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Business Demography in Poland: Microeconomic and Macroeconomic Determinants of Firm Survival

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Abstract

The paper presents a model assigning a bankruptcy probability to a company, developed on the basis of individual data from balance sheets and income statements of Polish companies, collected by Central Statistical Office of Poland in the 2001 – 2010 period. Determinants for warning signals for bankruptcies were examined together with the possibilities of early identification of such signals. The research was based on a logistic regression performed on categorized variables transformed using a weight of evidence approach. Scoring methods were used to create an indicator for grading the companies in the case of bankruptcies. In the forecasting model of a possible bankruptcy in a year's horizon the highest weight was assigned to the indicator for the ability to cover financial costs which explained the company's ability to meet the interest payments and capital costs. Indebtedness, share of cash reserves in assets and sales' revenues were considered in forecasting bankruptcies information regarding liquidity. Taking into account the direction of sales, the specialized exporters were least probable to go bankrupt. In the more generalized model which accounts for the macroeconomic situation the most important was the indicator for the ability to pay off debt. In the model forecasting bankruptcies three-years in advance - the early warning model - no dominant indicator was found. Weights of 20% were assigned to the indicators of liquidity, current assets turnover and the return on sales.

Keywords:

firm survival, micro-data, Polish companies, scoring methods

JEL:

L11, L25, G33, M13

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Introduction and aim of the research

The continuing importance of firm survivorship is indicated by data from a survey in which 40% of small and medium companies stated that surviving on the market was the highest company priority, while both increase of sales and profits were secondary goals. In the case of big companies, survival was the most important goal for 19% of subjects. The main goal of companies within this group was to increase their market share¹. The number of bankruptcies filed in the Polish industry has been increasing since 2008. Only in the first half of 2012 almost 400 companies announced bankruptcies. The main causes for bankruptcies are considered to be the increasing number of overdue payments, decreasing demand, limited investment opportunities and difficulties in obtaining new credits. In practice, negative equity and losses exceeding 50% of capital are considered to be early warning signs of a bankruptcy. Industries characterized by persistent problems in meeting due payments, such as construction, food, transport and cosmetics², are especially endangered. The competition that can be observed in these industries can lead companies to participate in calls for bids with unprofitable offers, which can in turn cause bottlenecks in payment streams. The increasing latency can cause a bankruptcy in spite of new orders and export opportunities. Nehrebecka (2011) indicates that Belgian companies on average live twice as long as Polish companies. The most 'short lived' ones usually belong to the transport industry, followed by those from the construction industry, other services and sales. Companies working in agriculture, hunting and forestry and manufacturing are expected to survive the longest.

Formation, development and bankruptcy of companies have an impact on employment, which makes such phenomena an especially important object of study. The issue is also important in the context of transmitting the effect of financial policy to companies. According to the financial accelerator theorem, there exists a mechanism which strengthens monetary shocks through company balances (Bernanke, Gertler, Gilchrist 1996). In the times of economical downturn, costs of credit increase and investment opportunities are limited which in turn increases the probability of a bankruptcy. Even though, as argued by Mączyńska and Zawadzki (2006), bankruptcies are normal phenomena in a market economy which ensure the necessary economical selection, they do not always contribute towards the long term increase

¹ Polish Confederation of Private Employers *Lewiatan* for the project 'Monitoring the state of Small and Medium Companies in the years 2010-2012'

² Polish Agency for Enterprise Development (2012)

of economical effectiveness. Effects of progressive globalization bring about the danger of chain bankruptcy.

On the institutional side, the European Commission identified the need to support companies. In Poland there are financial instruments that aim to provide companies, primarily small and medium ones, with more accessible credit (*Competiveness and Innovation Program* in the years 2007 - 2013). Polish bankruptcy regulations were created with the aim of liquidating only companies which are ineffective and beyond repair, and enabling restructuring for companies which are only temporarily insolvent.³ It is thus important to identify a troubled company as soon as possible and undertake the necessary actions. Eurostat regularly publishes a review of basic indicators connected with firm creation and survival and their effects on employment. Also, central banks (for example in Belgium) and statistical offices of several countries⁴ produce analyses in the area of business demography.

In the analysis of firm survival it is important to distinguish insolvent (bankrupt)⁵ companies from those leaving the market. The second is a broader phenomenon, which can be brought about by a voluntary decision to stop operating or liquidate, and serves as a basis for the traditional market and competition theory (as studied in the field of industrial organization). The monetary policy transmission, mentioned above, is normally used in modelling financial constraints in the case of continued operations. Therefore, better analysis results are obtained when operating solely on data regarding bankruptcies⁶. The existing data do not always provide information on the motives for leaving the market and, even more problematically, often lack the information on the causes for leaving out a given company from the observed sample (for example: not being required to provide reports for the year to the statistical office). Therefore, there are relatively few empirical papers modelling the firm survival which distinguish among the causes for leaving the market.

Forecasting insolvencies is one of the key issues for industrial subjects on the market. Investing cash and cash equivalents into a company is associated with the risk of not being profitable. Consulting companies which analyse the company's financial state offer help in this regard. The demand for services of this kind is constantly growing which emphasizes the need for statistical and econometric analysis of the company's financial reports.

³ Polish law for insolvency and recovery (2003)

⁴ Great Britain, USA, Japan, New Zealand, Australia

⁵ In the following article the terms *bankruptcy* and *insolvency* are interchangeable. Mączyńska (2009) argues that bankruptcy is an economic term, whereas insolvency is a legal term.

