DETERMINANTS OF FIRMS' BANKRUPTCY: THE CASE OF UKRAINE

by

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Abstract

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Bellovary et al. concluded that return on assets explained the most variation in firms' bankruptcy. Obviously, the decline of profitability should signal as a threat of bankruptcy. But we see a bunch of current papers that do not agree with this. For example, Lizal L. finds that for The Czech Republic it is not the case. This variable is insignificant. Janer J. finds this variable only marginally significant for France data. Having appropriate data for Ukraine, the goal of this paper is to confirm or refute findings of current papers.

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Mother and father were supporting me during the process of writing. I believe it is their merit, that I am where I am. Thank you my mother and father for your gratuitous support.

GLOSSARY

ABS	absolute value of log likelihood
AD	accumulated depreciation
AT	asset turnover
CA	current assets
CL	current liabilities
COGS	cost of goods sold
D	short- and long-term debt
Db	financial leverage
Dep	obsolescence of assets
FA	fixed assets
GP	gross profit
IC	initial price of capital
IT	inventory turnover
LQ	liquidity
Mar	gross-profit margin
MDA	multiple discriminant analysis
NI(L)	net income(loss)
OL	operating leverage
R	receivables
ROA	return on assets
ST	sales turnover
TA	total assets
TI	total inventory
TR	total revenue

Chapter 1

INTRODUCTION

Every other day we can come across the information about bankrupt firms in the newspapers' articles. Different specialists and experts usually say that these firms had poor marketing, logistic, personal or something else. And we cannot refute it because this is fait accompli.

According to the review of previous papers by Bellovary et al. (2007) return on assets was the most popular indicator, which explained major variation in bankruptcy. However, there are a number of current papers that disagree with this. Lizar L. (2002) finds this variable insignificant at all. Janer J. (2011) observes return on assets to be the only marginally significant. We test this question on Ukraine data to support or disprove findings of current authors.

We create a probabilistic model that explains bankruptcies of firms. This approach can help us in many scientific and practical ways. From the scientific point of view, it gives us a further field of research. Finding determinants of firm's bankruptcy should push us to dig deeper to explain each factor. For example, why the increase of operating leverage has lower influence on probability of going bankrupt than the increase in financial leverage or whether big firms are less influenced by comparable losses than small ones. From the practical point of view, it helps us make investment choices, evaluate required rate on borrowings, decide even whether to lend money or not and so on. While collecting investment portfolio we can predict what percentage of investments may go bankrupt. For portfolio

purposes it is really useful, because such an approach is more precise with large numbers, due to the average expected effect. Chief financial officers can employ these results to more strictly control the most important factors. Using the definition "most important factors" I mean factors that have the strongest influence on probability of going bankrupt or, at least, on perception by other parties of this entity going bankrupt. So such an analytical approach can be employed in both, scientific and practical fields. From banks' point of view, this is the answer to the question if they should add specific risk premiums while lending money to specific industries.

A precise question I pose in this research is: what are the determinants of firm's bankruptcy in Ukraine?

There were different articles on this topic, but only few of them relate to Ukraine: Nikolsko-Rzhevskyy O. (2003), Klos V. (2008) and Taran Y. (2012). While Nikolsko-Rzhevskyy O. (2003) and Taran Y. (2012) works were done on financial institutions, Klos V. (2008) work was based on non-financial institutions. I want to expand this topic in my research.

Firstly, my thesis is based on both, financial and non-financial industries, and observes data on a longer period. A longer time period allows us to extract more information from the data. Secondly, I believe that the list of variables could be beneficially expanded and some of them better specified. This would lead to defining more precise effects each variable has on bankruptcy's probability. Consistency with previous works would signal that we go in the same direction. In terms of global interest, the work is interesting, because it is intended to test this approach on the former Soviet Union republic – Ukraine. Although, papers dealt with the Ukrainian experience, my data allows to extract even more information. Ukraine is in poor economic conditions now and it has been so before, moreover, double

accounting in firms are typical for Ukraine. So some results discrepancies from other empirical studies may be observed. In developed countries three most utilized and effective (exerting the strongest influence on probability to go bankrupt) factors are return on assets, current ratio and working capital over total assets.

The most commonly used approaches are discriminant analysis, logit analysis and probit analysis. There are a number of works based on hazard models, e.g. Klos V. (2008). While the discriminant analysis predicts the future state – whether this firm will go bankrupt or not, the last ones predict probability of going bankrupt. Since probit and logit models differ only in tails, I will use one of them. I prefer to use multi-period probit analysis in my research, because we can observe same firms in time, meaning data in panel.

