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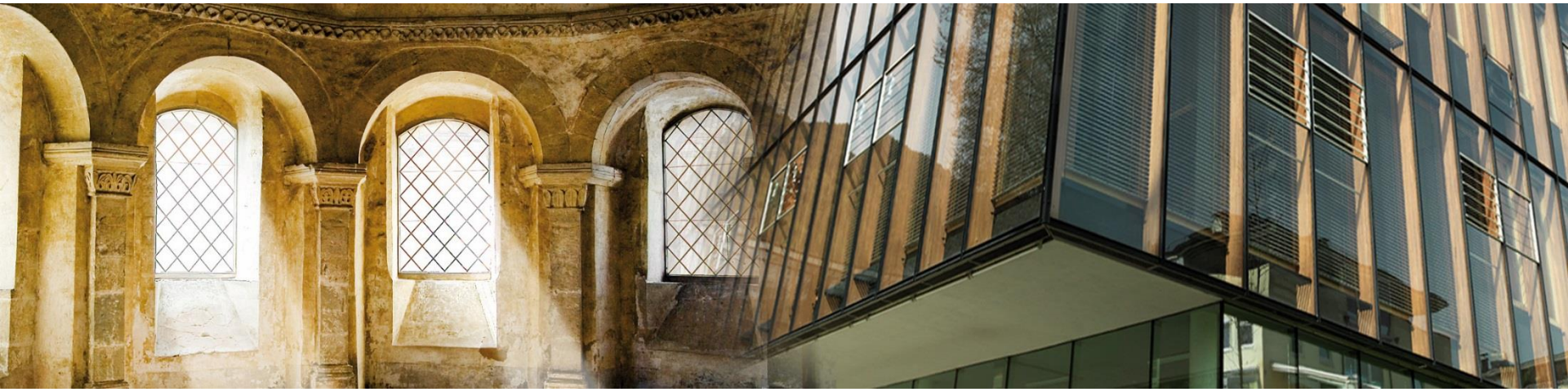

Inflation-adjusted accounting ratios, industry growth and their potential to assign companies into three economic states

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Introduction and problem statement

- Economic and financial stage of a firm cannot be captured by **dichotomous** thinking (bankrupt & non-bankrupt)

- This was recognized relatively early in research (Altman, 1968; Edmister, 1972)

- Degree of corporate health can instead be explained by a **continuum** between the extremes bankrupt and healthy, where a company moves steadily in-between both states (Cestari, Risaliti & Pierotti, 2013; Haber, 2005; Keasey & Watson, 1991; Ward, 1999)

- Despite of several years in research this continuum and the evolution of corporate crisis as well as the occurrence of different stages of corporate health are **not** clearly **measureable** **nor** have been **understood** (Platt & Platt, 2008, p. 132; Pretorius, 2009)

Relevance and aim of the study

Several motivations for the study supporting the relevance:

1. One **cannot** find many research papers analysing the stages of corporate health between solvent and insolvent, a fact which is also confirmed in the literature review of this paper.
2. **Not much attention** has been devoted to business failure prediction research considering the adjustment of accounting ratios for inflation and its effect on the potential early detection of crises and insolvencies.

Aim of the study:

- Division of companies into **three states of corporate health** (insolvent, recovered and healthy)
- **Detect** and **explain differences** between these types of firms using accounting ratios, industry-related accounting ratios and a proxy for insolvency rate of the industry

Methodology and research design

Selection of potential discriminating variables based on literature review
(Accounting ratios, age of the firm, industry-related accounting ratios & GDP_{growth} of industry as proxy for insolvency rate of industry [Altman et al. 2008, p. 229]; selected ratios of profitability were adjusted for yearly inflation)

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Winsorization of data
(proposed by Löffler & Posch, 2006, p. 15-19 in order to increase model quality and to eliminate extreme deviations from normality)

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Descriptive statistics and tests for differences
(using mean, median and standard deviation; test for differences to identify the most important risk drivers as proposed by Porath, 2011, p. 32 using U-test, t-test, ANOVA and H-test)

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Principal component analysis
(check for redundancy of data and to avoid multicollinearity in accordance with Afifi, May & Clark, 2003, p. 274; Chan, 2006, p. 56 and Klecka, 1980, p. 11)

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Computation of logistic regression functions
(in order to differentiate between the different types of companies and to detect the risk drivers)

Literature review (1/2)

- **First papers** in the field of insolvency prediction published by Beaver (1966), Altman (1968), Blum (1974) and Edmister (1972); purpose was to differentiate between **insolvent** and **solvent** firms using discriminant analysis, whereas accounting ratios were the dominant explanatory variables used

- With the years **other** potential **independent variables** were tested:
  - Macroeconomic variables (Hol, 2007; Liou & Smith, 2007; Tirapat & Nittayagasetwat, 1999)
  - Market variables (Chaudhuri, 2013; Kim & Partington, 2015; Kwon. Lee & Kim, 2013)
  - Qualitative variables (Iazzolino, Migliano & Gregorace, 2013; Pervan & Kuvek, 2013)

