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Assessment of the bankruptcy risk based on the solvency ratio

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Abstract. *The current paper sets to develop a methodology for assessing the bankruptcy risk for Romanian companies based on the solvency ratio. A previous study performed over a paired sample of 1176 Romanian companies showed that the solvency ratio had potential for predicting bankruptcy, but was not able to set a benchmark because of the differences between the structure of the paired sample and the structure of the population. The present research was performed over a larger sample, that included 53252 yearly financial statements and that was similar in structure to the entire population of Romanian companies. The results allow for the proposal of a methodology for assessing the bankruptcy risk based on risk classes.*

Keywords: ratio analysis, financial statements, corporate finance, accuracy, benchmark, risk classes.

JEL Classification: G33, M10.

1. Introduction

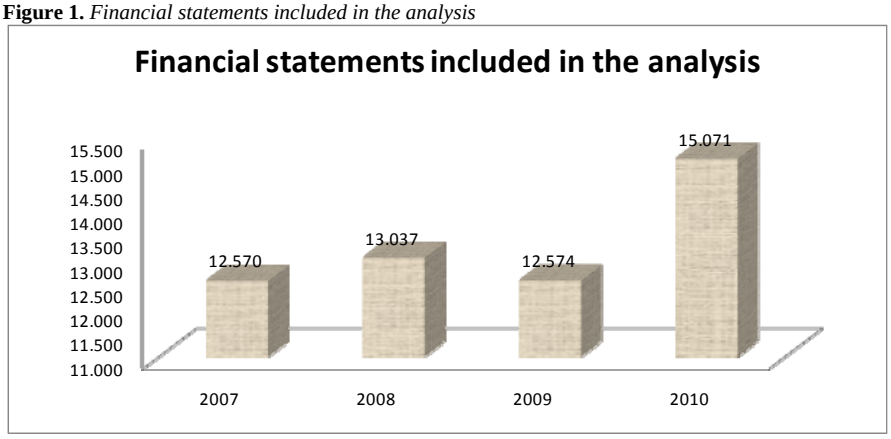
The assessing of the corporate bankruptcy risk has represented a central theme of the ratio analysis since the beginning of the 20th century (Yadav, 1986). Studies over samples of companies from all over the world have proved the usefulness of the financial ratios in the prediction of bankruptcy. During the last century, different univariate or multivariate methodologies for assessing the bankruptcy risk were proposed, in accordance with the characteristics of the populations. The need to renew the methodologies is permanent, as the characteristics of the populations continuously change. A previous study (Brîndescu-Olariu, 2016a) conducted over a paired sample of 1176 Romanian companies showed a general classification accuracy based on the solvency ratio of 67%. Although this level of accuracy leaves important room for error, it is considered enough to make the solvency ratio a useful classifier (Chung et al., 2008). As the tests were performed over a paired sample (588 bankrupt companies, 588 non-bankrupt companies), the optimal cut-off value was not considered fit for the entire population (which has a yearly bankruptcy frequency of less than 3%) and a methodology of analysis was not configured. The current study sets to develop a methodology for assessing the bankruptcy risk based on the solvency ratio, applicable to the entire population. Although other instruments for the evaluation of the bankruptcy risk exist, the methodology proposed will offer information fast, with minimal effort from the part of the analyst, being at the same time accessible to all stakeholders. The conclusions reached by the analyst based on the proposed methodology will be useful for either making quick decisions or as a starting point for a more detailed analysis.