⁶ A conclusion reached from the works of Ilmakunnas (1996), Mata, Antunes and Portugal (2010).

Financial indicators are significant determinants of the bankruptcy probability. A company's deteriorating state is reflected in its financial results, which in turn decrease its profitability, effectiveness or operating proficiency. This process can quickly create problems in maintaining business operations and financial balance in the macroeconomic environment and in turn lead to insolvency. That is why it is very important to construct early warning systems based on a reliable econometric analysis.

The aim of the research is to construct an indicator that would enable assigning a company a probability of entering bankruptcy. Based on the literature in this area an econometric model was constructed. In addition, it was investigated when the symptoms of a possible bankruptcy for a Polish company could be observed and if it was possible to indicate a group endangered with bankruptcy three years in advance. Tools enabling early identification of endangered companies provide a chance to influence the efficiency of a company. The analysis was performed with the use of a logistic regression on categorized variables transformed using the weight of evidence approach. Scoring methods have been used to create an indicator for grading the companies in the case of bankruptcies. Panel data from GUS collected in 2001-2010 were used for the estimation. Insolvency is a subject of theoretical consideration as well as empirical research of individual data provided in company reports. These, however, do not provide unambiguous conclusions. A model for company insolvency should take into account the environment of the subject. The known models for potential insolvency (Altman (1968, on USA), Keasey and McGuinness (1990, on UK), Charitou (2004, on Greece), Sheppard (1994, on Canada)) were prepared for different macroeconomic conditions and their use in Polish environment would be ineffective. The following analysis expands the existing knowledge on processes associated with bankruptcies of Polish companies. This research has an original concept and high added value as it was performed using representative data for over 5000 unlisted companies. The first part of the paper presents a review of literature on modelling company insolvency. Next, the methodology used for estimating the model is described. Then the detailed information on the database is presented, together with the characteristics of the variables used in the estimation, estimation results and conclusions.

I. Literature Review

Creation of new companies that survive long enough favours innovation, raises overall productivity through better resource allocation, and facilitates the implementation of new technologies in the economy (Giovannetti, 2007). Even though company bankruptcies provide a necessary economical selection they still involve a danger of chain insolvency and do not favour the growth of economic effectiveness (Mączyńska and Zawadzki, 2006).

A company's propensity for growth used to be analysed as independent of its size (*Law of Proportional Effects*, Gibrat's model (1931)). In the 90s several papers questioned the validity of Gibrat's law (for example Geroski (1995), Sutton (1997) and (1998)) and revealing a strong negative correlation between the company's size and its bankruptcy probability. Small companies experience more difficulties when trying to stay in the market (Auderetsch and Mahmood (1995), Evans (1987), Geroski, Mata and Portugal (2007)), as they are less effective and more prone to the risk of rising costs. Company size can be a result of limited accessibility of capital (Fazzari, Hubbard and Petersen, 1988), and as a result small companies are more in danger of losing liquidity. Bigger companies are better equipped with tangible assets and human capital and more often have a more diversified production, and are therefore less sensitive to fluctuations in demand. Competitive advantage of small companies can only be observed in the case of small, specialized companies aimed at niche markets (Porter, 1979). However, when considering the company's size at the moment of its foundation other conclusions are reached. Starting a big company requires covering larger costs associated with entering the market (sunk costs) which cannot be easily decreased and affect the long-term profitability of the company. The negative influence of the starting size on the probability of survival has been statistically significant in the model estimated by Geroski, Mata and Portugal (2007). Jovanovic (1982) points out that entrepreneurs starting a new company are unable to assess the opportunities for potential development and survival chances, and thus learn and correct their assumptions only later in time. Decreasing hazard functions were indicated by Mata and Portugal (1994) and Audretsch and Mahmood (1995). On the other hand, more recent literature on this topic estimates the influence of hazard to be of a non-monotonic form in the shape of an inverted U (Agarwal, Sarkar and Echambadi (2002), Cefis and Marsili (2005)). This means that the probability of company termination rises in the first years of the company's existence and falls afterwards. Harhoff, Stahl and Woywode (1998)

underline the dependence between the way a company leaves the market and its legal form. Limited liability companies are characterized by a higher than average liquidation rate.

It is possible to develop a policy supporting entrepreneurship which would ensure an appropriate environment for newly started companies by adjusting the help to different company cohorts according to their specific characteristics. Companies with the highest chances for continued existence are those that start during high GDP growth times in high concentration and low exit cost industries (Geroski, Mata and Portugal (2007)). Based on the research presented in Allen and Gale (2000), Bond (2003), Rajan and Zingales (2003) and Goerg and Spalara (2009) it can be said that the specification of the country's financial system influences a company's financial stability, especially during changes in the economic situation. Whether the company is an exporter is also an important factor for determining the company's probability of survival (Greenaway 2008). Export signals a company in good condition, with enough liquidity to sustain sunk costs and enter foreign markets (Chaney 2005). However, Giovannetti, Ricchuti and Veluchhi (2007) showed that operating on foreign markets increased the actual bankruptcy risk- being subject to international competition makes survival harder to achieve. Following expectations, companies that are big, innovative and technologically advanced are more likely to succeed internationally.