The next important step is to define dependent variable. Upon becoming bankrupt firms should declare it, but as a rule, they do not do it in Ukraine. So we deal with this problem by looking at firms' exits. More precisely at "final" exits, because some firms have year gaps in reporting, but then they again report. So only the exit with no further return is considered as exit.

Next, we define independent variables – determinants of enterprise bankruptcy. We use statements of both financial position and income statement, to create these variables. Comprehensive list of variable should possess high predictive quality.

After creating all variables I use the multi-period probit approach on this panel data. One variable return on assets model is the basic one, because this variable is the most predictive in "old" papers. Due to the shadow economy

effect it might be not very “explanatory”, so we will add other wide-spread variables to find out which of them are the most influential.

The thesis is divided into consecutive parts. In part two we go through the existing articles on this topic. In part three we more deeply dive in methodology – the used model. In part four we more closely discuss the dataset. In part five we discuss the results obtained. And in part six we state conclusions.

Chapter 2

LITERATURE REVIEW

This topic has been investigated by many researchers for quite a long period of time. According to Bellovary et al. (2007) since sixties there have been more than 170 articles on this topic around the world. Mostly research papers were written on the US economy, but we can observe a number of papers on other countries: Janer J. (2011) on France, Shirata Y. (2009) on Japan, Slotemaker R. (2008) on the Netherlands, Aliakbari S. (2009) on the United Kingdom and so on. The most common approaches are multiple discriminant analysis and probit/logit analysis.

Classical economist's point of view is that supply curve is a marginal cost for a firm. And while turmoil is turning out with demand, less productive firms are bound to leave the market. Olley and Pakes (1996), for example, employ the productivity approach in their work. Less productive firms are supposed to have higher exposure to bankruptcy. Additionally, there are other risks that threaten firms' conditions. Even in "capital structure indifferent universe" of Modigliani and Miller (1958), higher debt level pushes up required return on equity. So, high leverage makes firms more vulnerable. There is a wide range of used variables, so it would be beneficial for us to dig into previous works.

To start with, I want to present the study of Edward I. Altman. He makes use of the multiple discriminant analysis – Z-score model - in his paper. The final function he got is:

$$Z = .012X_1 + .014X_2 + .033X_3 + .006X_4 + .999X_5 \quad (1)$$

He had only balance sheets and income statements, but no cash flow statements, so do I in my thesis. He applies 22 most commonly used variables, out of which he employs five most influential variables: (1) working capital over total assets, (2) retained earnings over total assets, (3) earnings before interest and taxes over total assets, (4) market value of equity over book value of total debt and (5) sales over total assets. As can be seen all variables are adjusted to the size of assets, which eliminates the size influence on these variables and leaves only relative indicators. All these variables are found to have had the diminishing effect on probability to go bankrupt.

Let's also pay attention to the study of James A. Ohlson (1980). He employs the logit analysis. As dependent variables he utilizes purely paper approach – declaring bankruptcy. In his model he uses more variables than Altman. They are: (1) size, (2) total liabilities over total assets, (3) working capital over total assets, (4) current liabilities over total assets, (5) dummy – one if total liabilities exceeds total assets, zero otherwise, (6) return on assets, (7) funds provided by operations over total liabilities, (8) dummy – one if net income was negative in the last 2 years, zero otherwise and (9) adjusted growth in net income. As can be seen all variables are again adjusted for size. Four of them he finds to be statistically significant: (1) size, (2) total liabilities over total assets, (6) return on assets and (3) working capital over total assets. All in all he tested three models: predicting bankruptcy in one year, two years and one or two years. In all models the highest determination power has variable (2). He concludes that additional predictors are required in order to improve significantly the model.

Ohlson's logit model is preferred to multiple discriminant analysis, because it allows us to use dummy variables and provides us with probability of going bankrupt as a result. One of the assumptions used in the multiple discriminant analysis model is that independent variables have normal distribution, while dummies variables do not have this distribution. Moreover, the multiple discriminant analysis does not deal with probability. Its coefficients have no sense regarding probability, they show the effect on score variable instead.