2. Data and methodology

The data employed is the same as in Brîndescu-Olariu (2016b). More specifically, the study included a total of 53,252 yearly financial statements of Romanian companies, as shown in Figure 1. Only data made public online by the Ministry of Public Finances of Romania was used, as the target was to develop a methodology easily accessible. The required data for calculating the solvency ratio has as source the yearly balance sheet of the company:

$$\text{Solvency ratio} = \frac{\text{Total assets}}{\text{Total liabilities}} \times 100\%$$

Figure 1. *Financial statements included in the analysis*



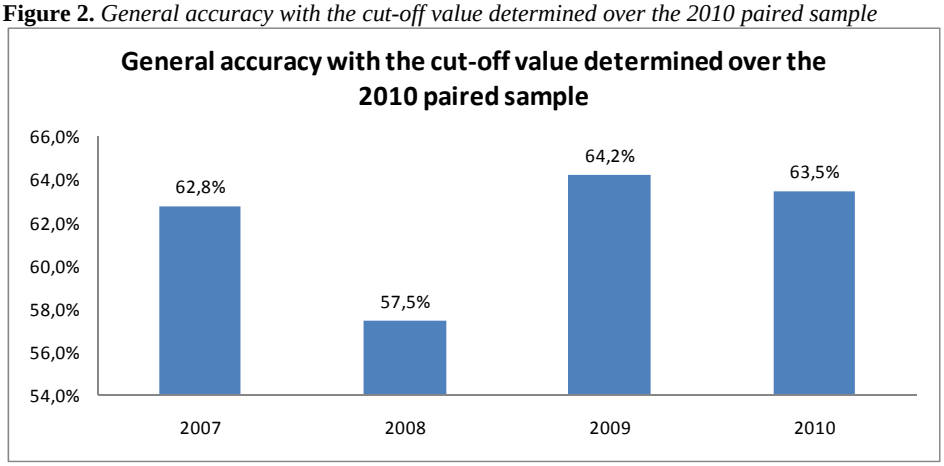
The data was processed in IBM SPSS. The "state" of the company was defined as a dependent variable, taking the values of 0 (non-bankrupt) or 1 (bankrupt). The solvency ratio was used as an explanatory variable. The state of the company was monitored for 2 years after the date of the financial statements of reference. Of the companies included in the study, 712 went bankrupt during the follow-up period.

Initially, the general classification accuracy was tested by using the cut-off value of the solvency ratio resulted from the study conducted over the paired sample (Brîndescu-Olariu, 2016a). As the classification performance was low, a new cut-off value was targeted, based on all the 2010 financial statements. For this purpose, the ROC Curve for the relationship between the solvency ratio and the dependent variable was built, based on the 2010 financial statements. The ROC Curve graphically reflects the relationship between the sensitivity and the specificity for all possible cut-off values (van Erkel and Pattynama, 1998). By inspecting the coordinating points of the ROC Curve, the intent was to identify the value of the solvency ratio which, used as a cut-off, would maximize the general classification accuracy. Although no cut-off value allowed for a general classification accuracy higher than the "by chance" accuracy, the Area under the ROC Curve, an indicator of the classification performance (Hanely and McNeil, 1982; Faraggi and Reiser, 2002), confirmed the useful potential of the solvency ratio in the assessment of the bankruptcy risk. Under these circumstances, a classification of the companies on risk classes was considered as a more realistic target of the methodology under development. For the configuration of the risk classes, the bankruptcy frequency was calculated on intervals of the solvency ratio, for each of the 4 years covered by the study. Although the dynamics of the bankruptcy frequency over the intervals of the solvency ratio was not perfectly monotone, 3 relevant intervals were identified.

3. Results

Using the optimal cut-off value for the 2010 paired sample (116%), the general classify-cation accuracy does not reach past 64.2% (for the 2009 data), as shown in Figure 1. Thus, as expected, the cut-off value determined over the paired sample does not allow for an accuracy level higher than the benchmark of 125% of the natural classification accuracy.