Financial indicators can signal a deteriorating situation of the company and enable bankruptcy forecasting. According to Mata, Antunes and Portugal (2010), the higher the share of short term debt in the credit structure, the higher the bankruptcy risk. Görgi and Spaliara (2009) showed that financial indicators were associated with the bankruptcy risk but the effect differed across the countries compared, England and France. An increase in profitability decreased bankruptcy risk in both, but the effect was stronger in England. High leverage companies demonstrated higher bankruptcy risk, but this effect was not statistically significant. The higher the coverage ratio (based on balance sheet data), the lower was the bankruptcy risk in England. Companies able to pay off their liabilities with their internal cash flows were thus more likely to survive. This indicator is significant in a market oriented financial system. A nonlinear influence of indebtedness on bankruptcy risk is described by Lopez-Garica and Puente (2006), which found that raising debt actually increased survival probability of a company with a relative small debt ratio whereas the opposite held for companies with a high debt ratio.

In Poland the topic of predicting company bankruptcies became a subject of interest for researchers in the second half of the 1990s. This was associated with the market transition of its economy (Mączyńska and Zawadzki (2006), Mączyńska (2009), Ptak- Chmielewska

(2010), Mączyńska (2011)). It was shown that early warning models were especially useful during times of socio-economic changes. Due to progressive integration with the European Union and the global transition to knowledge economy, the increasing competition became a constant challenge for companies. Utilizing historic event analysis techniques, Markowicz and Stolarz (2006) provided tables of company survival for companies created and liquidated in Poland during the 1990s. Ossowski (2004)⁷ presented an econometrical analysis of the determinants of firm survival, however, only on a small sample of companies from the Gdańsk voivodeship in the years 1992-1996. The Institute of Economic Sciences of the Polish Academy of Science developed 7 models for forecasting bankruptcies under the direction of Mączyńska, using the data on 80 companies listed on the Warsaw Stock Exchange. In the model with the best explanatory power the following explanatory variables were covered: operating profit/ asset value, equity value/asset value, (net financial profit + amortization)/total liabilities, working assets/ short term liabilities (Mączyńska, 2004). Poznańska (2005) and Jackson and Klich created an indicator of correlation between the number of companies which survived and developed and certain regional economic indicators for voivodeships (for example the unemployment rate, number of bank branches, quality of infrastructure, population density, level of education). The results showed that characteristics specific to individual company cohorts such as age, size and sales per employee were more significant than local variables.

Polish literature on company bankruptcies also discussed the issue of a company's financial structure. Newly created small and medium companies have a limited access to financing sources and have to rely on equity or possibly count on the help from specialized development agencies or (not always accessible) public funds (Bławat, 2004). Bank financing is highly limited (Marzec and Pawłoska, 2011). The capital market is financing companies only in their expansion phase. Engaging external capital requires proving the credibility of the newly founded enterprise or accepting a higher risk rate by the investors (for example venture capital funds). Trade credit is a significant source for financing current operations and often substitutes for bank credit, especially during economic downturn and restricted monetary policy (Pawłoska and Marzec 2011).

Wędzki (2008) presented a literature review on company bankruptcy forecasting based on financial indicators which were in turn based upon cash flow dynamics, concluding that the use of data from cash flow statements provided a better basis for forecasting bankruptcies

⁷ [in:] Bławat (2004), p. 105

when compared to models based on accrual indexes. Autonowicz (2010) presented a review of exogenous variables used in Polish company bankruptcy forecasting models, finding that indicators for financial liquidity and financial structure of the company were used to estimate the probability of a company becoming bankrupt within a year. Another type of variables often used in these analyses were derivatives of the asset productivity (such as: revenues/assets, net operating result/assets). A major issue in research on companies leaving the market is the exclusive focus on companies that submit to a formal bankruptcy procedure. This, however, represents only a small share of the whole population of companies ceasing operations and leaving the market which do not disappear from the REGON list.⁸ Nehrebecka (2011) proposes an analysis of the changes in the structure of Polish companies with the use of a method based on the Markov chain which would enable forecasts of the composition of the company sector, as well as the average time a company has left until going bankrupt. The findings indicate that across all sectors the longest lifespan is associated with non-specialized exporters. The larger the company, the longer is the average age and the average time left until a market exit. This implies that it is important to account for the differences between the subjects studied (active or inactive companies) and thus the changing definitions of the dependent variable.

II. Method, Data and Variables

In order to construct an indicator which would enable assessing the probability of a company to go bankrupt, a logistic regression was used. Due to a high number of financial indicators of a company's condition (explanatory variables) in the initial analysis the predicting force of each was determined (Gini coefficient⁹, Information Value Indicator) followed by clustering in order to limit the size of the analysis. Thanks to this variable selection procedure it was possible to avoid the collinearity problem, which was assured by

⁸ Autonowicz (2010) reports that in the years 2004-2008 only 0.30% of subjects unregistered from REGON and 0.02% of registered subjects were insolvent, page 213.

⁹ The *Gini* coefficient is used for a one dimensional assessment of the discriminating force of a variable. For this purpose a model with only one explanatory variable is estimated and the coefficient measures its predicting force. $GINI = 1 - \sum_{i=1}^n \left((c_i^{bankrupts} - c_{i-1}^{bankrupts}) (c_i^{non\ bankrupts} - c_{i-1}^{non\ bankrupts}) \right)$, where $c_i^{bankrupts}$ is the cumulative share of bankruptcies in the category i of the chosen trait. The result is equivalent to the Somer's D statistic.

calculating the appropriate *Variance Inflation Factor*¹⁰ statistics. The model was estimated on categorized variables transformed using the weight of evidence (WoE) approach. The WoE transformation is often used for the creation of scoring models using logistic regression, because such a transformation allows maintaining linear dependence in regard to the logistic function. In addition, WoE conveys information on the relative risk associated with each category of the particular variable, with a large negative value indicating a higher risk of bankruptcy.

$$WoE_i = \ln \left(\frac{p_i^{non\ bankrupts}}{p_i^{bankrupts}} \right) \quad (1)$$

where:

- i - category
- $p_i^{non\ bankrupts}$ - the percentage of not bankrupt companies that belong to category i
- $p_i^{bankrupts}$ - the percentage of bankrupt companies that belong to category i .

