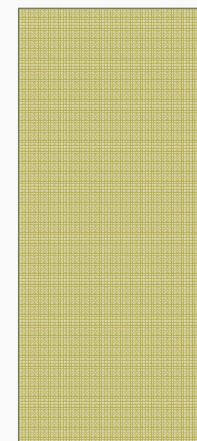


A logit model using accounting ratios to predict the failure of SME's

CORPORATE BANKRUPTCY

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PREDICTION MODELS USING ACCOUNTING INFORMATION

- INTRODUCTION

- For more than 70 years, business failures have been one of the most **discussed topics** in financial literature (Balcaen and Ooghe, 2006).
- Indeed, business failure matters a lot for a large number of stakeholders: **customers, suppliers, creditors and, of course, the firm's workers** (Weitzel and Jonsson, 1989; Daubie and Meskens, 2001).

PREDICTION MODELS USING ACCOUNTING INFORMATION

- **INTRODUCTION**
- Bankruptcy prediction studies (Beaver, 1966; Argenti, 1976; Ohlson, 1980; Altman, 1984; Morris, 1997; Guilhot, 2000; Daubie and Meskens, 2001; Ooghe and De Prijcker, 2006; etc.) generally consist on developing prediction models that allow to predict corporate bankruptcy **from accounting ratios**.
- Such models re particularly useful for the **banking** industry, allowing them to screen the financial situation of their borrowers in order to prevent “bad investments” (Altman and Hotchkiss, 2005).

PREDICTION MODELS USING ACCOUNTING INFORMATION

- INTRODUCTION

- In **Belgium**, the number of corporate bankruptcies is constantly evolving. Indeed, 12,306 firms went into bankruptcy over the course of the year 2013, which means that one in eighty active firms filed for bankruptcy. This number represents an increase of 11.35% compared to the situation of the previous year (Graydon, 2013).

PREDICTION MODELS USING ACCOUNTING INFORMATION

- INTRODUCTION

- The financial approach allows to identify the **relevant financial ratios, generally gathered into four families (i.e. liquidity, solvency, profitability and structure)** which help to predict bankruptcy in a given time horizon with the use of statistical tools or appropriate mathematics (Beaver, 1966; Altman, 1968; Ohlson, 1980; Becerra et al., 2005).

PREDICTION MODELS USING ACCOUNTING INFORMATION

- INTRODUCTION

- The main idea of prediction models is not only to determine that the company had lower ratios before the bankruptcy filing but to predict the probability of collapse **early enough** to minimize associated costs (Dighaye & Van Caillie 2002).
- Financial indicators (liquidity, solvency, profitability, etc.) are not necessarily predictors of bankruptcy but often **symptoms**.

PREDICTION MODELS USING ACCOUNTING INFORMATION

- **INTRODUCTION**
- **Most** empirical studies on bankruptcy prediction were performed in the **US context** (Beaver, 1966; Ohlson, 1980; Duan et al., 2012.).
- Few models devoted to the **Belgian** case. The best known are those developed by Ooghe & Verbaere (1982) Declerc et al. (1992) and by Ooghe et al. (2005).

