

# Book-Based VS. Market-Based Indebtedness Ratios in Bankruptcy Prediction on the Polish Capital Market

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## Abstract

Forecasting corporate bankruptcy constitutes an integral and relevant part of financial statement analysis and business valuation. Typically the evaluation of a risk of financial default is based on some ratios, including company's indebtedness. However, there are various versions of such metrics. In this paper, the book-based and market-based corporate indebtedness ratios are evaluated and compared in terms of the accuracy of their bankruptcy predictions, within a sample of data from the Polish market. The study is based on a sample of 80 firms, in which case at least one bankruptcy filing was announced in a period between the beginning of 2009 and the end of 2015. This sample is compared to the counter-sample of 80 randomly selected firms in which case no any bankruptcy filing occurred in the same years. The general usefulness of both versions of indebtedness ratio in credit risk evaluation has been confirmed by the statistical analysis presented in this study. Despite significant heterogeneity of the sample (which covers wide variety of businesses), the univariate logit models with only one ratio used as an explanatory variable are capable of identifying bankrupt firms (with one-period-ahead forecast horizon) in about 67-71% of cases. However, the research presented in this paper has not confirmed the supremacy of market-based indebtedness ratio over book-based one in predicting corporate financial distress.

## Keywords

Bankruptcy Prediction, Ratio Analysis, Fundamental Analysis, Indebtedness Ratio

## 1. Introduction

A comprehensive fundamental evaluation of a company is typically based on multiple quantitative and qualitative analytical tools. Financial statement analysis constitutes one of its most relevant parts. The most traditional and commonly applied approach to a financial statement analysis employs a set of simple accounting ratios based on corporate primary financial statements (i.e. income statement, balance sheet and cash flow statement). Each of the individual accounting ratios falls into one of the four main categories (profitability, indebtedness, liquidity and effectiveness ratios), depending on the aspect of a company's financial situation which it focuses on. Indebtedness ratios constitute a class of financial risk metrics and serve to quantify the company's exposure to the risk of bankruptcy.

Traditional approach to computing indebtedness ratio relies on dividing company's total liabilities (including provisions) by its total assets, on the ground of their respective carrying amounts (and not fair values), as reported in the company's balance sheet. Thus, one of the main advantages of such a ratio is its simplicity and easiness of computation. Its advantage lies also in the availability of all the necessary data for all firms (including public and private ones), as long as they prepare the balance sheet. However, it is also an important drawback, because the carrying (book) value of a company's shareholder's equity (as reported in its balance sheet) may significantly deviate from its market or fair value. Consequently, some financial analysts prefer computing indebtedness ratio on the ground of the market value of equity (where company's market capitalization, rather than its book value of net assets, is taken into account).

In this paper, the two alternative approaches to computing

indebtedness (i.e. book value-based vs. market-value based) are evaluated and compared in terms of their usefulness in corporate bankruptcy prediction, within a sample of data from the Polish market. First, the accuracy with which both versions of indebtedness ratios discriminate between bankrupt and non-bankrupt firms is evaluated. Then, after confirming the general usefulness of indebtedness metrics in quantifying corporate credit risk, the empirical safety thresholds (meant as values of ratios at which the probability of bankruptcy exceeds fifty percent) are estimated.

The study is based on a sample of 80 firms (whose shares have been traded on the Polish capital market), in which case at least one bankruptcy filing was announced in a period between the beginning of 2009 and the end of 2015. This sample (labelled further as “bankrupt firms”) is compared to the counter-sample of 80 randomly selected firms (labelled as “healthy firms”) in which case no any bankruptcy filing occurred in the same years.

Next section of this paper discusses the relevant literature. It is followed by the section which describes the data sample and analytical methodology applied in the study. Then, the obtained empirical findings are presented and interpreted. Finally, concluding comments as well as study limitations are discussed.