The categorisation was based on the division with the highest information value (IV), which measures the statistical Kullback-Leibler distance (H) between the bankrupts and non-bankrupts. The IV statistic, based on the WOE, allows measuring the predicting force of a particular characteristic. The IV value depends on the number of categories and division points. The variables for which the IV does not exceed 0.1 are assumed to be weak in their relative predicting force, while values exceeding 0.3 bear evidence of a strong discriminating force (Anderson, 1999).

$$IV = H(q^{non\ bankrupts} || q^{bankrupts}) + H(q^{bankrupts} || q^{non\ bankrupts}) \\ = \sum_i (p_i^{non\ bankrupts} - p_i^{bankrupts}) WoE_i \quad (2)$$

where:

- q - density function.

The final model was created following the top-down approach. Based on the estimated parameters, weights for particular explanatory variables were determined. As a result, a set of

¹⁰ The VIF statistic is defined based on the determination coefficient for a regression of a dependent variable X_j in respect to other explanatory variables R_j^2 $\left(VIF = \frac{1}{1-R_j^2} \right)$.

financial indicators allowing to grade companies was obtained and bankruptcy probabilities were assigned to companies.

The empirical analysis was based on the individual data collected from balance sheets and profit and loss accounts of Polish companies collected from *GUS* (Central Statistical Office of Poland) reports from the years 2001 to 2010. The models were estimated on databases which included all companies that went bankrupt and randomly chosen healthy companies. Companies that declared bankruptcies made up for 20% of the created samples. This approach is common for scoring methods where 'bad' subject constitute only a small share of the whole population and it has the purpose of improving the statistical characteristics of the applied tools. Before estimating the model it was tested whether the constructed sample is representative following the results of the non-parametric Wilcoxon-Mann-Whitney test¹¹, Kolmogorow-Smirnow test¹² and the non-parametric t-Student test¹³ for equality of averages for the continuous variables and the χ^2 ¹⁴ Pearson test and the Population Stability Index (*PSI*) for the discrete variables. The *PSI* coefficient is applied in order to investigate the differences in distribution of two categorized variables. The higher the value of the coefficient, the greater the statistical distance between the distributions.

Active subjects were analysed following the *GUS* definition. All of the tested companies were in one of the four legal statuses determined by their legal and economic activity: active operating subject, active formed subject, active liquidated subject, and active insolvent subject. Forecasting bankruptcies concerns only companies that were bankrupt as of December 31st, but still operated and received revenues during the reporting period. The tested companies were characterized by negative equity and losses exceeding 50% of the core capital.

In Table 1 the structure of Polish companies is shown in regard to their legal and economic activity. Since 2002 it was possible to observe a decreasing trend of bankruptcies, whereas since 2008 it has been possible to notice an increase in the number of companies

¹¹ The Wilcoxon-Mann-Whitney statistic: $U = n_1 \cdot n_2 + \frac{n_1 \cdot (n_1 + 1)}{2} - R_1$, where: n_k – size of sample k , R_1 – rank sum of sample 1.

¹² The Kolmogorow-Smirnow statistic: $D = \max_j D = \max_i |F_1(x_j) - F_2(x_j)|$, where: $F_k(x_j)$ cumulative distribution function of variable x_j in sample k .

¹³ The t-Student test statistic: $t = \frac{\bar{x} - \mu}{S} \sqrt{n}$, where: $\bar{x}$ sample average, μ population average, S standard deviation in the sample, n number of observations in the sample.

¹⁴ The Pearson χ^2 test statistic: $\chi^2 = \sum_{i=1}^m \frac{(O_i - E_i)^2}{E_i}$, where: O_i – the frequency of category i in the 1st sample, E_i – the frequency of category i in the 2nd sample.

going bankrupt. Due to the increasing risk of insolvency resulting from the number and value of overdue payments no improvement is expected in the short term.

Table 1: NUMBER OF COMPANIES BY LEGAL AND ECONOMIC STATUS

Year	Active operating subjects	Active formed subjects	Active liquidated subjects	Active insolvent subjects
2001	47600	31	505	262
2002	43594	16	230	224
2003	45248	20	219	255
2004	44152	14	149	226
2005	46098	15	125	158
2006	46813	8	129	98
2007	47960	7	116	82
2008	52840	46	161	98
2009	53517	29	169	132
2010	52902	41	151	120

Source: own calculations based on GUS data.

Based on the literature, the potential bankruptcy predictors were chosen with the focus on financial indicators. Signals for deteriorating financial condition of the company are: negative dynamics for revenue, assets and equity, decreasing profits, negative equity, increasing indebtedness, problems with financial liquidity, deteriorating operating efficiency and decreasing investment in tangible assets (Table 2). Explanatory variables that characterize the company's financial state were constructed, such as: turnover dynamics, asset dynamics, equity dynamics, profitability, indebtedness, liquidity and operating efficiency. The analysis included not only the current values of the indicators but also their statistical properties (for example the median) based on different time frames (for example a 3 years average).