PREDICTION MODELS USING ACCOUNTING INFORMATION

Study	Data	Estimation method	Ratios	Results
Moreau, 1978	1973 - 1978 Public limited Company	Linear discriminant analysis	log (total assets); working capital/total assets; operating profit or losses/total assets	Global 77.3%
Ooghe and Verbaere, 1982	/ Belgian enterprises	Linear discriminant analysis	(retained earnings + accumulated profit or loss)/(equity + liabilities); overdue taxes and social security debt/short term debt; liquid assets/restricted current assets; (work in progress, finished goods and contracts in progress)/current working assets; ST financial debt to credit institutions/ST debt;	D 76.8% ND 68.9%
Ooghe and al., 1991	1985 - 1990 Belgian enterprises	Logistic regression	ROA – average interest rate of debt (1 if >0, 0 if <0); (accumulated profit or loss + retained earnings) / (equity + liabilities - accrued charges and deferred income); ST financial debt/ST debt; overdue taxes and social security charges (1 if > 0, 0 otherwise); (inventory + AR – AP – taxes – advances received on contracts in progress) / total assets; cash and ST investments/total assets debts guaranteed/total debt; net return on operating assets before taxes;	D 85.3% ND 77.6%
Van Wymeersch and al., 1992	1984 - 1985 Non-financial firms	Linear discriminant analysis	cash flow/ total assets; variation of financial debt/total assets	D 75.6% ND 73.5%
Ooghe and Van Wymeersch, 2000	1977 - 1978 Belgian enterprises	Linear discriminant analysis	overdue debts to the tax authority and the ONSS/debt; cash flow/debt; overdue debts to the tax authority and the ONSS/ taxes, wages and social liabilities; retained profit/total assets; income tax expenses/earnings before tax EBIT/total assets; EBITDA/total assets; debt/total assets; cash flow/total assets; (current assets – stock – debt) / (non-cash expenses income tax expenses + profit)	D 84.8% ND 93.1%
Gaeremynck and Willekens, 2003	1995 - 1996 Private firms	Logistic regression	cash/current assets; ST debt/total debt; operating profit=1, operating loss=0; (cash + ST investments – ST bank debt)/total assets; return on equity; if firm has overdue tax and social security liabilities=1, 0 otherwise; (retained earnings + reserves)/total assets; likelihood of non-clean opinion	Global 72.4%
Dewaelheyns and Van Hulle, 2004	1996 -2001 Non-financial limited Liability corporations	Logistic regression	(current assets – inventory and W.I.P) / current liabilities; (reserves + retained earnings) / total assets; operating profits (losses)/total assets; (ST debt + LT debt) / total assets; sales/total assets	Global 83%

(*): model accuracy at one year

D: failing firms

ND: non-failing firms

Belgian studies for assessing bankruptcy

PREDICTION MODELS USING ACCOUNTING INFORMATION

- **INTRODUCTION**
- Most of studies focus on large firms and very **few** concerns the prediction of bankruptcy **for small and medium ones** (Peel & Peel, 1987; Storey et al., 1987; Keasey and Watson, 1991, Altman and Sabato, 2007; Ciampi and Gordini, 2008; Crutzen and Van Caillie, 2009).
- This is due to the great diversity of SME's and to the **lack of access to comprehensive financial data** of these firms (Van Caillie, 2000).

PREDICTION MODELS USING ACCOUNTING INFORMATION

- **VARIABLES**
- The choice of **ratios** for this case is justified by their recurrence in the Belgian (Ooghe and Van Wymeersch, 2000) and international literature (Altman, 1968; Taffler, 1982; Frydman et al., 1985) as well as by their relevance to the problem of failure of small and medium-sized Belgian firms.

PREDICTION MODELS USING ACCOUNTING INFORMATION

- HYPOTHESES
- **Hypothesis 1:** “A higher *liquidity* ratio decreases the probability of bankruptcy at one year”
- **Current Ratio**

PREDICTION MODELS USING ACCOUNTING INFORMATION

- HYPOTHESES
- **Hypothesis 2:** “A higher **profitability** ratio decreases the probability of bankruptcy at one year”
- **Earnings Before Interest and Taxes / Total Assets**

PREDICTION MODELS USING ACCOUNTING INFORMATION

- HYPOTHESES
- **Hypothesis 3:** “A higher **debt structure** ratio decreases the probability of bankruptcy at one year”
- **Equity / Total Assets**

PREDICTION MODELS USING ACCOUNTING INFORMATION

- HYPOTHESES
- **Hypothesis 4:** “A higher ratio of fiscal charges on added value decreases the probability of bankruptcy at one year”.
- ***Fiscal charges / Added Value***