Bellovary et al. (2007) collected all articles on this topic and found the most frequently used determinants. According to their findings, the seven mostly used ratios are related to cash or non-cash results and current assets. Return on assets – first variable – explains more than half of the information. It is obvious that profitability is a must for an enterprise, but one year profitability should not be a prevailing factor. So we need to pay more attention to other factors. Only the eighth variable is debt related. So the capital structure does not seem to be crucial for the bankruptcy threat. From these observations we define a minimum set of variables. We need at least one variable per each of the following groups: profitability, liquidity and firm's size.

Return on assets is ubiquitous variable and there are researches that found this variable to be insignificant. Lizar L. (2002) finds return on assets to be insignificant. In Janer J. (2011) return on assets is significant only at 95% (not 99%). He utilizes assets turnover ratio, which is significant and sometimes stands as a substitute for return.

According to the Ukrainian data there was a research done in 2003 by Oleksandr Nikolsko-Rzhevskyy. He studied determinants of banks' bankruptcy. He used the multi-period logit model with 16 regressors to

predict bankruptcy. He utilized capital structure ratios – current and long-term capital structure variables, but most variation was explained by profit over total assets – return on assets.

Another work was done in 2008 by Vira Klos. Analyzing survival of firms she employed hazard model. As in the previous works, survival is explained by ratios observations, albeit the analysis of previous existence also incorporated. Industry dummies are used to control for industry specific shocks, industry export orientation etc. Her major finding is that growth decline increases hazard up to 4th years.

Taran Y. (2012) uses banks' data to find predictors of failure. He defines failure as an appointment of temporary administration in bank. One of the questions he wants to answer is whether predictors changed from 98th crisis to 08th one. He finds that capital adequacy and liquidity were predictors in both periods. In 08th period he finds that retail deposits share become an indicator. Since currently banking system is more close to 08th one, he recommends to pay attention to retail deposits indicator.

In this work we, firstly, have longer and more up-to-date period of observations, which allows us to extract more information from the data. Secondly, we utilize more explanatory variables that allow us to capture different effects. And finally, we, in my opinion, more properly express other variables. For example, I liquidity is better captured by ratio of current assets to current liabilities, than by ratio of net current assets to total assets.

Searching through the literature we see that multiple discriminant analysis was used before probit and logit models. Nowadays people move toward probit and logit ones, but anyway the ratio analysis is useful due to its simplicity. Finally, the literature overview shows that we will be able to

make the first report on the Ukrainian data for financial and non-finance firms by using multi-period probit model.

Financial assets around the world are described in two dimensions: return and risk. This description in return-risk dimensions is first described by Markowitz (1952) in his modern portfolio theory. Since financial assets are claims on real business we can apply this approach to firms.

The question may arise why firms go bankrupt in general. The first possible reason is inappropriate allocation of resources in economy. According to neoclassical economist such as Marshall A. (1890) and others, consumers maximize their utilities and firms maximize their profits. So firms react to changes in people preferences. Suppose demand for some specific goods falls due to shifting to the other one. People start drifting from fast food consumption towards heath goods (gym, swimming pool etc). There is a leftward shift in demand for fast food. Eventually marginal firms leave the market until demand equates supply. The second reason for going bankruptcy is industry structure. Maybe industry poses ever increasing return to scale feature and according to Spence M. (1983) all small firms will be beaten out by a large one. Since in industry with decreasing marginal costs (same as decreasing average costs), the firm ultimately must make a choice between merger and exit.

Chapter 3

METHODOLOGY

In this chapter we discuss plausible evaluating methodology for posed questions. Main concerns are models and variables.

We are interested in finding this marginal firm, which is subject to failure. There are other things that may affect bankruptcy probability such as bad management, bad luck issues (fire) etc. But these effects must be reflected in financial figures, so we will count on them.

We estimate bankruptcy determinants for enterprises. There are virtually two possible cases: a firm goes bankrupt or does not. For this type of the analysis we have three possible methodologies: multiple discriminant analysis (MDA) and probit and logit models. MDA is quite an obsolete approach, that is why, nowadays authors shift toward probit and logit. They move away from MDA approach, because it doesn't provide probability of bankruptcy. We use multi-period probit model to answer thesis's question.

