prediction of Chinese importers: A between-countries approach. *Expert Systems with Applications*, 29, 244-255.
- Vintila, G. (2004). Corporate Financial Management, *Didactica si Pedagogica Publishing House*, Bucharest, fourth edition.
- Wilcox, J. (1973). A prediction of Business Failure Using Accounting Data. *Journal of Accounting Research*, 11, 163-179.
- Youn, H. & Gu, Z. (2010). Predicting Korea lodging firm failures: An artificial neural network model along with a logistic regression model. *International Journal of Hospitality Management*, 29, 120-127.
- Zavgren, C. & Friedman, G. (1988). Are Bankruptcy Prediction Models Worthwhile? An Application in Securities Analysis. *Management International Review*, 28, 1, 34.
- Bucharest Stock Exchange, www.bvb.ro.
- Online Statistics Education: An Interactive Multimedia course of study: http://onlinestatbook.com/chapter10/difference_means.html.
- Romanian National Securities Commission, www.cnvmr.ro.