PREDICTION MODELS USING ACCOUNTING INFORMATION

- HYPOTHESES

- **Hypothesis 5:** “A higher **Cash Flow / Total Debt** ratio decreases the probability of bankruptcy at one year”

PREDICTION MODELS USING ACCOUNTING INFORMATION

- **DATA**
- In this study, we rely on a sample of **7,152 Belgian SMEs** (Bureau Van Dijk database).
- Out of this sample, 3,576 firms were declared bankrupt between the **years 2002 and 2012**.
- The sample is divided into two parts. The first part includes **70 percent** of the observed group (5,006 firms) and acts as the **training group**. The rest of the sample (2,146 firms) represents the **control group** that is used to **test** the model.

PREDICTION MODELS USING ACCOUNTING INFORMATION

- **METHODOLOGY**
- Since the dependent variable, *bankruptcy*, is dichotomous, we use a binary logit regression model as is the case in many studies regarding the occurrence of bankruptcy filing (Ohlson, 1980; Premachandra, Bhabra and Sueyoshi, 2009).
- A **logit** model describes the relationship between a dichotomous dependent variable that can take value 1 (bankrupt firm) or value 0 (healthy firm), and k other explanatory variables x_1, x_2, \dots, x_k .

PREDICTION MODELS USING ACCOUNTING INFORMATION

- RESULTS

- DESCRIPTIVES

Variable	Bankruptcy						Healthy					
	Observations	Mean	Median	Min	Max	Std. Dev.	Observations	Mean	Median	Min	Max	Std. Dev.
Curr	3576	0.93	0.85	0	79.65	1.52	3576	2.97	1.26	0	99.94	7.11
Return	3576	-1.52	2.37	-600	652.5	35.37	3576	30.17	16.83	-774.06	957.85	67.16
Fin_Indep	3576	-5.21	1.55	-100	99.41	31.49	3576	33.50	30.55	-99.77	100	33.17
AV_Tax	3576	9.83	3.33	0	850.71	32.65	3576	13.47	7.89	0	887.82	29.60
CF_ID	3576	-0.01	-0.02	-6.27	132.04	2.23	3576	0.60	0.16	-28.31	253.96	5.11
ln(ta)	3576	5.94	5.88	1.95	10.99	1.34	3576	6.33	6.16	1.71	13.58	1.44
age	3576	12.07	9.00	1	97	10.97	3576	15.76	13	0	111	13.16
brussels	3576	0.17				0.37	3576	0.12				0.32
wallonia	3576	0.26				0.44	3576	0.21				0.41
d_agr_ind	3576	0.15				0.35	3576	0.09				0.29
d_energy	3576	0.00				0.05	3576	0.00				0.07
d_constr	3576	0.22				0.42	3576	0.17				0.37
d_catering	3576	0.09				0.28	3576	0.07				0.25
d_admin	3576	0.14				0.35	3576	0.24				0.43
d_soc	3576	0.01				0.10	3576	0.10				0.30
d_other	3576	0.03				0.18	3576	0.04				0.19

