

## THE POTENTIAL OF THE DEBT RATIO IN THE PREDICTION OF CORPORATE BANKRUPTCY

**Daniel BRÎNDESCU-OLARIU**

West University of Timisoara  
*contact@levier.ro, www.levier.ro*

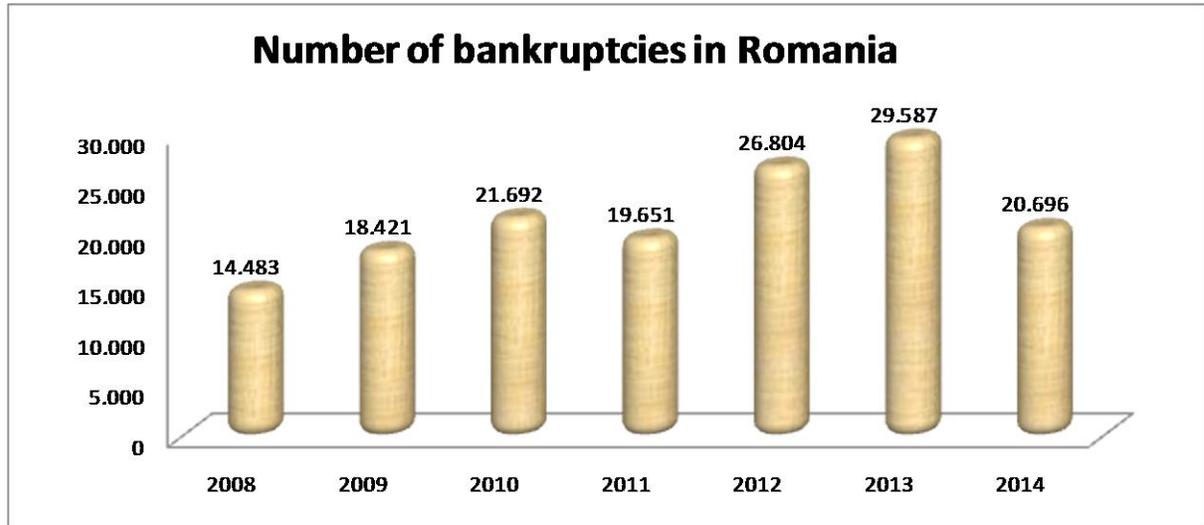
**Abstract:** *The current study evaluates the potential of the debt ratio in predicting corporate bankruptcy. The population subjected to the analysis included all companies from Timis County with yearly sales of over 2200 Euros. The interest for the debt ratio was based on the recommendations of the scientific literature, as well as on the availability of information concerning its values to all stakeholders. The event on which the research was focused was represented by the manifestation of bankruptcy 2 years after the date of the financial statements of reference. All tests were performed over a paired sample of 1424 companies. The methodology employed in evaluating the potential of the debt ratio was based on the general accuracy ensured by the ratio (61.8%) and the Area under the ROC Curve (0.644). The results suggest limited practical utility of the debt ratio in the prediction of bankruptcy within a simple univariate analysis. This conclusion shows that, although the general belief is that high debt ratios are the main cause of corporate bankruptcy, the use of the debt ratio alone for the prediction of corporate bankruptcy leads to relatively poor results. It is expected that the inclusion of the debt ratio within multivariate models for bankruptcy prediction would exploit its potential more fully.*

**Keywords:** *Corporate finance, Risk, Failure, Financial ratio, Financial analysis, Classification accuracy.*

### INTRODUCTION

In the context of the economic crisis, as well as that of the changes generated by the entrance of Romania in the European Union, the annual frequency of bankruptcy cases has increased at national level since 2007, reaching almost 3% by the end of 2013 (Brîndescu-Olariu, 2014a). Although the number and frequency of bankruptcy cases have registered an important decrease in 2014, this was mostly due to the legislation changes which restricted the possibilities of filing for bankruptcy (law 85/2014).

Figure 1 Number of bankruptcies in Romania



Source of data: Romanian National Registry of Commerce

The increased frequency of the annual bankruptcy cases was accompanied by an increase in the loan default ratio, Romania topping in this regard at the end of 2012 the 4th place within the European Union and the 6th place worldwide (Brîndescu-Olariu, 2014b).

Before 2007, the importance of the bankruptcy phenomenon from a macroeconomic perspective was limited in Romania, as there was little culture for bankruptcy filing at microeconomic level.