Figure 2. *General accuracy with the cut-off value determined over the 2010 paired sample*

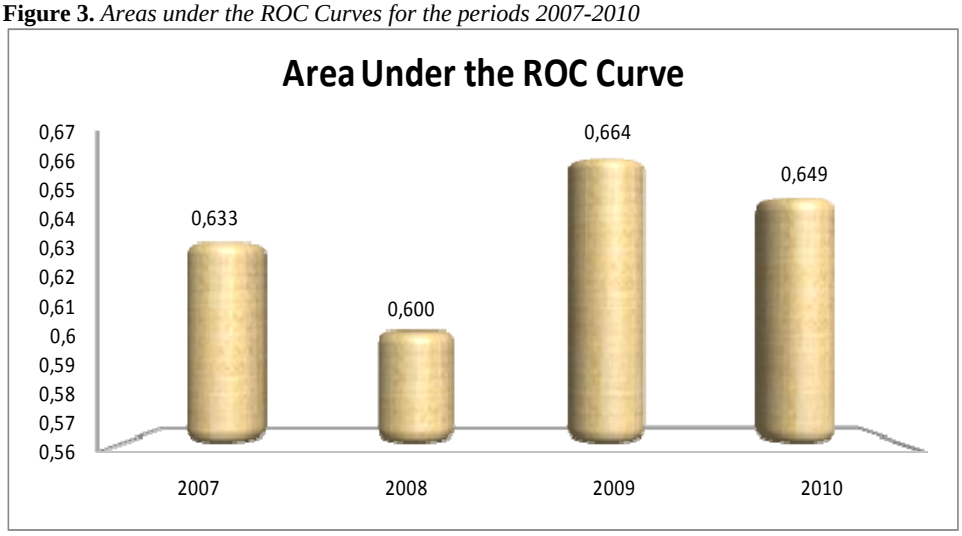


By estimating that all the companies with solvency ratios lower than 116% would go bankrupt in 2 years, while the companies with solvency ratios higher than 116% would continue their activities under normal circumstances, the analyst would be correct in most of the cases (in 63.5% of the cases, based on the 2010 financial statements). Nevertheless, by simply classifying all the companies as non-bankrupt, the analyst would be correct in over 97% of the cases. This is due to the structure of the population as, each year, less than 3% of the Romanian companies go bankrupt. Thus, using the solvency ratio as a bankruptcy predictor over the entire population with a cut-off value of 116% does not prove efficient in assessing the bankruptcy risk.

Under these circumstances, a new benchmark was searched, by using the entire 2010 population. More specifically, the value of the solvency ratio that best splits the entire 2010 population as bankrupt or non-bankrupt was targeted. As the minimum value that the solvency ratio can take is 0% and as the bankruptcy frequency for the 2010 population was 2.85%, by simply choosing 0% as cut-off value, the general accuracy of the classification would be of 97.15% (the "by chance" accuracy). The analysis thus targeted the identification of a cut-off value that would allow for a general accuracy superior to the "by chance" accuracy. For the identification of the optimum cut-off value over the 2010 population, the ROC Curve was built using the IBM SPSS software. The cut-off value was searched by inspecting the coordinating points of the ROC Curve. No value of the solvency ratio proved to allow for a general classification accuracy higher than the "by chance" accuracy. The ROC Curves were built for all 4 years included in the analysis and

the Areas under the ROC Curves were calculated, for a revaluation of the classification capacity of the solvency ratio. The values of the Areas under the ROC Curves are shown in Figure 3. They confirm a poor, but valid classification capacity of the solvency ratio (Tazhibi et al., 2011). While using a single cut-off value of the solvency ratio in order to predict the state of a company did not prove efficient, the prediction capacity of the solvency ratio (poor as it is) can still be of use for classifying the companies on risk classes.

Figure 3. *Areas under the ROC Curves for the periods 2007-2010*



For the identification of relevant risk classes, the population was first classified on 10 intervals of the solvency ratio, for each year. For each interval, for each year, the bankruptcy frequency was determined. A risk index was calculated for each interval (for each year). The risk indexes are shown in Table 1.