The probability of a firm going bankrupt is a non-linear function. To find the marginal effect we further will calculate them, because coefficients in multi-period probit regression are effects on latent variable Y.

$$P[Bankruptcy_t = 1|Y_t] = G(Y_t) \quad (2)$$

Since the firm either goes bankrupt or not, the sum of probabilities should sum up to one. The probability of not going bankrupt is one minus probability of going bankrupt.

$$P[Bankruptcy_t = 0|Y_t] = 1 - G(Y_t) \quad (3)$$

As was mentioned before it is difficult to create "bankruptcy" variable because many enterprises do not declare themselves as bankrupt. We believe that exit variable can be measured by reporting suspension. So we created the following variable:

$$Exit_t = \begin{cases} 1; if\ Rep_t = 1\ and\ Rep_{t+1} = 0 \\ 0;\ otherwise \end{cases} \quad (4)$$

where:

$Exit_t$ – Dummy for event of exit,

Rep_t - 1 if submit reports for period t, 0 otherwise.

Then we encounter the next setback – some firms have a year gap in their reporting, presumably due to some poorness of data. That is why we interpret this as not exit, if the firm continues reporting after the gap. So our dependent variable is the final exit.

$$B_t = \begin{cases} 1; if\ Rep_t = 1\ and \sum_{t+1}^{2010} Rep_t = 0 \\ 0;\ otherwise \end{cases} \quad (5)$$

where:

B_t – Dummy for event of final exit,

Rep_t - 1 if submit reports for period t, 0 otherwise.

This dependent variable approach also solves the issue of endogeneity. Quite often researches encounter the problem when they are not sure whether independent variable affects dependent one or vice versa. In our case, because we, at some point, observe firm's ratios, it means that the firm exits only after these ratios are observed. So the observed state affects their decision.

Now we need to define independent variables. The following set on indicator should well enough explain the probability of bankruptcy events (Table 1). Also we show expected signs of coefficients' estimates.

All variables have pre-test expected signs. Three of them are expected to increase bankruptcy probability. These are operating leverage, financial leverage and oldness of assets. All expectations are based on previous works, except oldness of assets. Since we have not encountered such variable before, we base our expectations on common sense. List of dummies should capture industry differences. Let's go through all variables.

Table 1. Expected results

Regressor	Expected sign
Size	-
Return on assets	-
Operating leverage	+
Liquidity	-
Financial leverage	+
Oldness of assets	+
Margin	-
Assets turnover	-
Inventory turnover	-
Sales turnover	-
Industry dummies	N.A.
GDP	-

3.1 Size variable

The size variable is measured as a natural logarithm of total assets. It is assumed that firms grow up due to different economic benefits: economy of scale, market power etc. If it is so, then bigger firms should be less vulnerable than smaller ones. Big firms with the same ratios as small ones should be less probable to go bankrupt. That is why, we expect a negative sign of this coefficient.

3.2 Return on assets

$$ROA_t = \frac{NI(L)_t}{TA_t} \quad (6)$$

where:

ROA_t – return on assets in period t,

$NI(L)_t$ – net income(loss) in period t,

TA_t - total assets in period t.

According to Bellowary J. et al. (2007), this indicator explains more than half of variations in bankruptcy differences. However, other authors, for example Lizar L. (2002), find this variable to be insignificant for The Czech Republic. This indicator poses few positive features: it provides the information of how well the firm works through net results in numerator of indicator and it is adjusted to the size of the firm through total assets in denominator of indicator.

3.3 Operating leverage

$$OL_t = \frac{FA_t}{TA_t} \quad (7)$$

where:

FA_t – fixed assets in period t,

TA_t – total assets in period t.

This indicator is positively associated with risk. More fixed costs among total costs less flexible is the firm during downturn. As we do not have such data, we use a balance sheet substitute. We measure operating leverage using the share of fixed assets in total assets. Smith R. and Winakor A. (1935) found opposite variable, current assets to total assets, to drop before bankruptcy.

3.4 Liquidity ratio

$$LQ_t = \frac{CA_t}{CL_t} \tag{8}$$

where:

CA_t – current assets in period t;

CL_t – current liabilities in period t.

Liquidity is a measure of firms' short-term flexibility. The higher is the ratio, the more resources company has to overcome current expenses. Different authors use different forms of this ratio. Klos V. (2008) uses working capital over total assets. This variable is found to have negative significant effect on probability of going bankrupt. However, we will use current assets over current liabilities, because it better reflects current firm's liquidity.

3.5 Financial leverage

$$Db_t = \frac{D_t}{TA_t} \tag{9}$$

where:

TA_t – total assets in period t;

D_t – short- and long-term debt in period t.