With the bankruptcy not representing a concerning phenomenon in the past, limited efforts were made at national level for the development of specific bankruptcy risk assessment tools. Instead, the scientific interest for the assessment of the bankruptcy risk was purely theoretical, with most researchers settling for testing foreign models for bankruptcy prediction over small isolated samples of Romanian companies. Several national models were elaborated over time, but most of the development methodologies were relatively superficial, as the public interest for the subject was low. The increase of the annual bankruptcy frequency has made the public significantly more aware of the phenomenon. As the state of bankruptcy affects all the stakeholders of the company, the existence of instruments for bankruptcy prediction becomes important.

Under these circumstances, there is a need for the development of methodologies specific to the current characteristics of the Romanian companies. Recent studies (Brîndescu – Olariu, 2014a, Brîndescu – Olariu, 2014b, Brîndescu – Olariu, 2014c, Dima et al., 2011) have reconfirmed the potential of financial ratios in the prediction of the bankruptcy risk, financial risk, financial performance or stock prices. The present paper is focused on testing the potential of the debt ratio for corporate bankruptcy prediction, 2 years prior to the possible event. The hypothesis of the research is that the debt ratio is positively correlated to the bankruptcy risk and thus can represent a useful tool for the assessment of the bankruptcy risk.

Only publically available data was used. If the research would prove the usefulness of the debt ratio in the prediction of corporate bankruptcy, it could be

continued with the development of a methodology of analysis for the assessment of the bankruptcy risk based on public data (and thus accessible to all stakeholders).

## **POPULATION AND METHODOLOGY**

The population initially subjected to the analysis included all the companies from the Timis County that submitted financial statements to the fiscal authorities in the period 2001 – 2011 (247,037 yearly financial statements).

Financial ratio analysis was not considered applicable for companies with no yearly income, as the continuity of the operating activity represents a fundamental hypothesis of the financial ratio analysis.

Three phenomenons with national impact were also considered for their potential of changing the profile of the companies that declare bankruptcy:

- The changes brought to the laws concerning bankruptcy through the adoption of law 85/2006;
- The entrance within the European Union in 2007;
- The manifestation of the economic crisis starting with the last quarter of 2008.

Under these circumstances, it was concluded that the initial population shows important problems of homogeneity, which do not recommend a unitary treatment:

- The companies with no activity cannot be evaluated based on the same methodology as the companies with a financial history;
- The companies that became bankrupt after the issue of law 85/2006 show different characteristics compared to the companies that went bankrupt before 2007, under different laws;
- The cases of bankruptcy registered after 2009 have different causes compared to the cases appeared before the beginning of the economic crisis.

Taking all the aforementioned differences into account, the initial population was adjusted:

- all the yearly financial statements that reported sales under 10,000 lei were excluded;
- only financial statements from the period 2007 – 2010 were retained.

The research targeted the risk of bankruptcy after 2 years from the date of the financial statements taken as reference in the analysis. As the interest was focused on the phenomenon of bankruptcy during the crisis period, the first financial statements included in the study were from 2007.

The last year for which data concerning the status of the companies was available was 2012. Under these circumstances, the last financial statements included in the study were those from 2010.

Holding all the above into account, the target population included all companies from Timis County that submitted yearly financial statements to the fiscal authorities during the period 2007-2010 and that registered yearly sales of at least 10000 lei (aprox. 2200 Euros).

In accordance, 53,252 financial statements from the period 2007-2010 were included in the analysis. The companies of which financial statements were included for

one year were not necessarily included for the following periods. As the study did not target a dynamics analysis, the yearly financial statements can be regarded as individual subjects.

The source of the data was represented by the online publications of the Ministry of Public Finances of Romania.

Of the entire target population, 712 companies went bankrupt in the period 2009 – 2012, two years from the date of the financial statements of reference:

- of the 12,570 companies included with financial statements for 2007 in the research, 30 went bankrupt in 2009 (0.24%); the rest of the companies continued their activity under normal conditions at least until the end of 2012.
- of the 13,037 companies included with financial statements for 2008 in the research, 94 went bankrupt in 2010 (0.72%); the rest of the companies continued their activity under normal conditions at least until the end of 2012.
- of the 12,574 companies included with financial statements for 2009 in the research, 159 went bankrupt in 2011 (1.26%); the rest of the companies continued their activity under normal conditions at least until the end of 2012.
- of the 15,071 companies included with financial statements for 2010 in the research, 429 went bankrupt in 2012 (2.85%); the rest of the companies continued their activity under normal conditions at least until the end of 2012.

