Financial Distress of Companies in Poland

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Abstract

The study examines main determinants of financial distress of companies in Poland during the recent transformation period. Data compose a sample of 1995-97 annual financial statements of 200 unlisted companies in Poland. Degree of financial distress is expressed either by the binomial variable or by the trinomial ordered variable. The attempted models (binomial and trinomial logit) explain the distress variable for 1997 by the financial indicators evaluated on the basis of financial statements from previous years. The results are sensitive to the choice of explanatory variables in the models. The forecast accuracy of the estimated models lies in the range of 80-90 percent. In the second half of the 1990's, the financial condition of companies in Poland was determined by the degree of liquidity, profitability, and the financial leverage variables. (JEL C25, G33)

Introduction

The degree of financial distress of a company is determined by the ability to service its debts. This ability is routinely assessed by financing banks which may rate the commercial debts on the basis of their own credit rating models, e.g. along the recent Basel accords ["Principles...", 2000, rule number 10). Financial soundness and financial distress of a company is the outcome of a plethora of factors. The identification and subsequent quantification of these factors is not always possible. Moreover, the term "financial distress" is also not an easy subject for quantification. Therefore, the task of modelling financial distress always depends on some quantifying assumptions.

In this paper, the qualitative variables' models are used. It means, it is assumed that the state of company's financial situation may be expressed by means of a qualitative variable, such as the binary one, where "1" denotes financially sound company and "0" represents a company in financial distress. It also means, it is assumed that such a variable may be explained by a number of other factors-variables, which are either quantitative or qualitative. The qualitative variables' models are sometimes referred to as microeconometric models, i.e. models specified and estimated for large data sets, such as sets of individuals, families, and firms.

Models of Predicting Financial Distress and Bankruptcy

Finance and microeconometrics are occupied with bankruptcy and financial distress topics since the Altman seminal article in 1968 [Altman, 1968]. Numerous studies and surveys evidence various development paths of the Altman's approach. Major trends include: refinement of the traditional matched-pair multivariate linear discrimination model, logit model [Ohlson, 1980], neural networks, and other concepts, such as the gambler's ruin model. The approaches to bankruptcy prediction are surveyed in Morris [1997].

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This study focuses on binomial and multinomial microeconometric models, such as the logit model. Logit models are applied in a large number of recent bankruptcy and financial distress studies. In this regard, it is worth it to mention papers of Johnsen and Melicher [1994], Lennox [1999], Theodossiou, Kahya, Saidi, and Philippatos [1996], Kaiser [2001], Bernhandsen [2001], Neophytou, Charitou, and Charambolis [2000], Barniv, Agarwal, and Leach [2002], and many others.

Microeconometric studies on financial distress of companies in Poland date back to the late 1990's. The application of linear discriminant analysis to analyzing bankruptcy in Poland can be found in the works of Hadasik [1998], Michaluk [2000], and Maczynska and Zawadzki [2001]. The details can be found in Gruszczynski [2001]. Orlowski, Zolkiewski [2001] also examined questions of business failures in Poland. Their research is based on aggregate data rather than on microdata on companies.

A number of studies on failure and distress were also performed in other Central and East European countries. Papers by Lizal [2002] for the Czech Republic, by Hajdu and Virag [2001] for Hungary, and Hunter and Isachenkova [2000] for Russia are worth mentioning in this regard.

Major predictors of financial distress and bankruptcy, which are pointed out in the literature as well as the direction of their impact on probability of failure, are [Lennox, 1999; Kaiser, 2001]: unprofitability (the more unprofitable the company, the higher probability of failing), debt (the higher the debt, the higher the probability of default), cash flow difficulties (a company with healthy cash flow has relatively easy access to external financing), firm age (during the beginning period of growth the chance of failure increases; the medium age is connected with stable probability of default, and afterwards, the chance of failure decreases), firm size (also an inverse U-shaped effect on the probability of moving in or out of financial distress), the legal status, corporate shareholder (the existence of corporate shareholders has a negative effect on the probability of moving into financial distress), multiple creditors (firms with multiple creditors are less likely to run into financial distress), diversification (diversified firms are less likely of moving into financial distress).

The factors of predicting financial distress are commonly represented by the variables calculated on the basis of financial reports as well as on ownership-specific and industry-specific information. The qualitative factors are expressed by binary variables.