According to Modigliani and Miller (1958), with higher debt level the cost of equity goes up. This is due to the increase of risks held on shareholders shoulders. This risk increases probability of bankruptcy. To estimate financial leverage we use ratio of total debt to total assets.

3.6 Oldness of assets

$$Dep_t = \frac{AD_t}{IC_t} \tag{10}$$

where:

AD_t – accumulated depreciation in period t;

IC_t – initial price of capital in period t.

As firm stop investing, its assets become more obsolete. The reduced level of reinvestment should flag concern for investors. A company, which reduces spending on capital might experience problems, does not have investment opportunities or has other issues that signal on performance

deterioration. Overall this increases bankruptcy propensity. Before, we have not faced this variable in other papers. Even Bellowary J. et al. (2007) do not find this variable among the used by different authors.

3.7 Margin

$$Mar_t = \frac{GP_t}{TR_t} \tag{11}$$

where:

GR_t – gross profit in period t;

TR_t – total revenue in period t.

Aghaie A. and Saeedi A. (2009) included this variable in their research, however they dropped it during the picking final set of variables. This indicator may well be of both positive and negative signs. On the one hand, high profitability may insure any company from negative operating issues. Price decrease, as a result of downturn, would hurt less firms with higher margin. On the other hand, high margin might indicate a new rising industry, where companies are more volatile. More volatile companies have higher probability to go bankrupt.

3.8 Asset turnover

$$AT_t = \frac{TR_t}{TA_t} \tag{12}$$

where:

TA_t – total assets in period t;

TR_t – total revenue in period t.

This is one of five variables used by Altman E. (1968). Observing the turnover cycle we can judge how long it would take to turn assets in cash in case of down pressure on a firm. Faster firms scroll assets, lesser risks are associated with the firm, and less prone to bankruptcy it is.

3.9 Inventory turnover

$$IT_t = \frac{COGS_t}{TI_t} \tag{13}$$

where:

TI_t – total inventory in period t;

$COGS_t$ – costs of goods sold in period t.

The indicator possesses almost similar characteristics as assets turnover. Faster company turns its inventory, less chances of write-off or other negative issues it has.

3.10 Sales turnover

$$ST_t = \frac{TR_t}{R_t} \quad (14)$$

where:

TR_t – total revenue in period t;

R_t – receivables in period t.

The indicator possesses almost similar characteristics as assets turnover. Faster company collects its receivables, less chances issues related to delay of payments take place.

3.11 GDP

It is measured in constant 2005 million dollars. As real GDP is a comprehensive indicator of the economy conditions, we use it in our model to capture economy's effects. Because market return defines expected return of portfolio according to Markowitz H. (1952), we need such indicator. GDP is a good measure of countries growth, because it measures overall country product.

Chapter 4

DATA DESCRIPTION

We have a large database, because as in almost all countries around the globe, in Ukraine enterprises are required to provide their reports at least ones per year. We collected balance sheets' and financial reports' lines out of these reports. Totally we have from 8.7 to 16.2 thousands observations in a year. But some companies have gap years in reporting, whereas others have reports just for one period. That is why, we firstly clean the data.

The data range is from 2001 to 2010, so we have the panel data. The last year of observed exits is 2009. If the firm discloses report in 2009 and does not do so in 2010, we observe exit. But we do not have data on 2011, so exits in 2010 are not revealed. The number of observed firms differs from period to period (table 2).

Table 2. Observations, thousand (except Exits)

Year	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10
Total firms	12.9	16.2	14.7	13.8	9.1	11.8	11.0	10.3	9.6	8.7
Firms w/o outliers	11.1	14.1	12.7	11.7	8.0	10.0	9.1	8.2	7.5	6.8
Exits	1209	1732	1351	1399	940	1161	1057	725	831	1209

Due to typos and mistakes in data we have outliers in data that could substantially hurt results. Far outliers are presented in the table 3.

We drop top 1 percent in all abovementioned observations and bottom 1 percent when P1 is not zero. After cleaning for outliers we are left with the following observations (table 2). Within the available data there are a large number of final exits.