## 2. Literature Review

Analysis of indebtedness (also labelled as solvency or financial leverage) examines the firm’s capital structure, including the mix of its financing sources and the ability of the firm to satisfy its debt and investment obligations, [15], [1], [11]. Indebtedness ratios are applied not only in a pure financial analysis (e.g. in equity valuation and credit risk assessment), but also in a corporate strategy analysis, planning and management, [14], [16], [5].

The literature is quite silent on optimal or safe values for indebtedness ratios. It is obvious, however, that relatively high financial leverage may be more affordable in the case of companies with relatively low operating risks (i.e. low demand cyclicity, low operating leverage, stable sale prices, etc.), while firms operating in more turbulent economic environments (e.g. construction companies, real estate developers or car manufacturers) should follow more prudent and conservative financing structures (with higher share of equity in total assets). However, according to the author’s observations from the Polish capital market, the subjective general safety thresholds between 60% a 66% are often assumed for the share of total liabilities and provisions to total assets.

Reliability and inter-company comparability of indebtedness ratios may be distorted by accounting policy choices as well as by operating and financial decisions. For example, inventory cost flow methods (e.g. FIFO vs. LIFO or weighted-average) may affect the comparability and reliability of reported total assets and equity [9]. Also, in an effort to appear less risky and to lower their cost of capital, firms often attempt to structure financing in a manner that

keeps debt off-balance sheet, e.g. through operating leases instead of capital ones, [7], [13], [6]. [8] found that in a broad sample of companies reporting under US GAAP, the leverage ratio adjusted for off-balance sheet liabilities exceeds the reported leverage ratio by at least 20%, on average.

However, despite these common distortions and drawbacks of indebtedness ratios, they appear statistically significant in huge majority of statistical models for bankruptcy prediction, [3], [2]. Particularly, those models usually include a total indebtedness ratios, meant as total liabilities divided by total assets, which often turns out to be the most statistically significant of all accounting ratios tested, [10], [17], [12], [4], [1].

## 3. Data and Methodology

In this paper book-based and market-based indebtedness ratios are compared, as financial distress prediction tools, in a sample of firms listed on the Warsaw Stock Exchange. Accordingly, the following two alternative indebtedness ratios have been investigated:

Book-based indebtedness = total liabilities at book value the end of the year / (total liabilities at book value plus total shareholder’s equity at book value at the end of the year),

Market-based indebtedness = total liabilities at book value at the end of the year / (total liabilities at book value plus total shareholder’s equity at market value at the end of the year).

In the case of book-based ratio both inputs (i.e. total liabilities and total shareholder’s equity) were extracted from a given company’s consolidated balance sheet, at their carrying amounts. In contrast, in the case of market-based ratio the total liabilities are entered as reported (i.e. with the same carrying amount as for the book-based ratio), while the shareholder’s equity is entered at its market value (i.e. company’s market capitalization) as at the end of the year, computed by multiplying a given company’s stock price on last trading day of a year by the number of its common shares at the end of the same year.

The data from a period between the beginning of 2009 and the end of 2015 have been used. Within this timeframe, as many as 80 firms listed on the Warsaw Stock Exchange faced at least one bankruptcy filing. The companies included in that sample, labelled further as “bankrupt firms”, form the primary sub-sample. To enable a statistical analysis, this sample has been extended by adding 80 randomly selected firms, in which case no any bankruptcy filing was announced in the same period (this sub-sample is further denoted as “healthy firms” or “non-bankrupt firms”). All the accounting numbers used in this study have been collected from primary sources, that is from annual reports issued by the companies included in the sample.

According to our analysis (not presented here), no any industry seems to dominate in the sample, although two businesses (construction and IT) make up about 30% of the investigated bankruptcy filings. It seems therefore that the sample of corporate failures, included in this study, may be considered representative of a broad spectrum of diverse

Polish companies. In contrast, a time-series distribution shows that two years of economic slowdown (2012-2013) seem to be slightly over-represented, while other periods, particularly those featured by fast growth of Polish economy, seem to be under-represented. However, it seems logical, because bankruptcy rates tend to rise / fall when macroeconomic conditions deteriorate / improve.