Models for Polish Companies

This section demonstrates the models of financial distress specified and fitted to the data on Polish companies from the base collected by the Institute of Economics of the Polish Academy of Sciences. The database includes financial reports of some 200 unlisted companies on Poland for three years: 1995, 1996, and 1997. The reports were collected directly from companies for the purpose of implementing the Institute's research project on company's restructuring in the 1990's.

The 1997 financial reports of the companies were examined by a group of experts (accounting and legal experts) who selected 23 companies in bad financial situations (financially distressed) as well as 23 companies financially sound. These 46 companies constitute major samples for specification of binomial models. Furthermore, an additional 25 companies were sampled from the remaining group of firms. They represent firms in a medium financial shape: inconclusive state between no problem and severe problem. This third group of companies was added to the major sample for specification of trinomial models.

The endogenous variable y_{it} represents the state of financial distress of i-th the company in year t. There are two types of endogenous variables considered. The first type is binomial Y: $y_{it} = 0$: company is financially distressed (severe problem company); $y_{it} = 1$: company is financially sound (no problem company). The second type is ordered trinomial Y: $y_{it} = 1$: company is financially distressed; $y_{it} = 2$: financial condition of the company is undetermined; $y_{it} = 3$: company is financially sound.

Key specifications of the attempted models are as follows:

$$\begin{aligned} Probability(y_{it} &= k) = Logit(predictor\ variables_{t-1}) \quad , \\ Probability(y_{it} &= k) = Logit(predictor\ variables_{t-2}) \quad , \end{aligned}$$

where *Logit* denotes either binomial logit or multinomial (trinomial) ordered logit, the term *predictor variables* indicates the list of explanatory variables for the logit models and t=1997. The specification assumes that the financial state of a company in 1997 may be determined by its characteristics for 1995 and/or 1996.

The explanatory variables for the logit models originate in the financial statements of the companies. There are four groups of financial indicator variables taken into account: liquidity ratios, profitability ratios, activity ratios and debt management ratios—altogether 17 indicators. All these ratios were calculated for each company for the three annual statements: 1995, 1996, and 1997. Financial characteristics of companies in 1995 and/or 1996 were regarded as the only predictors of distress in 1997. Thus, models assume one or two-year lag for explaining the 1997-stand of the company. Lag length is due to the financial data format. The legal format of financial statements in Poland before 1995 was significantly different from that in 1995 and after because of major changes in the law on accounting introduced in 1995. The four classes of models considered in the research are presented in Table 1.

TABLE 1
Description of Logit Models for Financial Distress

Logit Model	Predictor (Explanatory) Variables from:	
Y_{97}	X_{95}	X_{96}
Binomial Logit	BLM 95	BLM 96
$Y = 0$ or $Y = 1$		
Trinomial Ordered Logit	TLM 95	TLM 96
$Y = 1$ or $Y = 2$ or $Y = 3$		

The explanatory variables for the model in each class are selected in a sequence of the following steps:

1) The financial ratio X explaining Y is significantly correlated with Y. For the binomial Y, the ordinary correlation coefficient with X variable is adequate to demonstrate the degree of correlation. For the ordered trinomial Y, the correlation is replaced by the chi-square test of independence. The model may only accept the ratios for which the hypothesis of independence (with Y) is rejected. The direction (sign) of this association is then determined by a simple XY-correlation coefficient, where the Y variable is treated as dichotomous (with $y_i = 2$ rejected).
2) The ratios-predictors of distress are accepted to the model as explanatory variables only if they are weakly correlated between themselves. For this purpose, the examination of an interdependence matrix was the major method of selecting variables.

3) The model is accepted only if the sign of YX-correlation is the same as the sign of relevant X parameter estimate in the logit model. In such an application, this rule is very practical and intuitive. In Polish econometric literature, this is called the principle of coincidence. It means that once it is assured that the increasing values of X are associated with the increasing values of Y (from 0-1 in the binomial model or from 1-3 in the trinomial model), the models accepted shall have a positive sign of the parameter's estimate for the X variable. The decreasing values of X associated with increasing values of Y shall result in accepting the model with the negative sign of the parameter's estimate for the X variable. For the trinomial models, the principle of coincidence is verified by using the XY-correlation coefficient where the Y variable is treated as dichotomous (with $y_i = 2$ rejected).
4) From each predictors group the model shall include only 1 or 2 predictors. This rule is the necessity. The predictors are highly correlated inside one group and therefore, there is no use in including more than 1-2 predictors from each group. In such a situation, the selected predictor conveys a majority of information from the entire group.
5) The explanatory variables (predictors) included into a model are significant. This condition is not applied rigorously. The incorrect indication of a significance test is here possibly due to multicollinearity of explanatory variables as well as to the small sample.
6) The model has a good ex-post predictive capacity. The forecast accuracy is calculated as the share of correct forecasts of Y in the sample. The forecast of Y is the state (0 or 1 for the binomial model and 1, 2, or 3 for the trinomial model) with the largest probability predicted from the estimated model.