Table 3. Descriptive statistics of constructed ratios

	mean	max	min	P1	P5	P95	P99
ROA	-0.5	3095.5	-50008.0	-0.6	-0.3	0.2	0.7
Liquidity	46.8	389161.0	0.0	0.1	0.3	18.2	220.5
Debt	0.1	56.231	0.0	0.0	0.0	0.4	0.7
Asset turnover	9.7	354992.7	0.0	0.0	0.0	5.5	13.7
Inventory turnover	19.2	132872.0	0.0	0.0	0.0	29.7	140.7
Sales turnover	1242.1	35300000.0	0.0	0.0	0.4	269.7	2248.4

We have numbers from different statements. The first source of data is the statement of financial position. We collected such data from above-mentioned companies. We have a wide range of lines from balance sheets. Total assets are summed in the following table (Table 4). For the size control we create a variable, which is equal to natural logarithm of total assets.

Table 4. Average total assets of observed firms, ml

Year	‘01	‘02	‘03	‘04	‘05	‘06	‘07	‘08	‘09	‘10
Total assets	352	429	500	546	534	781	1008	1404	1965	2356
YOY	-	22%	16%	9%	-2%	46%	29%	39%	40%	20%

We observe the double digit growth of assets in almost all periods (except 2004 and 2005). This observation supports the fact that we follow the same companies, and they are growing during the history. Table 5 provides the information on “structure” of these assets.

Table 5. Average balance operating leverage

Year	‘01	‘02	‘03	‘04	‘05	‘06	‘07	‘08	‘09	‘10
Leverage	0.63	0.61	0.60	0.58	0.57	0.56	0.54	0.53	0.52	0.51

We can see a slight decrease in leverage. This means that operating assets have lower and lower share in total assets of observed firms. Firms show less fixed capital on their books, maybe due to less intensive usage or using operating leasing.

Table 6. Average return on assets, %

Year	‘01	‘02	‘03	‘04	‘05	‘06	‘07	‘08	‘09	‘10
ROA	1.2	-0.9	-0.8	0.5	-0.1	0.5	1.8	0.2	-1.5	-0.9

Table 6 shows the average tendency to show zero profit – zero return on assets. Persistent filling of zero profit raises a question of cooking the books. Zero average return means that firms did not earn money during 10 year period. Obviously, they underreport profits so as not to pay taxes.

Moreover, we calculate asset turnover for all firm, with interest how this variable affects bankruptcy vulnerability (table 7). Logically thinking firms with fast assets turnover are less sensitive to market downturns, because they can faster turn their assets into money.

Table 7. Average asset turnover

Year	‘01	‘02	‘03	‘04	‘05	‘06	‘07	‘08	‘09	‘10
Turnover	1.3	1.2	1.4	1.5	1.5	1.7	1.8	1.8	1.3	1.4

Assets turnover follows similar to return on assets path – it fluctuates near the mean reverting value. In assets turnover case this value is 1.5. We as well test this variable as a substitute for return on assets – most popular variable within researchers.

All variables are not determined by others. We do not observe any significant factors’ intercorrelation (APPENDIX 1). The highest correlation is .3 between return on assets and margin. Net income in numerator of both indicators explains it. However, correlation is negligible.

Chapter 5

ESTIMATION RESULTS

To start, we look at mean statistics for bankrupt firms and for other firms. This overview could be treated as the eyeball test. Obviously, firms that are prone to bankruptcy should emanate deteriorating trends in their operating ratios. Further, we start building our multi-period probit model. We already mentioned what ratios will be used. But we are going to expand the model from one dependent variable to all variables step by step to follow explanatory power of variables. As a starting point we employ one variable model, using the most widespread explanatory variable – return on assets. Adding other variables we get to extended model. Then we run regression for big and small firms separately in order to wonder whether differences occur. Afterwards, we add GDP variable to count for economic conditions and again run regression for big and small firms.

The main driver of bankruptcy, according to Bellowary J. et al. (2007) is return on assets. Taking this into account we expect observable differences for bankrupt and non-bankrupt firms (Table 8).

On average, return on assets of a bankrupt firm is 6.5 percentage points below ratio of non-bankrupt firm. Taking into account that average ROA is not far from zero, we can conclude that 6.5 percentage points is a substantial difference.

On average, for non-bankrupt firms liquidity ratio is .7 higher than for bankrupt ones. However, in some years, e.g., 2007, ratio is higher for

bankrupt firms. Further research is needed to explain why such differences may occur. Maybe in booming economy they attract a lot of long-term capital and overinvest in current capital. Nevertheless, looking at robust firms we can see that liquidity ratio continued to grow even after the crisis.