Table 1. *Risk indexes on intervals of the solvency ratio*

No.	Solvency ratio	2007	2008	2009	2010
1	Solvency ratio < 80%	105%	127%	144%	144%
2	80% <= Solvency ratio < 100%	232%	106%	174%	146%
3	100%<= Solvency ratio < 110%	147%	202%	199%	181%
4	110%<= Solvency ratio < 120%	144%	81%	57%	89%
5	120%<= Solvency ratio < 140%	36%	137%	110%	73%
6	140%<= Solvency ratio < 160%	114%	96%	90%	94%
7	160% <= Solvency ratio < 180%	0%	54%	35%	60%
8	180% <= Solvency ratio < 200%	112%	104%	24%	58%
9	200% <= Solvency ratio < 220%	0%	0%	56%	34%
10	Solvency ratio >= 220%	41%	42%	17%	23%

By inspecting the dynamics of the risk indexes over the 10 intervals of the solvency ratio for the 4 years included in the analysis, 3 risk classes are proposed (Table 2).

Table 2. *Risk classes*

No.	Risk class	Interval of the solvency ratio
1	Class 3 (High risk)	0%<= Solvency ratio < 110%
2	Class 2 (Moderate risk)	110%<= Solvency ratio < 200%
3	Class 1 (Low risk)	Solvency ratio >= 200%

The values of the risk indexes over the 3 risk classes are shown in Figure 4. The dynamics of each index over the 4 years show relative stability, which reinforces the practical utility of the proposed classification system.

Figure 4. *Dynamics of the risk indexes on risk classes*

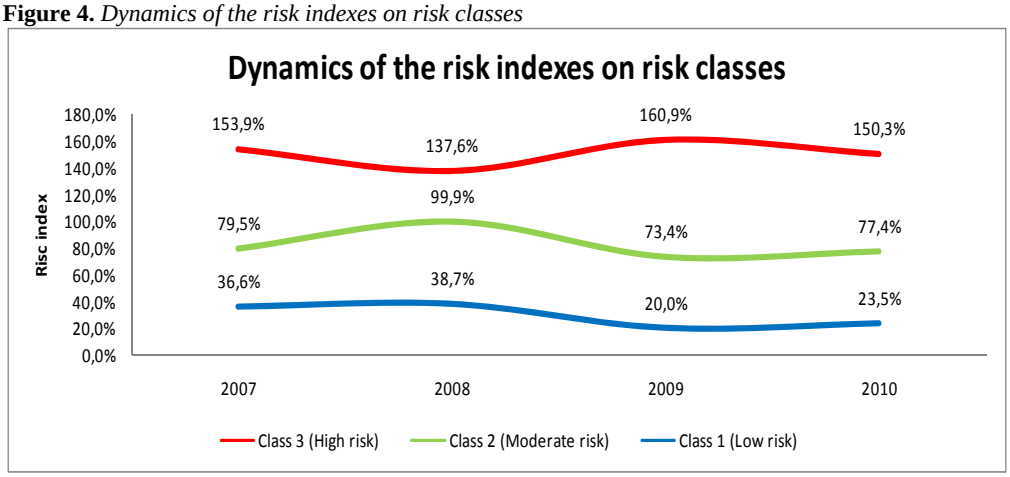
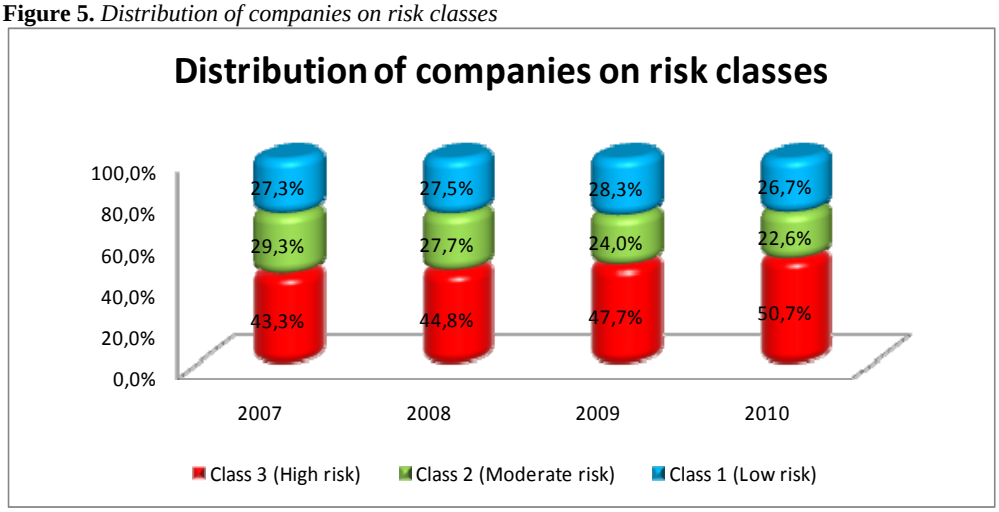