PREDICTION MODELS USING ACCOUNTING INFORMATION

- RESULTS

- CORRELATION MATRIX

	VIF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Curr	1.26	1.00															
2 Return	1.16	0.16	1.00														
3 Fin_Indep	1.39	0.38	0.32	1.00													
4 AV_Tax	1.01	0.07	0.00	0.08	1.00												
5 CF_TD	1.1	0.38	0.11	0.17	0.02	1.00											
6 brussels	1.08	-0.02	-0.01	-0.05	0.00	0.02	1.00										
7 wallonia	1.07	-0.03	-0.03	-0.07	-0.03	-0.03	-0.22	1.00									
8 ln(ta)	1.24	0.07	0.02	0.17	0.00	0.00	-0.04	-0.03	1.00								
9 age	1.19	0.13	-0.03	0.24	0.04	0.02	0.03	-0.05	0.31	1.00							
10 d_agr_ind	1.22	-0.02	-0.04	-0.01	-0.03	-0.02	-0.05	0.01	0.13	0.09	1.00						
11 d_energy	1.02	0.00	0.00	0.01	-0.01	0.00	-0.02	0.00	0.10	0.01	-0.02	1.00					
12 d_constr	1.32	-0.01	-0.02	0.02	-0.05	-0.02	-0.07	0.02	-0.09	-0.04	-0.18	-0.03	1.00				
13 d_catering	1.21	-0.04	-0.02	-0.11	0.01	0.02	0.03	-0.02	-0.23	-0.07	-0.11	-0.02	-0.14	1.00			
14 d_admin	1.32	0.07	0.07	0.09	0.02	0.03	0.09	-0.02	0.09	-0.03	-0.18	-0.03	-0.23	-0.14	1.00		
15 d_soc	1.18	0.07	0.16	0.16	0.03	0.03	-0.01	0.03	-0.02	-0.02	-0.09	-0.01	-0.12	-0.07	-0.12	1.00	
16 d_other	1.08	-0.02	0.00	-0.04	0.01	0.00	0.05	-0.01	-0.07	-0.02	-0.07	-0.01	-0.09	-0.06	-0.09	-0.05	1.00

PREDICTION MODELS USING ACCOUNTING INFORMATION

- RESULTS
- LOGISTIC REGRESSION

	Model 1 (Control Variables)		Model 2 (All Variables)	
	Coef.	Std. Err.	Coef.	Std. Err.
Curr Return			-0.09***	0.03
Fin_Indep			-0.01***	0.00
AV_Tax			-0.03***	0.00
CF_ID			-0.01**	0.00
brussels	0.70***	0.09	0.01	0.02
wallonia	0.30***	0.07	0.61***	0.11
ln(ta)	-0.13***	0.02	0.11	0.08
age	-0.02***	0.00	-0.12***	0.03
d_agr_ind	-0.01***	0.00	0.46***	0.12
d_energy	0.34***	0.10	-0.62	0.60
d_constr	-0.67	0.51	0.24*	0.10
d_catering	-0.04	0.08	-0.51***	0.14
d_admin	-0.32**	0.12	-0.61***	0.10
d_soc	-0.87***	0.09	-2.23***	0.28
d_other	-2.77***	0.23	-0.71***	0.20
cons.	-0.53	0.17	1.78***	0.19
Model Chi2	590.84***(11 df)		2,060.37*** (16 df)	
Log Likelihood	-3,173.95		-2,439.19	

† Partially significant at $P < 0.10$; *, **,*** Significant at $P < 0.05$, 0.01 , and 0.001 , respectively. The model is estimated on the training group.

	Likelihood-ratio test	
	LR chi2	Prob > chi2
Between M1 and M2	1,469.52	0

The results of the likelyhood test confirm that Model 2 fits the data significantly better than the more restrictive model (Model 1).

PREDICTION MODELS USING ACCOUNTING INFORMATION

- RESULTS

- Classification rate

	Observations	Status	Percentage of good predictions	Percentage of incorrect predictions
Training	2,146	Bankrupt	82.97%	17.03%
		Healthy	75.22%	24.78%
		Global	79.23%	20.77%

The prediction accuracy is calculated using the control group.

PREDICTION MODELS USING ACCOUNTING INFORMATION

- CONCLUSION
- Satisfactory prediction **accuracy** ;
- Ratios as **profitability** and **liquidity** are excellent predictors of bankruptcy for Belgian SMEs;
- The healthy sample was not **paired** with the bankrupt sample (possible to increase the prediction rate). Also, further research could focus on intra-sectorial analysis.
- Qualitative information such as managers' characteristics, the changes in **governance**,

PREDICTION MODELS USING ACCOUNTING INFORMATION

- CONCLUSION

- This study may be of interest for **investors** or **managers** to help them to anticipate bankruptcy risks.
- It can also be useful for **banks** and other credit institutions in the assessment of credit risk of firms. Thanks to such models, they could better identify firms with a higher risk of failure in their lending decisions.