One-period-ahead bankruptcy prediction horizon has been investigated. To make sure that only data which were publicly available on the bankruptcy filing date are taken into account, for bankruptcy filings announced between the beginning of April and the end of December of  $t$ -th year (i.e. when annual financial statements for the preceding year have already been published), data from annual reports for  $t-1$  period have been used. In contrast, for bankruptcy filings announced between the beginning of January and the end of March of  $t$ -th year, data from annual reports for  $t-2$  period have been used (as the most recent annual financial information available).

The research was conducted in four steps. First, medians of both indebtedness ratios within both sub-samples have been compared and the statistical significance of differences between those medians has been checked. Then, two univariate logit models for bankruptcy prediction have been estimated, each with one indebtedness ratio as the only explanatory variable. In the third step the estimated logit models have been evaluated in terms of their in-sample prediction accuracy. Finally, on the ground of the estimated

models the empirical safety thresholds for both indebtedness ratios have been simulated.

To avoid possible distortions of model parameters, brought about by outlying observations (i.e. companies with unusually high or low values of indebtedness ratios), both logit regressions were estimated on the samples which exclude outliers. An inter-quartile range rule has been applied in identifying outliers. However, in the third step of the research the whole original sample (i.e. including outliers) has been used. In classifying firms as bankrupt or healthy ones an arbitrary threshold for bankruptcy probability, equalling 50%, has been assumed.

## 4. Results and Discussion

Table 1 presents medians as well as additional statistics computed for both investigated ratios.

As expected, bankrupt firms tend to have substantially higher values of both indebtedness ratios, as compared to non-bankrupt companies. Wilcoxon Rank-Sum test statistics, which exceed a critical value of two by high margins, confirm that both sub-samples differ significantly in terms of median values of both ratios. The additional statistics inform that both ratios show significant variations not only between bankrupt and healthy firms, but also within both groups of companies (although dispersion tends to be higher within a sub-sample of bankrupt firms, particularly in the case of book-based ratio).

**Table 1.** Selected statistics for both alternative indebtedness ratios within sub-samples of bankrupt and non-bankrupt firms.

		Book-based indebtedness ratio	Market-based indebtedness ratio
Median	Bankrupt	75,3%	73,2%
	Non-bankrupt	47,7%	43,5%
Arithmetic mean	Bankrupt	89,8%	64,6%
	Non-bankrupt	47,9%	42,8%
Standard deviation	Bankrupt	109,3%	26,2%
	Non-bankrupt	19,8%	22,6%
Wilcoxon Rank-Sum test statistic for the difference between two medians*		6,69	5,27

\* value above two means that the difference between medians is statistically significant at 5% significance level

Source: authorial computations.

Table 2 displays the parameters and statistics of book-based and market-based logit models, respectively. Both models are statistically significant (with double digit values of F-statistics). As expected, slope coefficients are positive for both ratios. The general prediction accuracy (in the range between 67% and 71%) of both models seems to be quite good, given that they were estimated on the ground of samples which include firms from diverse industries and given that only one ratio is used as an explanatory variable in each model. In terms of accuracy of predictions, at the arbitrarily assumed probability threshold of 50% the book-based indebtedness ratio seems to outperform that based on

market value of equity, both within whole samples as well as within both sub-samples (i.e. bankrupt and non-bankrupt firms). Accordingly, our data do not confirm the supremacy of market value of equity over its book value (carrying amount) in predicting financial distress, with one-period-ahead forecast horizon. However, it is worth noting that in the case of book-based model the accuracy of predictions for non-bankrupt firms exceeds the accuracy of predictions for bankrupt ones. In contrast, market-based model seems to do better in identifying bankrupt firms rather than the healthy ones.

**Table 2.** Parameters of book-based and market-based logit models and analysis of their bankruptcy prediction accuracy.