Figure 5 shows the distribution of the companies on risk classes for the period 2007-2010.

Figure 5. *Distribution of companies on risk classes*



4. Conclusions

The studies undertaken prove that the solvency ratio has relevant potential for predicting corporate bankruptcy. Although this potential is not high enough to allow for a sure diagnose, it can offer useful information about the level of risk. As the corporate bankruptcy is a relatively rare phenomenon within the Romanian economy (with yearly frequencies of 1-3%), the "by chance" classification accuracy reaches past 97%. The solvency ratio does not hold the capacity of perfectly splitting the population (in future bankrupt/non-bankrupt companies) based on a single cut-off value, so that it may allow for a general classification accuracy of more than 97%. Nevertheless, results show that high bankruptcy frequencies are more common for the lower intervals of the solvency ratio. Under these circumstances, the findings allow for the proposal of a methodology of analysis based on risk classes. Three risk classes are proposed, in accordance with the values of the solvency ratio:

- Class 1: solvency ratios of 200% to $+\infty$ – low level of bankruptcy risk;
- Class 2: solvency ratios of 110-199% – moderate level of bankruptcy risk;
- Class 3: solvency ratios of 0-109% – high level of bankruptcy risk.

Using the proposed methodology, the analyst should start by calculating the value of the solvency ratio of the company under investigation (using the data from the last balance sheet). Based on the value obtained, the company should be included in one of the 3 risk classes. The users of the analysis report (stakeholders of the company) should adopt a specific position towards the company, in accordance with its risk class. Each stakeholder should establish its own policies towards companies from each of the 3 risk classes. In the process of developing such policies, the stakeholders will consider their particular interests in the companies under investigation, but also the following information concerning the risk level of each class:

- of 1,000 companies included in class 3 (high level of bankruptcy risk), 43 will become bankrupt within 2 years;
- of 1,000 companies included in class 2 (moderate level of bankruptcy risk), 22 will become bankrupt within 2 years;
- of 1,000 companies included in class 1 (low level of bankruptcy risk), 7 will become bankrupt within 2 years.

Thus, the mere inclusion of a company with a solvency ratio of less than 110% in class 3 does not automatically imply that the company will go bankrupt. In fact, the company will probably not go bankrupt, as 95.7% of the companies form class 3 continue their activities under normal circumstances. Nevertheless, the risk of such a company going bankrupt is approximately 2 times higher compared to companies from class 2 and 6 times higher compared to companies from class 1.

The higher probability of bankruptcy that's associated with lower solvency ratios is connected to the debt service (as well as other debt repayments) and to the assets' capacity of generating cash. While debt can stimulate the return on equity based on a leverage mechanism, high amounts of debt involve high debt payments. Most debt needs