Table 2: LIST OF VARIABLES AND THEIR DEFINITIONS

Indicator	Definition of the indicator
Return on assets – ROA	Net profit / Total assets
Return on sales – ROS	Net profit / Sales revenues
Return on equity - ROE	Net profit / Equity
Gross profit margin	(Revenues on sales-Cost of sales) / Sales revenues
Margin on operating profit	Operating result/ Net sales
Current asset turnover	Sales revenues / Fixed assets
Fixed asset turnover	Sales revenues / Property, plant and equipment
Asset turnover	Sales revenues / Total assets
Operating profit	Operating revenues – Operating costs
EBITDA	Operating revenues – Operating costs + Other operating revenues
Book value	Total assets - (Short term liabilities + Long term liabilities)
Asset structure indicator	(Property, plant and equipment – Short term liabilities) / Current assets

Indicator	Definition of the indicator
Liquidity indicator	Current assets / Short term liabilities
Current liquidity indicator	Cash / Short term liabilities
Short liquidity indicator	(Current assets - Inventory) / Short term liabilities
Financial leverage indicator	Total assets / Equity
Short term debt indicator	Short term liabilities / Total assets
Debt to equity indicator	(Short term liabilities + Long term liabilities) / Equity
Debt to assets indicator	(Short term liabilities + Long term liabilities) / Total assets
Short term debt in relation to equity	Long term liabilities / (Long term liabilities + Common stock + Preferred stock)
Dynamics of revenues indicator	Sales revenues in the current year/ Sales revenues in the previous year
Dynamics of net results indicator	Current year's net result / Previous year's net result
Dynamics of operating profit	Current year's operating profit / Previous year's operating profit
Debt handling (being able to pay off) indicator	(Net result + Amortization) / (Short term liabilities + Long term liabilities)
Financial costs covering indicator	Net operating profit / Financial costs

Source: own work.

An additional explanatory variable is industry. Based on information obtained from PKD2007 (*Polish Classification of Activity, NACE, ver. 2.0*), five categories were defined: industry, trade, transport, construction and other services. A division based on the direction of sales was also introduced, based on Marczewski (2007) and identifying the economic subjects as: non-exporting, non-specialized exporter (a subject that exports independently of export magnitude) or specialized exporter (a subject for which 50% of revenues are obtained through export).¹⁵ A variable describing the ownership structure (whether foreign capital has a majority share in equity) was also included. The legitimacy for including the aforementioned variables is confirmed by the data provided in Table 3. The highest number of bankrupt companies is found in industry. A relatively high share of active bankruptcies is also a concern in the construction industry. Having taken into account the direction of sales it is possible to notice that specialized exporters perform the best.

¹⁵ The share in exports was calculated as the ratio of revenues from exported products, goods and materials compared to revenues from selling products, goods and materials.

Table 3: NUMBER OF COMPANIES BY LEGAL AND ECONOMIC STATUS AND INDUSTRY SECTORS IN 2010

	Active operating subjects	Active formed subjects	Active liquidated subjects	Active insolvent subjects
Depending on the activity ¹⁶				
Industry	16368	3	70	73
Construction	5483	0	17	14
Trade	15685	3	28	16
Transport	2829	0	3	7
Other services	10225	2	30	8
Depending on exporting activity				
Non exporting	37086	40	115	77
Non specialized exporter	11388	0	21	35
Specialized exporter	4434	1	15	8
Depending on the ownership structure				
National	46319	40	141	108
Foreign	6583	1	10	12

Source: own calculation based on GUS data.

III. Results

The research was performed on three samples. The first included companies observed in 2009 (Model I). In order to include the macroeconomic variables the analysis was repeated on a sample constructed in an analogous way, but including companies observed in the years 2003-2009 (Model II). In Model I and Model II the bankruptcy probability was predicted for a one year horizon. Also, for companies observed in the years 2003-2007 a model for early warning symptoms was estimated in order to identify bankruptcy symptoms in advance (Model III). Having identified problems early on it is possible to engage in a crisis mechanism which could prevent a possible bankruptcy. It seems that companies do not perform well in identifying dangers and creating long term strategic scenarios.

¹⁶ The following sectors were removed from the *Polish Classification of Activities 2007* sample: section A (Agriculture, forestry and fishing), K (Financial and insurance activities) and O (Public administration and defense; compulsory social security).

Table 4: EVALUATION OF COMPANIES BASED ON MODEL I^{a)}

Variables	Weight in the total grade in %	Value	Partial grade
Share of cash in total assets (average of 3 years)	12	- ∞ - 0,01016	0
		0,01016 - 0,0310	41
		0,0310 - 0,1678	70
		0,1678 - + ∞	133
Direction of sales: (0 – non exporting, 1 - exporting, 2 – specialized exporter)	13	0	36
		1	0
		2	166
Liquidity indicator	15	- ∞ - 0,8246	0
		0,8246 - 1,8707	86
		1,8707 - + ∞	121
Financial costs covering indicator	37	- ∞ - -1,2581	0
		-1,2581 - 2,4129	120
		2,4129 - + ∞	327
Debt to assets indicator (average of 6 years)	13	- ∞ - 0,35203	118
		0,35203 - 0,51728	77
		0,51728 - 0,80442	36
		0,80442 - + ∞	0
Sales revenues	12	- ∞ - 1759	0
		1759 - 29973	135
		29973 - + ∞	84