Out of the 17 financial ratios, the potential predictors selected in the first step of the procedure indicated above include 8 ratios for the models BLM 95 and TLM 95, and 12 ratios for the models BLM 96 and TLM 96. The number of ratios significantly correlated and associated with Y is larger for 1996 than for 1995. Evidently, symptoms of financial distress increase in number by approaching the year 1997 (year of companies' classification).

The ratios for all models include the liquidity ratios, which are positively correlated with Y. This means that the companies with higher liquidity have better chances to be financially sound after 1-2 years than the companies with liquidity problems.

The profitability ratio most frequently chosen for the models is "operating ROA" (return on assets defined with the operating profit in numerator). All the profitability ratios are selected to TLM 96. The profitability is also positively correlated with Y. The higher profits of the company, the higher probability to stay in good financial shape.

The asset management ratios selected for the models are: liabilities turnover and inventory cycle. Debt ratios significantly correlated with Y are debt ratio and ratio of liabilities (adjusted for most liquid assets) to sales. Both correlations are negative. Increasing debt is inevitably associated with company's decreasing ability to survive.

According to the specification procedure the models estimated in each class (BLM 95, BLM 96, TLM 95, and TLM 96) include financial ratios which are possibly weakly intercorrelated, represent various groups of predictors (liquidity, profitability, activity, and leverage), produce the model's coefficient with the expected sign, are possibly significant in the model, and generate (as a group) correct forecasts for the sample.

From the variety of logit models fitting to the specification procedure, the detailed estimation results for one model from each class are presented. For binomial Y, two models are presented in Tables 2 and 3.

TABLE 2
Estimation Results for the BLM 95 Model

Variable	Parameter Estimate	Standard Error	t-statistic	Probability
Const.	0.3133	0.8286	0.3781	0.7053
Operating ROA	8.7592	3.2861	2.6656	0.0077
Inventory Cycle	-8.0069	4.5512	-1.7593	0.0785
Akaike Criterion	1.1276	Hannan-Quinn Criterion		1.1723
Schwartz Criterion	1.2469	McFadden R-squared		0.2807
		Actual Number	Predicted	
Prediction Accuracy	y_i	of Companies	Number	% Correct
	0	23	19	82.61
	1	23	20	86.96

TABLE 3
Estimation Results for the BLM 96 Model

Variable	Parameter Estimate	Standard Error	t-statistic	Probability
Const.	-4.7238	1.5925	-2.9663	0.0030
Gross Profit Margin	16.1075	6.5392	2.4632	0.0138
Liability Turnover	0.5761	0.2025	2.8447	0.0044
Akaike Criterion	0.6134	Hannan-Quinn Criterion		0.6580
Schwartz Criterion	0.7326	McFadden R-squared		0.6516
		Actual Number	Predicted	
Prediction Accuracy	y_i	of Companies	Number	% Correct
	0	23	20	86.96
	1	23	20	86.96

The trinomial ordered logit model is used to describe Y defined as: $y_{it} = 1$ (company financially distressed, $y_{it} = 2$ (undetermined financial condition), $y_{it} = 3$ (company financially sound). It is assumed that the states of Y correspond to the values of an unobserved latent variable y^*. The values of y^* represent the level of financial distress of the company. Accordingly, it is assumed that:

$$\begin{aligned} y_i &= 1 \text{ for } y_i^* < \tau_1 \quad , \\ y_i &= 2 \text{ for } \tau_1 \leq y_i^* < \tau_2 \quad , \\ y_i &= 3 \text{ for } \tau_2 \leq y_i^* \quad . \end{aligned}$$