Table 8. Descriptive statistics of bankrupt and not bankrupt firms

Year	‘01	‘02	‘03	‘04	‘05	‘06	‘07	‘08	‘09
ROA, not bankrupt, %	-0.15	-2.1	-1.5	0.3	0.6	1.0	2.3	0.2	-0.8
ROA, Bankrupt, %	-5.2	-7.9	-8.6	-6.7	-7.3	-6.2	-3.3	-4.5	-9.0
Liquidity, not bankrupt	3.0	3.5	3.6	3.8	3.8	4.1	3.9	3.9	4.2
Liquidity, bankrupt	1.6	2.2	2.4	2.7	3.8	3.7	4.3	3.8	3.4
Debt, not bankrupt	2.3	3.0	4.0	5.5	6.5	7.3	8.5	9.6	9.6
Debt, bankrupt	2.1	2.1	3.1	4.3	3.4	4.1	6.2	9.3	10.3
Asset turnover, not bankrupt	1.2	1.1	1.3	1.6	1.7	1.8	1.9	1.9	1.3
Asset turnover, bankrupt	.5	.5	.5	.7	.7	.9	1.4	1.6	.7

Until 2007 the upward trend in debt position of non-bankrupt firms can be observed, whereas debt position of bankrupt firms could be explained as stable. But in 2007-2009yy the abrupt growth of debt position of bankrupt firms might be a result of balance sheet write-offs etc.

Only in the pre-crises years bankrupt firms built up assets turnover to the other firms’ level. However, these firms usually show worse statistics in

term of turnover. After the crisis the drop is observed even in non-bankrupt firms.

In table 9 we also see the worsening trend in firms' ratios as they approach bankruptcy. Deterioration while approaching bankruptcy is observed.

Table 9. Trends in ratios of bankrupt firms

Year(s) before bankruptcy	5	4	3	2	1	0
ROA	-1.3%	-2.2%	-2.6%	-3.4%	-4.7%	-6.7%
Liquidity	3.5	3.6	3.3	3.1	3.0	2.9
AT	1.4	1.3	1.3	1.2	1.0	0.8
Dep	34.4%	37.3%	39.8%	43.4%	44.5%	46.2%

Return on assets drops significantly before bankruptcy. While liquidity declines a bit, asset turnover in the last year is, on average, below one, meaning revenue is lower that total assets. Depreciated assets grow up to bankruptcy, which might be explained as a decline in investment in fixed capital.

We start from running regression only on intercept to afterwards find goodness of fit of following models. Results for the first bunch of models are presented in table 10. Coefficients are marginal effects for the average firm.

Pseudo R^2 is calculated as

$$1 - \frac{ABS(\log likelyhood\ model)}{ABS(\log likelyhood\ intercept)} \quad (15)$$

Where:

$ABS(log\ likelyhood\ model)$- absolute value of log likelihood of the model;

$ABS(log\ likelyhood\ intercept)$- absolute value of log likelihood of the model with only an intercept.

Table 10. Regression results 1

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
ROA	-.355***	-.286***	-.148***	-.144***	-.135***
	(.008)	(.008)	(.008)	(.008)	(.008)
Size			-.022***	-.021***	-.023***
			(.0006)	(.0006)	(.0006)
OL			-.060***	-.052***	-.048***
			(.004)	(.004)	(.004)
LQ		-.001***	-.001***	-.0004***	-.0004***
		(.0001)	(.0001)	(.0001)	(.0001)
Db			.025***	.0152*	.004
			(.008)	(.008)	(.008)
Dep			.015***	.016***	.005**
			(.003)	(.003)	(.003)
Mar			.004	.003	-.005
			(.006)	(.006)	(.006)
AT		-.026***	-.019***	-.020***	-.022***
		(.0008)	(.0008)	(.0008)	(.0008)
IT			-.0004***	-.0001	-.0002*
			(.0001)	(.0001)	(.0001)
ST			-5.62e-06	-.00001**	-.00002**
			(.00001)	(.00001)	(.00001)
GDP					1.27e-06***
Industry dummies	No	No	No	Yes	Yes
Pseudo R^2	3.3%	5.3%	65.4%	66.0%	66.3%

*p<0.1; **p<0.05; ***p<0.01.

The explanatory power rocket as we move from Model 2 to Model 3. So, some of the added variables have a huge explanatory power according to our study. To find out what variable is the most explanatory we run a bunch of regressions, adding one-by-one variables to Model 2. While extending Model 2 with depreciation variable, the explanatory power of the model jumps up to 62.0%, which is almost 65.4%. So obsolescence of assets can be treated as the strongest indicator of increasing bankruptcy probability.