An important hypothesis circulated in the theory and practice of bankruptcy risk analysis is that the overuse of leverage is one of the main causes of bankruptcy (Brîndescu-Olariu, 2015). The overuse of leverage involves low autonomy ratios and high debt ratios, which would sustain the hypothesis of a positive correlation between the debt ratio and the probability of bankruptcy.

Previous studies (Brîndescu-Olariu, 2015) conducted over companies from the Timis County confirmed the existence of a negative correlation between the autonomy ratio and the probability of bankruptcy within a 2-year span, as well as the statistical utility of the autonomy ratio for the valuation of the bankruptcy risk. Under these circumstances, the current study targets to test the existence of the presumed positive correlation between the debt ratio and the probability of bankruptcy and to evaluate the capacity of the debt ratio to predict the state of bankruptcy two years prior to its occurrence.

The debt ratio employed in the study had the following form:

$$\text{Debt ratio} = \frac{\text{Total debt}}{\text{Total financing sources}} \times 100\%$$

The data employed in the calculation is taken from the year-end balance sheets of the companies and is easily accessible online to all stakeholders. In accordance with the current accounting rules, “total debt” includes long-term and short-term debt. Long-term debt includes liabilities that the company employs as financing sources at the end of the year and are payable in more than one year (from the date specific to the balance sheet). In most of the cases, these liabilities consist of bank loans, financial lease contracts or

loans from the shareholders. Less frequently, the long-term debt may include liabilities from the operating activity.

Short-term debt includes liabilities that the company employs as financing sources at the end of the year and are payable during the following year (in less than 1 year from the date specific to the balance sheet). These commonly include trade payables, wages owed to employees, short-term bank loans or short term debt service for long-term bank loans or lease contracts, due taxes.

The term “total financing sources” includes equity, provisions, unearned revenues, long-term and short-term debt. The value of the financing sources inevitably equals the value of the total assets, as no assets can exist in the property of the company without correspondent financing sources. In the same manner, all financing sources are inevitably found under some form of assets.

Thus, mathematically, the debt ratio can also be calculated using the following formula:

$$\text{Debt ratio} = \frac{\text{Total debt}}{\text{Total assets}} \times 100\%$$

Although the mathematical result would be the same, the approach of the analysis could be different: while the first formula focuses the attention on the structure of the financing sources (showing the percentage of the debt), the second formula is focused on the measure in which the assets of the company are financed through debt.

In accordance with many of the approaches from the international literature, the ratio was tested over a paired sample. In order to build a paired-sample, each of the 712 companies that went bankrupt in the period 2009 – 2012 was associated with the company from the same economic field that had the closest turnover in the year of reference for the financial statements included in the analysis.

The data was processed by using the SPSS software. The state of the company two years from the date of the financial statements of reference was defined as the dependent variable, a binary variable that can take the following values:

- 1, for the companies that went bankrupt 2 years after the date of the financial statements of reference;
- 0, for the companies that continued their activity under normal conditions at least until the end of 2012.

In order to simplify the explanations, the companies that went bankrupt 2 years after the date of the financial statements of reference will simply be referred to as „bankrupt”, while the companies that continued their activity under normal conditions at least until the end of 2012 will be referred to as „non-bankrupt”.

When defining the target population, the companies that close their activity for other reasons than bankruptcy during the period of analysis were excluded.

As an example, the value of the variable „State” was „1” for all the companies that went bankrupt in 2011 and it was associated with the financial ratios of the respective companies from 2009. These companies were not included in the analysis for

the following years (for 2010 with the financial statements and for 2012 with the state variable), even if they still existed.

Initially, the performance of the ratio as predictor of bankruptcy was tested through the Area under the ROC Curve over the entire paired sample of 1424 companies. The ROC Curve reflects graphically the relationship between the sensitivity and the specificity for all possible cut-off values (van Erkel, Pattynama, 1998). The area under the ROC Curve thus isolates the classification performance of a classifier with no connection to a specific cut-off value, which makes it one of the most viable solutions for measuring the classification performance and for comparing classifiers (Hanely, McNeil, 1982, Faragi și Reiser, 2002).