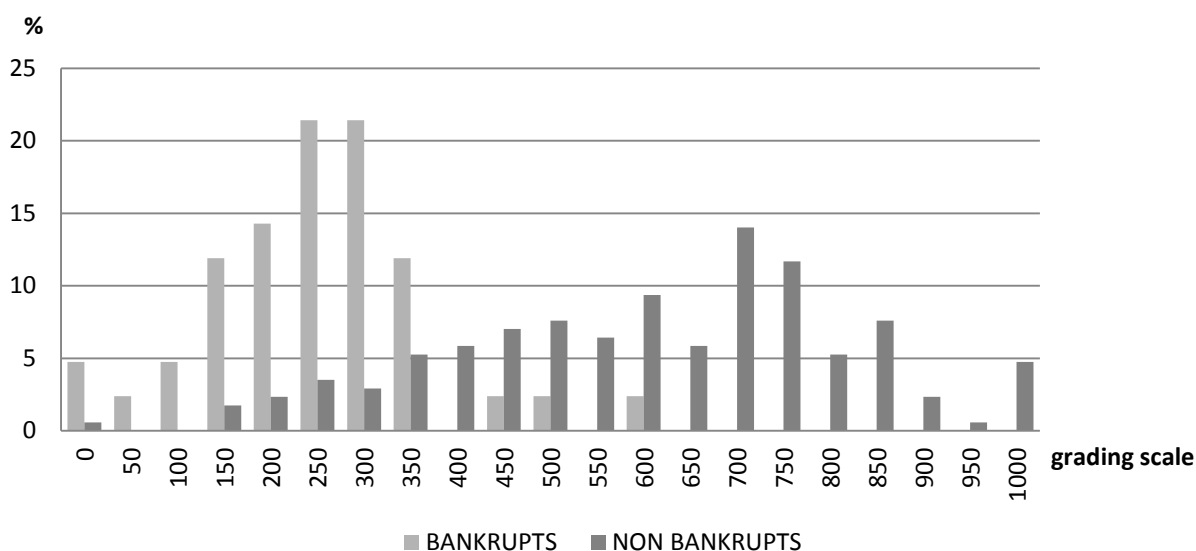
Source: own calculation based on GUS data.

a) Evaluating companies examined in 2009.

In the final version of Model I variables presented in Table 4 were included. The greatest weight was assigned to the indicator of ability to cover financial costs (37%). This indicator was also mentioned by Mączyńska and Zawadzki (2006) as significant for forecasting firm bankruptcy, because it reflects the degree in which operating profits can decrease without preventing the company from covering its financial costs. A higher value of this indicator translates to higher financial security of a company (Görgi and Spaliara, 2009). In the case of rating the company's creditworthiness, interest repayment is considered to be risky if the operating profit covers less than twice the credit interests. The best grade was assigned to companies for which the covering ratio exceeded 2.41 and the highest risk of bankruptcy was assigned to companies with indicators below 1.26. The indicator for current liquidity (weight of 15%) is the second most important characteristic that can signal a potential bankruptcy. It is commonly included in models containing at least one indicator of financial liquidity (e.g. Görg, Spaliara, 2009). Companies for which this indicator does not exceed 0.82 were considered to be the most endangered ones. The share of cash in total assets, direction of sales and the ratio of debt to assets and sales' revenues are also good bankruptcy predictors. In line with the results of Chaney (2005) specialized exporters are considered to be performing best.

The distribution of grades across companies which have or have not gone bankrupt shows that the selected indicators (explanatory variables) allow identifying a potential bankruptcy to a significant degree (Graph 1). In order to identify the danger of potential bankruptcy for a given company, an overall grade is being assigned based on Table 4, with partial grades assigned for specific intervals of the indicators of the financial state of a company. The overall grade is the sum of the partial grades, the analysis of which can be based on Graph 1. The information collected in the database indicated that no company that obtained more than 600 points went bankrupt within a year. However, for companies with less than 200 points bankruptcy was almost certain. Bankruptcy was predominant among companies from the 200-300 points interval.

Figure 1: DISTRIBUTION OF COMPANY GRADES BASED ON THE MODEL FOR “BANKRUPTS” AND “NON BANKRUPTS” (MODEL I)



Source: own calculation based on GUS data.

The research was repeated on a sample constructed for companies observed in the years 2003-2009, which allowed accounting for macroeconomic variables (change in GDP, year average WIBOR 3M, share of dangerous credit, concentration index) and the year variable which represented the influence of time (global shocks). In Model II (Table 5) the greatest weight was assigned to the indicator of ability to meet current liabilities (36%). It links the information on indebtedness with both profitability (here defined as the company cash flow) and amortisation. The indicator for debt covering is relatively rarely observed in literature on the subject (Antonowicz, 2010). However, many of its statistical properties make it useful in this regard. The highest bankruptcy probability was assigned to companies for

which the indicator of being able to pay off debt was not larger than 0.0003, with lowest probability of bankruptcy assigned to companies for which the indicator was bigger than 0.34. Grades for different years describe the general macroeconomic climate to a great degree. Increased investment in the years 2004-2007 can be linked to Poland's accession to the EU and the simultaneous easing of its monetary and fiscal policy (CIT dropped to 19%). Better grades were obtained for the period after the accession and before the financial crisis. In particular, the years 2005 and 2007 were significantly beneficial for the survival of companies. This effect could have been magnified by decreasing corporate credit rates since 2005. The relatively low grade for the year 2008 presents an adequate reaction to the global financial crisis.