	Logit model with book-based indebtedness ratio		Logit model with market-based indebtedness ratio	
	Coefficient	t-Statistic	Coefficient	t-Statistic
Intercept	-3,66	-6,46	-2,48	-5,06
Slope	5,97	6,71	4,61	5,65
F statistic	45,07		31,91	
Number of observations, after removal of outliers	153 (73 bankrupt / 80 non-bankrupt)		160 (80 bankrupt / 80 non-bankrupt)	
Correctly predicted: bankrupt*	70,00%		68,75%	
Correctly predicted: non-bankrupt*	72,50%		66,25%	
Correctly predicted: total*	71,25%		67,50%	

\* within the whole sample of 80 bankrupt and 80 non-bankrupt firms; a threshold of probability of 50% has been assumed for classification of companies  
Source: authorial computations.

Finally, the empirical safety thresholds for both versions of indebtedness ratios (meant as values of ratios at which the probability of bankruptcy exceeds 50%) have been estimated, on the ground of the logit models discussed above. According to those estimates, to keep a company sustainable, its managers should ensure that its total liabilities are kept at the level not exceeding 61-62% of total assets, but preferably no more than 55-60% (to keep the risk of insolvency significantly lower than 50%). In the case of the market-based indebtedness ratio, its upper safety threshold seems to lie near 53-54%. Its value below 50% / above 60% suggests remote / increased risk of insolvency.

## 5. Conclusions

In this paper, the book-based and market-based corporate indebtedness ratios have been evaluated and compared in terms of the accuracy of their bankruptcy predictions, within a sample of data from the Polish market. The study is based on a sample of 80 firms, in which case at least one bankruptcy filing was announced in a period between the beginning of 2009 and the end of 2015. This sample has been examined on the background of the counter-sample of randomly selected non-bankrupt firms.

According to the findings of the statistical analysis presented in this paper, both alternative versions of indebtedness ratios (i.e. book value-based and market-value based) are informative in a credit risk analysis and corporate bankruptcy prediction. Consequently, they are useful in business valuation as well. The whole sample of bankrupt and non-bankrupt firms, investigated in this study, covers very broad spectrum of various businesses. Despite this heterogeneity of the sample, the estimated univariate logit models (with only one financial statement ratio used as an explanatory variable) turned out to be capable of correctly separating the bankrupt companies from the "healthy" ones in about 67-71% of cases. However, the empirical research presented in this paper do not confirm the supremacy of market value of equity (i.e. company's market capitalization) over its carrying (book) amount in predicting financial distress. Thus, the obtained findings are relevant for financial statement users, because they constitute another evidence that financial numbers reported in financial statements (in the

balance sheet in this case) are informative and useful in the credit risk analysis. The findings are particularly relevant for those practitioners who deal with private (or closely held) companies, where market value of equity (market capitalization) is a non-observable variable but where the book value of equity may be easily extracted from the company's balance sheet.

However, it must be kept in mind that this empirical study has some significant limitations. First, the research covers relatively short period (less than ten years) during which only few incomplete business cycles developed in Poland. Furthermore, during those years Polish economy did not experience any single year of recession (meant as the fall of the gross domestic product), which means that majority of businesses included in our data sample enjoyed relatively favourable macroeconomic conditions (and were not exposed to harsh market pressures) during the investigated years. Last but not least, many Polish firms benefited from multiple government grants (EU funds) after Poland joined European Union in 2004. All this implies a pretty high risk of obtaining biased empirical results. In particular, it seems likely that the estimated safety thresholds of both investigated indebtedness ratios may be overstated. If this is the case, than the safe capital structure (i.e. share of liabilities in total assets) under more adverse macroeconomic conditions may differ from the estimates obtained and presented in this paper. The final limitation of the study stems from the fact that the examined financial statement ratios have been computed on the ground of annual reports only, instead of the most recent quarterly reports. This may reduce the predictive accuracy of the estimated bankruptcy prediction models to some extent.

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