The area under the ROC Curve (AUC), can take values between 0 and 1 (Skalska și Freylich, 2006). An AUC of 0.5 corresponds to a "by chance" classification accuracy, while an AUC of 1 corresponds to a perfect accuracy.

The evaluation of predictors by their AUCs is usually based on the following grid (Tazhibi, Bashardoost și Ahmadi, 2011):

- 0.5 – 0.6: fail;
- 0.6 – 0.7: poor;
- 0.7 – 0.8: fair;
- 0.8 – 0.9: good;
- 0.9 – 1: excellent.

In a second step, could the ratio be confirmed as a possible predictors by its AUC (over 0.6), the general classification accuracy would be determined.

The general accuracy of the classification represents the percentage of companies correctly classified, a weighted average of the sensitivity and the specificity. The sensitivity represents the accuracy of the classification of bankrupt companies. The specificity represents the accuracy of the classification of non-bankrupt companies.

The optimal cut-off value for the 2010 sample was used for out-of sample tests (over the 2007-2009 samples). The optimal cut-off value for the 2010 sample was determined through the inspection of the coordinating points of the ROC Curve.

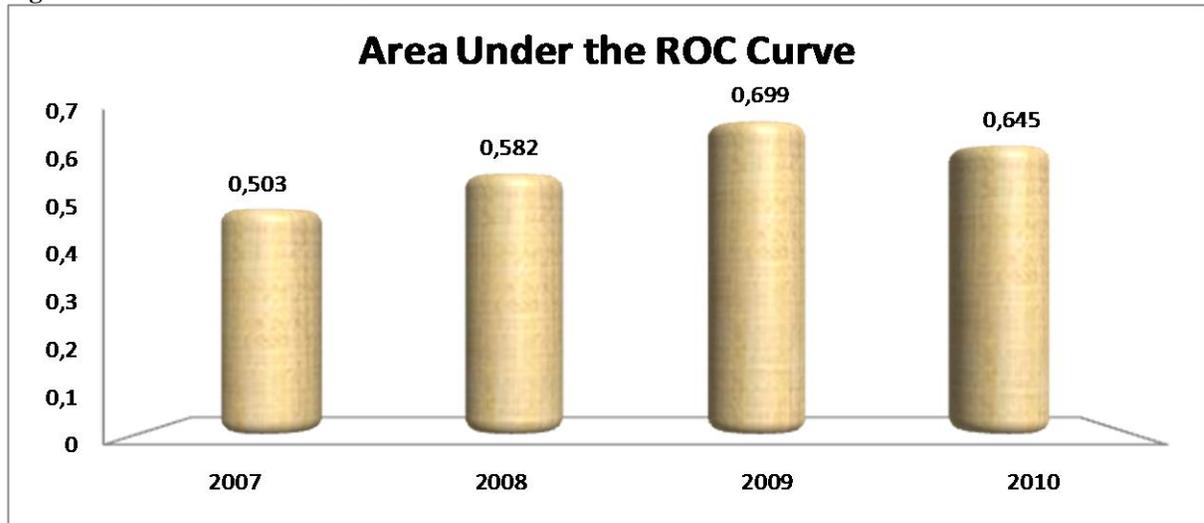
As the samples used were paired, the weight of the bankrupt companies was equal to the weight of the non-bankrupt companies (50%). For such a sample, the „by chance” accuracy is 50% (by classifying all 1424 companies as bankrupt, the analyst would be correct in 50% of the cases). A ratio is considered a useful classifier if it allows for a general accuracy at least 25% higher than the „by chance” accuracy (Chung, K., Tan, S., Holdsworth, D., 2008).

Based on this benchmark, the ratio would be considered as potentially useful if it would offer an accuracy of at least 62.5% ( $a = 50\% \times 125\%$ ).

## **RESULTS**

The Area under the ROC Curve over the 2007-2010 paired sample specific to the debt ratio was of 0.644, which can be evaluated as relatively poor, but valid classification accuracy (Tazhibi, Bashardoost and Ahmadi, 2011).