Table 5: EVALUATIONS OF COMPANIES BASED ON MODEL II^{a)}

Variables	Weight in the total grade in %	Value	Partial grade
Cash in total assets (median of 3 years)	4	- ∞ - 0,00943	0
		0,00943 - 0,04089	8
		0,04089 - 0,09579	18
		0,09579 - 0,21888	27
		0,21888 - $+\infty$	41
Total indebtedness indicator (maximum of 3 years)	17	- ∞ - 0,22929	195
		0,22929 - 0,49967	160
		0,49967 - 0,83642	101
		0,83642 - 1,40856	53
		1,40856 - $+\infty$	0
Asset turnover indicator (average of 6 years)	15	- ∞ - 2,05201	0
		2,05201 - 3,09408	37
		3,09408 - 5,6962	87
		5,6962 - $+\infty$	156
Liquidity indicator	9	- ∞ - 0,22426	0
		0,22426 - 0,62006	23
		0,62006 - 1,13247	49
		1,13247 - 1,579	78
		1,579 - $+\infty$	99
Year	3	2003	0
		2004	14
		2005	30
		2006	23
		2007	29
		2008	16
		2009	29
Sales revenues (average in 8 years)	8	- ∞ - 10384	41
		10384 - 13329	86
		13329 - $+\infty$	0
Ownership structure (0 – majority of equity is owned by national subjects; 1 – majority of equity is owned by foreign subjects)	8	0	0
		1	81

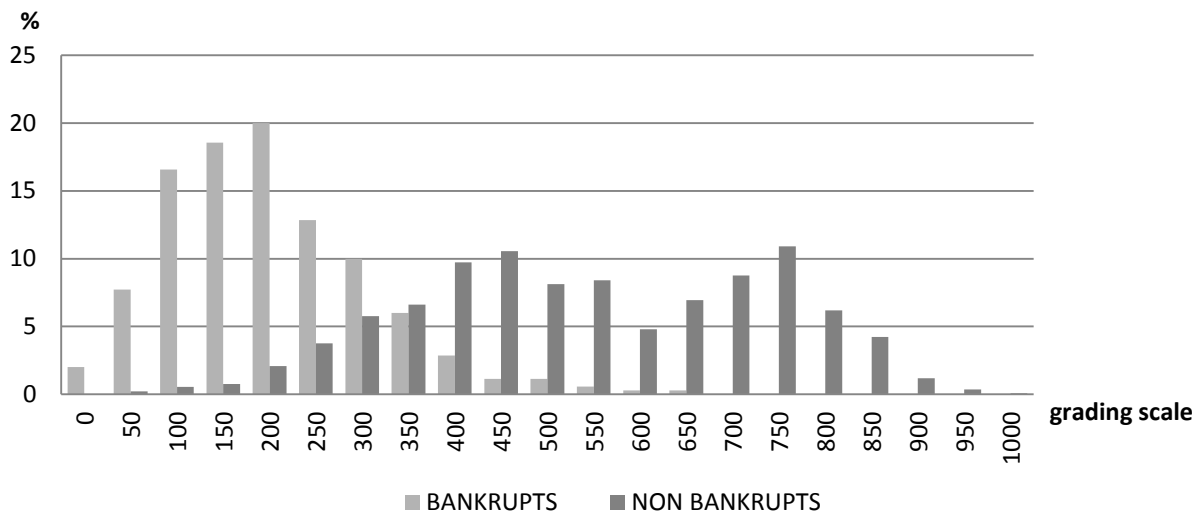
Ability to pay-off debt	36	$-\infty$	-	0,00029	0
		0,00029	-	0,07108	64
		0,07108	-	0,15789	118
		0,15789	-	0,33873	170
		0,33873	-	$+\infty$	312

Source: own calculation based on GUS data.

a) Grades for companies examined in 2003-2009.

In Model II it was also possible to determine insolvency risks to a large extent (Graph 2). The distribution of grades for bankrupt and non bankrupt companies does not overlap significantly.

Figure 2: DISTRIBUTION OF COMPANY GRADES BASED ON THE MODEL FOR “BANKRUPTS” AND “NON BANKRUPTS” (MODEL II)



Source: own calculation based on GUS data.

In Table 6 the results for the early warning model are presented. Following the literature, early warning was defined as the detection of bankruptcy symptoms in a three year advance period. The likelihood of a bankruptcy within a three year's horizon was forecasted on the basis of company information from the years 2003-2007. In the early warning model the weight of no variable exceeded 20%. The most endangered companies were those for which cash holding (6 year median) did not exceed 0.014, debt to asset ratio (6 year median) was lower than 0.23, current assets turnover (3 year average) was lower than 0.68, liquidity (6 year average) did not exceed 0.73, return on sales (6 year average) was below 0.07 and sales revenues were lower than 1100. When it comes to the ownership structure, companies with a large share of local capital in equity were more prone to bankruptcy. It is also possible to notice that the distribution of grades for bankrupts and non bankrupts were overlapping more in the early warning model (see Graph 3) than it in case of models I and II. This shows that 3