Then we run specification of Model 5 for top 25% of firms in term of size and bottom 25% (Table 11).

Table 11. Model 5 for different sizes

Variable	Model 5	Model 6 (top 25%)	Model 7 (bottom 25%)
ROA	-.135***	-.071	-.158
Size	-.023***	-.006	-.083
OL	-.048***	-.026	-.108
LQ	-.0004***	-.0001	-.0004
Db	.004	.005	.005
Dep	.005**	.005	.0002
Mar	-.005	.00002	-.035
AT	-.022***	-.015	-.039
IT	-.0002*	-.00004	.00006
ST	-.00002**	-6.47e-06	-.00003
GDP	1.27e-06***	6.98e-08	5.99e-06
Industry dummies	Yes	Yes	Yes
Pseudo R^2	66.3%	42.8%	75.5%

*p<0.1; **p<0.05; ***p<0.01.

However, high Pseudo R^2 Models 6 and 7 show all coefficient are insignificant for the average firm in their group. This is a result of the decreased number of observations, while we look only at small or big firms.

After we run models 1 – 3 on forward exit to find out whether exit could be forecasted one period ahead (Table 12).

Pseudo R^2 is lower than in Model 1-3, which is obvious considering that we forecast exit one period ahead. Nevertheless, the obsolescence variable still shows the highest explanatory power.

We observe the significance of some industry variables in the extended model 5. Extractive, wholesale and retail trade and real estate industries are significantly more risky than average firms. So providing credit lines or investing equity in them, the investor should demand higher return. On the contrary, financial sector and health care and social assistance are less risky than others, so risk-averse investors and pension funds should focus on them.

Table 12. Regression results 2

Variable	Model 8	Model 9	Model 10
ROA	-.317***	-.273***	-.140***
	(.009)	(.010)	(.010)
Size			-.024***
			(.0008)
OL			-.059***
			(.005)
LQ		-.0005***	-.0003**
		(.0001)	(.0001)
Db			.050***
			(.010)
Dep			.015***
			(.003)
Mar			-.019**
			(.008)
AT		-.014***	-.013***
		(.0008)	(.0009)
IT			-.0007***
			(.0001)
ST			1.08e-06
			(.00001)
GDP			
Industry dummies	No	No	No
Pseudo R^2	2.4%	3.1%	62.4%

*p<0.1; **p<0.05; ***p<0.01.

Chapter 6

CONCLUSION

Based on Ukrainian firms' fillings, the usage of multi-period probit model to explain firms' exits in current or in the next period is of significance of explanatory variables. Interesting results are observed on operating leverage and depreciation variables.

According to Bellowary J. et al. (2007) return on assets is the most explanatory variable among others. Based on our research we find that obsolescence of assets gains the most information about the probability of exit. I believe that it could be explained by cooking the books methods. I can hardly believe that all firms, during ten years on average had return on assets near zero (Table 6). That is why, not renewing assets could stand as a main indicator of possible bankruptcy. Nevertheless, return on assets is found to be highly significant.

Balance operating leverage is another risk factor. It should make the firm more prone to bankruptcy. However, we find this variable to have an opposite effect. The most probable explanation is confidence and efforts. Maybe only more confident firms spend money on capital. More likely explanation is spent efforts. Investing a big amount of money in capital, spending a lot of efforts on firm's development, should push managers to work harder, so as not to allow the firm to go bankrupt. So further research in this direction might be interesting.

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APPENDIX A, Correlation matrix.

	size	OL	ROA	LQ	Db	Dep	Mar	AT	IT	ST
size	1									
OL	-0.03	1								
ROA	0.03	-0.10	1							
LQ	-0.02	-0.06	0.08	1						
Db	0.21	-0.10	-0.08	-0.11	1					
Dep	0.02	-0.11	-0.01	0.00	0.04	1				
Mar	-0.02	0.01	0.30	0.21	-0.02	0.01	1			
AT	-0.21	-0.30	0.25	-0.11	0.08	0.06	-0.11	1		
IT	-0.05	0.08	0.05	-0.01	0.00	0.02	0.01	0.21	1	
ST	-0.08	0.06	0.07	0.02	-0.01	0.02	0.06	0.16	0.04	1