Predicting Corporate Bankruptcy

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Introduction

- Since 2005 *x* number of companies have gone bankrupt. It’s a costly economic event. In addition to the firm itself losses, bankruptcy hurts shareholders, employees, bondholders, suppliers and even real estate value.
- Purpose: To determine whether or not the likelihood of success or failure of a publicly traded firm can be predicted effectively. If so this model could be used internally to identify early warning signs.
- With this model CFO’s, corporate finance teams & financial analysts could take corrective action to prevent failure
- Alternate uses are pricing credit swaps and debt evaluation

Hypothesis

Hypothesis

- The probability of a firm going bankrupt can be forecast from key financial ratios found on the income, cash flow statements and balance sheet of the firm

Research questions

- What contributes the most to corporate failure?
- How to reduce chances of bankruptcy?
- What are other uses?
- Can early signs prevent the worst outcome?

Literature Review

- Michele Modina and Filomena Pietrovito in “Rating, capital structure and bankruptcy prediction” find capital structure is the most important economic variable in firms defaulting.

Methodology

- Since I wish to capture the probability of success or failure, I chose Logit to predict an outcome of 1 or 0. To be interpreted as 1 = default

  0= non-default
- Having a binary outcome violates the assumption of linearity
- A logistic transformation makes it possible to model a nonlinear association in a linear way
- I use logit to forecast 3 months ahead the odds of default

$$\ln(odds) = ln\left(\frac{P}{1-p}\right) = the\ logit(p)$$

Methodology- The Model

$$b = \text{probability of bankruptcy}$$

$$logit(b_{it}) = \ln\left(\frac{b_{it}}{1 - b_{it}}\right) = \alpha + \beta \boldsymbol{X}_{it-1}$$

where $\boldsymbol{X}$ is a matrix of independent variables lagged one period. Taking the inverse of the logit function in a nonlinear association to regress in a linear form.

$$Z = \alpha + \beta \boldsymbol{X}_{it-1}$$

$$f(b_{it})^{-1} = f(z) = \frac{1}{e^{-z}}$$

where, $f(z)$ is between 0 and 1 and indicates the probability of bankruptcy in 3 months.

$$f(b_{it})^{-1} = \frac{1}{1 + e^{-(\alpha + \beta \boldsymbol{X}_{it-1})}}$$

Data

Historical data:

- 2005-2017
- Panel data structure
- Quarterly periodicity

Data sources:

- Compustat
- CRSP
- BankruptcyData.com

In-sample

- Q1 2005 to Q4 2016

Out-of-sample - Forecast

- Q1 2017

Data

Binary dependent variable:

- Bankruptcy 1 if filed; 0 if no default

Independent variables:

- Cash flow ratio
- Quick ratio
- Debt ratio
- Profitability
- Size

Dummy independent variables:

- Failed to file
- Restatement
- Year to control for economic climate
- 10 industry sectors to normalize data

Variable description

Dependent variable	***Symbol***	***Description***	***Source***
Bankrupt	b	Probability a firm will default[1] ranges from 0 to 1	Compustat
Independent variables	***Symbol***	***Description***	
Cash flow ratio	c	Cash flow from operations/current liabilities	Compustat
Quick ratio	q	(Current assets – inventories) / current liabilities	Compustat
Debt ratio	r	Total liabilities/total assets	Compustat
Profitability	p	Return on equity = net income/ shareholders' equity	Compustat
Size (market cap)	s	Total number of shares × share price	CRSP & Compustat
Dummy variables		***Description***	
Failed to file statements on time	d_1	Dummy variable coded 1 for firms that failed to file financial statements on time; 0 otherwise	CRSP & Compustat
Restatement	d_2	Dummy variable coded 1 for firms that restated financial statements; 0 otherwise	CRSP & Compustat

Variable description- Control for year specific economic climate

Dummy variables		*Control for year specific economic climate*
Year 2005	d_3	Dummy coded 1 when year is 2005; 0 if not in year
Year 2006	d_4	Dummy coded 1 when year is 2006; 0 if not in year
Year 2007	d_5	Dummy coded 1 when year is 2007; 0 if not in year
Year 2008	d_6	Dummy coded 1 when year is 2008; 0 if not in year
Year 2009	d_7	Dummy coded 1 when year is 2009; 0 if not in year
Year 2010	d_8	Dummy coded 1 when year is 2010; 0 if not in year
Year 2011	d_9	Dummy coded 1 when year is 2011; 0 if not in year
Year 2012	d_{10}	Dummy coded 1 when year is 2012; 0 if not in year
Year 2013	d_{11}	Dummy coded 1 when year is 2013; 0 if not in year
Year 2014	d_{12}	Dummy coded 1 when year is 2014; 0 if not in year
Year 2015	d_{13}	Dummy coded 1 when year is 2015; 0 if not in year
Year 2016	d_{14}	Dummy coded 1 when year is 2016; 0 if not in year
Year 2017	d_{15}	Dummy coded 1 when year is 2017; 0 if not in year

Variable description- Control for industry

Industry dummy variable description

Industry		*Control for the effect of industry sector*	
Basic industries	d_{16}	Dummy variable coded 1 for firms in the basic industries; 0 otherwise	CRSP
Capital goods	d_{17}	Dummy variable coded 1 for firms in the capital goods industry; 0 otherwise	CRSP
Consumer durables	d_{18}	Dummy variable coded 1 for firms in the consumer durables industry; 0 otherwise	CRSP
Consumer non-durables	d_{19}	Dummy variable coded 1 for firms in the consumer non-durables industry; 0 otherwise	CRSP
Consumer services	d_{20}	Dummy variable coded 1 for firms in the consumer service industry; 0 otherwise	CRSP
Energy	d_{11}	Dummy variable coded 1 for firms in the energy sector; 0 otherwise	CRSP
Finance	d_{12}	Dummy variable coded 1 for firms in the finance industry; 0 otherwise	CRSP
Healthcare	d_{13}	Dummy variable coded 1 for firms in the healthcare industry; 0 otherwise	CRSP
Technology	d_{14}	Dummy variable coded 1 for firms in the technology sector; 0 otherwise	CRSP
Transportation	d_{15}	Dummy variable coded 1 for firms in the transportation industry; 0 otherwise	CRSP

Expected Coefficient Signs

Expected coefficient signs of non-dichotomous variables

Variable	Expected sign	Explanation
Cash flow ratio	(+/-)	Cash flow of one or greater will enable the firm to meet its obligation, reducing default risk, less than one will increase the chances of default
Quick ratio	(+/-)	A value of one or greater will reduce default probability, otherwise increases probability of default
Debt ratio	(+/-)	Lower ratio will have a negative effect; a higher ratio will increase probability of default
Profitability	(-)	Return on equity should decrease the probability of default
Size (market cap)	(-)	Larger firms have more resources, access to credit and default less on loans

Results

- Firms relying primarily on debt financing have a higher probability of default
- Cash flow and profitability have a negative effect on the likelihood of default

Conclusion

- Predicting bankruptcy accurately will give CFO's and the finance department the ability to make changes in the areas that need it the most.

- To be used as a tool to enhance or correct capital structure practices and positively influence the financial health of the firm