Figure 2 Area under the ROC Curve

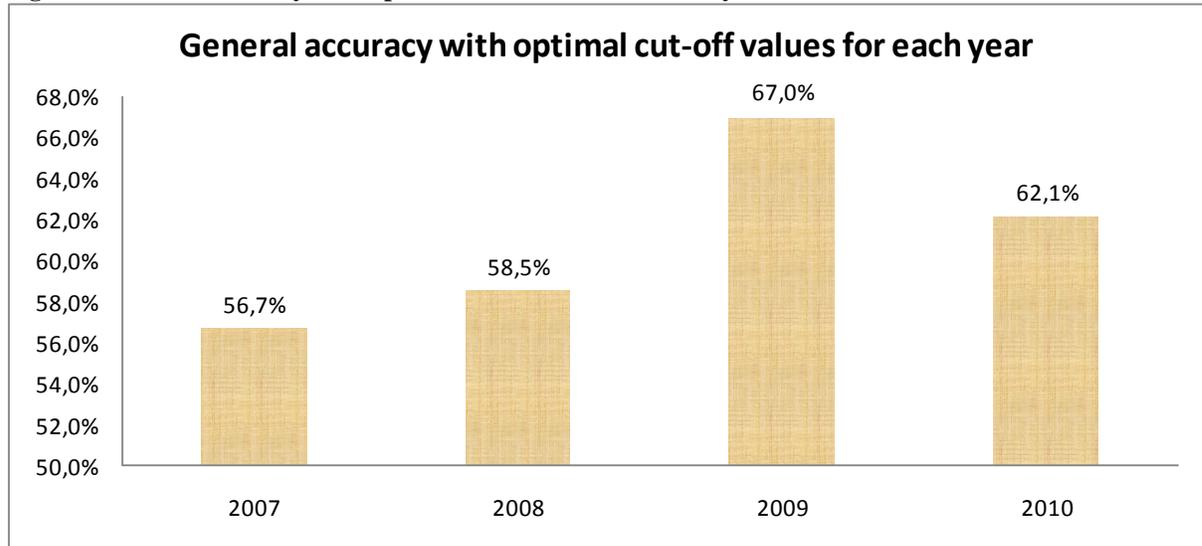


Under these circumstances, the ratio was submitted to additional tests. The AUC was determined for each of the 4 yearly paired samples. The AUC remains over 0.6 for the last 2 years of analysis (figure 2), the period in which the majority of the population is concentrated.

Based on the coordinating points of the ROC Curve for 2010, an optimal cut-off value was determined (debt ratio = 86%). By classifying all the companies from the 2010 paired sample that registered debt ratios higher than 86% as bankrupt and all the companies from the 2010 paired sample that registered debt ratios lower than 86% as non-bankrupt, the general classification accuracy would be of 62.1%. Thus, the in-sample general accuracy just underlaps the 62.5% benchmark.

Out of sample accuracy tests were performed over the 2007-2009 paired samples. The optimal cut-value for 2010 was used. The general accuracy reached its peak level for the 2009 sample (64.5%), but decreased to 54.8% for 2008 and to 51.7% for 2007. The out-of-sample general accuracy for the entire 2007-2009 sample was of 59.9%. The variations of the general accuracy registered in 2008 and 2007 are partly generated by variations of the cut-off value (and partly by the reduction of intrinsic classification capabilities of the debt ratio). The general accuracy levels correspondent to the optimal cut-off values for the 4 yearly paired samples are reflected in figure 3.

Figure 3 General accuracy with optimal cut-off values for each year



The general accuracy for the entire sample of 1424 companies was of 61.8% at a cut-off value of 90.3%.

## CONCLUSIONS

The Area under the ROC Curve for the entire paired sample shows that the debt ratio can be used as a tool for the assessment of the bankruptcy risk, although with relatively poor accuracy levels. This conclusion is sustained by a general classification accuracy of 61.8% over the entire paired sample of 1424 companies. Commonly used in this field, the paired sample was useful in evaluating the potential of the debt ratio. Nevertheless, as the structure of both the base-sample and the test-sample are significantly different from the structure of the target population, an optimal cut-off value for the entire population cannot be determined. The research proves the some potential of the debt ratio in the prediction of bankruptcy and underlines the need for determining an optimal cut-off value through research over the entire population (or a sample with the same structure). Considering the relatively low accuracy levels showed over the pair-sample, a limited classification performance over the entire population is expected also. Under these circumstances, a univariate methodology of analysis based only on the debt ratio could be useful for a quick and simple evaluation. It is expected that the debt ratio would be even more useful in a more complex analysis, included within a multivariate model.

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