Parameters τ (also identified as limit points) are unknown and subject to estimation. The latent variable y^* is explained in terms of explanatory variables X as follows:

$$y_i^* = x_i^T \beta + \varepsilon_i \quad . \tag{1}$$

Vector x_i represents the financial ratios for the i-th company, β is the parameter vector, and ε_i is the disturbance term. If the distribution of ε_i is logistic, then the model is ordered logit. In this case, the probabilities of Y for each state are:

$$P(y_i = 1 \mid x_i) = A, \qquad P(y_i = 2 \mid x_i) = B - A, \qquad P(y_i = 3 \mid x_i) = 1 - B \quad , \tag{2}$$

where:

$$A = \frac{e^{\tau_1 - x_i^T\beta}}{1 + e^{\tau_1 - x_i^T\beta}} \quad \text{and} \quad B = \frac{e^{\tau_2 - x_i^T\beta}}{1 + e^{\tau_2 - x_i^T\beta}} \quad .$$

Elements of β as well as the limit points τ_1 and τ_2 are estimated by maximum likelihood.

The examples of two ordered logit models from each group (TLM 95 and TLM 96) are presented in Tables 4 and 5.

TABLE 4
Estimation Results for the TLM 95 Model

Variable	Parameter Estimate	Standard Error	t-statistic	Probability
Quick Ratio	1.2654	0.4804	2.6340	0.0084
ROA	1.4402	1.6272	0.8851	0.3761
Dept Ratio	-2.6851	1.4980	-1.7925	0.0731
		Limit Points		
τ_1	-0.6002	0.9092	-0.6602	0.5091
τ_2	1.5527	0.9198	1.6880	0.0914
Akaike Criterion	1.8490	Hannan-Quinn Criterion		1.9124
Schwartz Criterion	2.0084	McFadden R-squared		0.2220
Prediction Accuracy	Actual Number	Predicted	Sum of All	
y_i	of Companies	Number	Probabilities	Error
1	23	25	23.4263	-0.4263
2	25	25	24.5721	0.4279
3	23	21	23.0015	-0.0015

TABLE 5
Estimation Results for the TLM 96 Model

Variable	Parameter Estimate	Standard Error	t-statistic	Probability
Cash Ratio	1.5917	0.7087	2.2459	0.0247
Net Profit Margin	4.0927	2.0412	2.0051	0.0450
Liabilities Ratio	0.1747	0.0606	2.8848	0.0039
		Limit Points		
τ_1	0.6926	0.4229	1.6376	0.1015
τ_2	2.9942	0.5825	5.1402	0.0000
Akaike Criterion	1.7635	Hannan-Quinn Criterion		1.8269
Schwartz Criterion	1.9228	McFadden R-squared		0.2610
Prediction Accuracy	Actual Number	Predicted	Sum of All	
y_i	of Companies	Number	Probabilities	Error
1	23	20	23.3184	-0.3184
2	25	32	25.3139	-0.3139
3	23	19	22.3677	0.6323

The binomial and trinomial models explaining financial distress of Polish companies by means of their previous financial data give an insight into several key determining factors. As in other economies, financial distress of companies in Poland is determined mainly by the degree of liquidity, profitability, and by the size of debt. The best predictors of financial distress of Polish companies in the second half of the 1990's were the loss of liquidity (liquidity ratio), diminishing profitability (return on assets), increasing debt (debt ratio), and decreasing turnover of liabilities.

The models containing the reasonable collection of 2-3 financial ratios are able to predict the state of the company's financial distress in Poland after 1 or 2 years. The precision of such forecast lies in the range of 70-80 percent. Selection of variables according to some universal rules, resulted in obtaining a good number of prediction models with acceptable statistical and economic properties.

It is worth it to note that models with predictors from 1995 (two-year lag) perform worse than models with predictors from 1996 (one-year lag). The average prediction accuracy for BLM and TLM models is as follows: 84.60 percent for the 95-binomial model and 90.70 percent for the 96-binomial model; 86.85 percent for the 95-trinomial model and 87.33 percent for 96-trinomial model. The difference in forecast precision between 1995 and 1996 is much higher for the binomial models than for the trinomial ones.

Extensions

The attempt of applying logit models to prediction of financial distress gives satisfactory and promising results, despite the small sample size and the limitation in the data only to financial variables. One major flaw in this research lies in the soft, imprecise way to assess the last (1997) financial standing of a company. Of course, much obvious classification of companies is possible in the research on bankruptcy: bankrupt vs. non-bankrupt.

Extensions may include the examination of corporate governance variables and their influence on financial distress in Poland. The preliminary attempt in this regard can be found in Gruszczyński [2003].

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