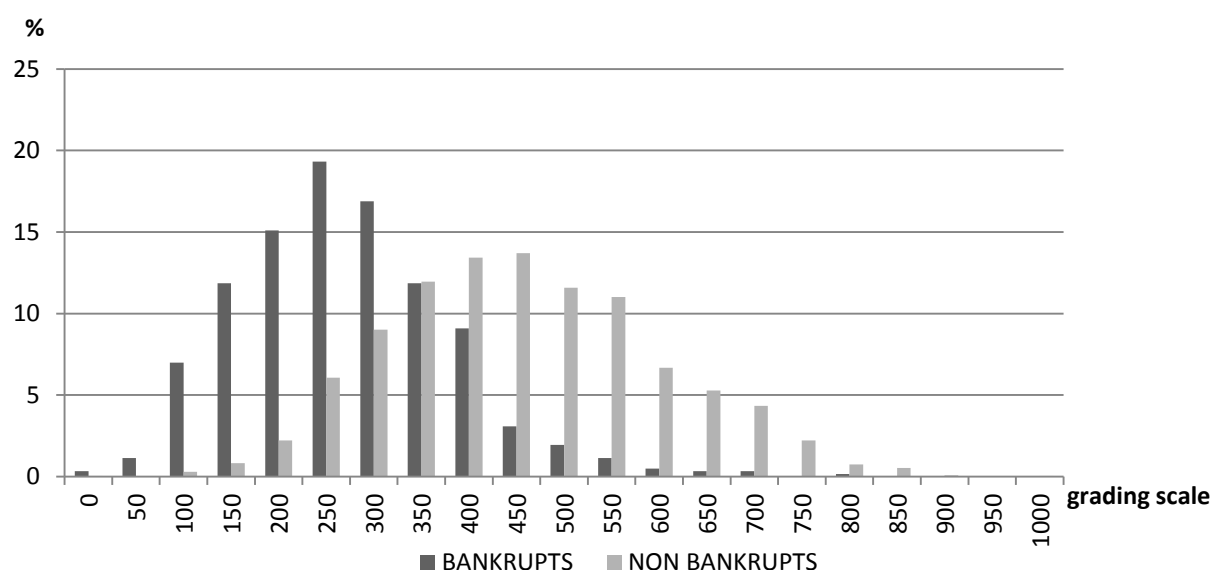
years prior to bankruptcy not all companies experience the warning symptoms and for a large number of companies with the symptoms it is not too late to overcome the difficulties.

**Table 6: EVALUATIONS OF COMPANIES BASED ON MODEL III
(EARLY WARNING MODEL)**

Variables	Weight in the total grade in %	Value	Partial grade
Cash holding indicator (median of 6 years)	11	-INF - 0,0137	0
		0,0137 - 0,03238	18
		0,03238 - 0,06737	41
		0,06737 - 0,21119	63
		0,21119 - +INF	103
Debt to assets ratio (median of 6 years)	14	-INF - 0,23255	154
		0,23255 - 0,51357	85
		0,51357 - 0,84316	52
		0,84316 - 1,14131	25
		1,14131 - +INF	0
Current assets turnover (median of 3 years)	18	-INF - 0,67991	0
		0,67991 - 3,0067	64
		3,0067 - 4,91121	114
		4,91121 - 6,53562	151
		6,53562 - +INF	205
Liquidity indicator (average of 6 years)	20	-INF - 0,72528	0
		0,72528 - 1,08168	42
		1,08168 - 1,5744	67
		1,5744 - 3,97779	131
		3,97779 - +INF	207
Return on sales (average of 6 years)	18	-INF - -0,066	0
		-0,066 - -0,01057	50
		-0,01057 - 0,01282	99
		0,01282 - 0,04736	121
		0,04736 - +INF	157
Year	3	2003	0
		2004	17
		2005	28
		2006	20
		2007	24
Sales revenues	7	-INF - 1100	23
		1100 - 3739	45
		3739 - 7905	63
		7905 - 37209	44
		37209 - +INF	0
Ownership structure (0 – majority of equity is owned by national subjects; 1 – majority of equity is owned by foreign subjects)	9	0	0
		1	83

Source: own calculation based on GUS data.

Figure 3: DISTRIBUTION OF COMPANY GRADES BASED ON THE MODEL FOR “BANKRUPTS” AND “NON BANKRUPTS” (MODEL III)



Source: own calculation based on GUS data.

Conclusions

Logistic regression combined with scoring methods was used to determine grades for companies in relation to their bankruptcy propensity. In the model for forecasting a bankruptcy within a one year horizon the highest weight was obtained for one of the most basic indicators used in fundamental analysis- the indicator of covering financial costs which enables assessing a company’s ability to meet interest and credit payments. The highest grade was assigned to companies for which this indicator did not exceed 2.4. For the forecasting of bankruptcies, information regarding liquidity, indebtedness, share of cash in total assets and sales revenues was also included. Taking into account the direction of sales specialized exporters got the best grades (in line with the results of Chaney (2005) and Greenaway (2008)). Results of Puchalska (2010) on the advantage of export companies obtaining higher revenues, profitability and technological prowess were confirmed, with insolvent active subjects representing only 0.1% of the whole exporters’ sample. In the more general model that takes the macroeconomic situation into account the indicator of the ability to pay off credit turned out to be the most significant one. In the model forecasting bankruptcies in a three year’s horizon (the early warning model) no dominant influence factor was determined. Weights of 20% were assigned to liquidity, active assets turnover and return on sales. The analysis of data on three years prior to bankruptcy enabled identification of a set of companies

which were already in danger of a statistically almost certain bankruptcy as well as a set of companies for which it was not too late to undertake rescue measures.

The created variable defining the bankruptcy risk can be used in further analyses, for example a model of the investment return rate or analyses of the financial liquidity of companies.

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