to be paid in cash (there are exceptions like advance payments from costumers, which will not be repaid in cash, but through the delivery of goods or services). The company generates cash, as well as goods and services, through the use of its assets (mostly within its operating activity). Lower solvency ratios involve low values of the assets compared to the value of the debt. This translates into low capacity of generating cash, goods and services, compared to the debt payments. As a consequence, companies with lower solvency ratios show higher risks of not being able to generate enough cash, goods and services to cover the debt payments. Companies that are not able to pay their debts on time may end up in bankruptcy, although this is by no means a certainty. Creditors often accept delays and, if the company encounters serious payment difficulties, may agree to reschedulings. If the operating activity does not prove capable of ensuring the payment of the debt, there is always the possibility of the company liquidating part of its fixed assets. Nevertheless, selling fixed assets usually takes time and involves value losses. The most reliable fixed assets in such cases are land and buildings. Therefore, when evaluating the bankruptcy risk (or the default risk in general) associated to a company based on the solvency ratio, the structure of the assets should also be taken into account. A high current assets ratio may ensure more short-term liquidity, but it may also be associated with lower returns on assets and, thus, less operating profits, with negative impact on the long – term payment capacity. A high percentage of land and buildings within the fixed assets may bring extra insurance in case of liquidation, as the loss of value in such circumstances is lower. It should also be noted that the figures employed in ratio analysis are taken from the balance sheet, which is why they might not correspond to current market values. The depreciation policy tries to account for the value loss generated by physical and moral depreciation, but it is usually off from the real market value loss. Especially in case of forced liquidation, machinery suffers greater value loss compared to land and buildings (as a difference between market value and liquidation value). In addition, the book value of land and buildings is usually closer to their market value, as, in Romania, the fiscal laws strongly encourage their revaluation every 3 years.

Thus, in case of difficulty in making the current payments based on the operating cycle, a company has the alternative of selling part of its fixed assets. Companies with low solvency ratios do not possess a great margin when it comes to selling assets to cover the debt. If the percentage of land and buildings within the existing assets is low, the probability of the company not being able to gather enough cash from the forced liquidation of assets is even higher.

Another possible solution for the company paying its debt even when the cash generated by its operating activity is not enough is the injection of capital from the shareholders. This may be done under the form of equity (as an increase of the shared capital), but, for the vast majority of the small Romanian companies, it is being done through the shareholders current account. This basically means that the company contracts new debt in order to pay existing ones, but the new debt is to the shareholders, who will not put the same pressure on the company for payback (especially as, for many of the small companies, the shareholders are also the managers). Therefore, when evaluating the

bankruptcy risk based on the solvency ratio, the analyst should also consider the personal payment capacity of the stakeholders.

As for the configuration of policies towards companies from different risk classes, a bank might decide to avoid companies as long as they fit in class 3, or at least to perform a more detailed analysis compared to standard procedures. A higher level of interest could be set, in order to cover the extra risk taken by the bank. Extra guarantees could be demanded (from the company itself or from its shareholders). In the same manner, suppliers might avoid selling on credit to companies from class 3, while costumers might avoid making payments in advance. The positioning of the company in class 3 should suggest to the costumers that there is a higher that average probability of the company not being still present on the market in the near future. To the employees, it should suggest that the probability of restructuring is higher than average.

The static analysis (based on the value of the solvency ratio from a single year) could be completed with an evaluation of the dynamics of the ratio (for two years or more). A decrease of the solvency ratio from one period to the other should be interpreted as an increase of the bankruptcy risk. Mathematically, such a decrease would only be possible if the growth index of the debt would be higher than the growth index of the total assets. The causes responsible of the dynamics of the solvency ratio should be identified by analysing the dynamics of the debt as well as the dynamics of the total assets. Most commonly, for a small or medium sized company, an increase of the total debt would be based on contracting a new long-term bank loan (which would increase both the long-term and the short-term financial liabilities), the injection of additional capital through the shareholders current account (as long-term or short-term debt), contracting a short-term bank loan, the increase of accounts payable based either on an increase in the level of activity (and thus an increase of the value of acquisitions), either on an increase of the days payable outstanding (in agreement with the suppliers or through delays based of the company's inability to pay on time). The increase of the debt can translate into an increase of the assets or a replacement of equity. A lower growth index of the assets (compared to the growth index of the debt) can be based on a slower increase of the equity (or even a decrease of the equity), based on poor levels of the return on equity or on the distribution of dividends.

In order to limit the bankruptcy risk, stakeholders could try to impose to the company the increase of the solvency ratio through the increase of the equity (through new injections of shared capital, retention of earnings, transformation of the debt from the shareholders current account into shared capital) and the decrease of the debt.

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