- A **combination** of accounting ratios with non-accounting ratios leads to improved disctinction between the different types of firms (Altman, Sabato & Wilson, 2010; Grunert, Norden & Weber, 2005; Iazzolino, Migliano & Gregorace, 2013; Muller, Steyn-Bruwer & Hamman, 200)

- Application of accounting ratios is **not** without criticism:
  - Potential for **manipulation** by managers (Keasey & Watson, 1991; Sharma, 2001; Tsai, 2013)
  - **Backward-looking** character (Anderson, 2007, p. 137; Madrid-Guijarro, Garcia-Perez-de-Lema & van Auken, 2013)

Literature review (2/2)

- However, they seem to have **relevance** for prediction purposes as they are especially effective as predictors when companies **move** towards insolvency and they contain in several cases **valuable information** about the economic and financial health of a firm (Ak, Dechow & Sun, 2013; Huang & Zhang, 2012; Milburn, 2008)

- Low number of studies analysing different stages of corporate health (Situm, 2015); mixed results can be found, whereas at the majority of the studies a **clear segregation** between the different stages was **difficult**.

- Empirical evidence shows that the inclusion of inflation **can** help to improve the predictability of models as higher inflation increases a firm's vulnerability to distress and insolvency (Bhattacharjee et al., 2009; Butera & Faff, 2006; Liou & Smith, 2007); however, within the study of Norton & Smith (1979), the consideration of inflation did not provide better classification

Hypothesis and research questions

Hypothesis:

The inclusion of inflation adjusted accounting ratios into a prediction model can improve the segregation of firms into different states of corporate health.

[in some studies the consideration of inflation as explanatory variables for insolvencies increased prediction accuracy of models – e.g. Bartley & Boardman, 1990; Butera & Faff, 2006; Gudmundsson, 2002; Liou & Smith, 2007; Tirapat & Nittayagasetwat, 1999; however, no study was found where inflation-adjusted ratios were applied to the stages of insolvency, recovery and healthy, so that a new design was tried within this study]

Research questions:

- Which accounting ratios are significant in explaining the differences between the various types of firms?
- Can the adjustment of profitability ratios for inflation help to improve the classification accuracy and hence the performance of prediction models?
- Can the inclusion of industry growth help to improve the assignment of companies into the different economic stages of company health?

Definitions and sample description

- **Distress** = two consecutive years of negative NITA adjusted for yearly inflation [in accordance to Krueger & Willard, 1991]
- **Recovery** = two consecutive years of positive NITA adjusted for yearly inflation [similar to the concept of Jostarndt & Sautner, 2008; their distress and recovery indicator was interest coverage based on EBIT]
- Adjustment for inflation based on Coulthurst, 1986, p. 33; Solnik & McLeavey, 2009, p. 43:

$$i_{real} = \frac{(1 + i_{nominal})}{(1 + \text{inflation rate})}$$

- Division of companies into **development** (initial) and **validation** sample

	Development of distress indicator $NITA_{infl.}$				Number of identified companies
	2008	2009	2010	2011	
Insolvent firms (Group = 0)	Companies filed for insolvency under Austrian insolvency law in 2012				64/10
Recovered firms (Group = 1)	-	-	+	+	49/10
Healthy (Group = 2)	+	+	+	+	234/60
Yearly inflation rate	3.2 %	0.5 %	1.9 %	3.3 %	

The industry classes were based on the Austrian ÖNACE 2008 code and contain: B = Mining and quarrying, C = Manufacturing, D = Electricity, gas, steam and air condition supply, E = water supply, sewerage, waste management and remediation activities, F = Construction, G = Wholesale and retail trade and repair of motor vehicles and motorcycles , H = Transporting and storage, I = Accommodation and food service activities , J = Information and communication, L = Real estate activities, M = Professional, scientific and technical activities, and N = Administrative and support service activities.

Main results (Part I)

The table shows the different models computed in order to distinguish between insolvent and healthy firms (model I – IV) and between recovered and healthy firms (model V). Model I consists only of accounting ratios, although within model II a dummy variable has been included denoting the contribution of the respective industry of the firms to GDP growth ($GDP_{growthind.}$). Model III considers inflation-adjusted accounting ratios and this model is replicated in model IV, but here once again the GDP growth variable has been included. Model V contains only pure accounting ratios, as it was not possible to include neither the GDP growth variable nor inflation-adjusted accounting ratios. All of the models have been constructed using the data from the initial sample, although the ratios have been winsorized on the 2 percent level in order to increase model performance as proposed by Löffler & Posch (2007, p. 15 – 19). The explained variance of the models was appraised by R^2 of Nagelkerke (Burns & Burns, 2008, p. 579 – 580). The accuracy was computed by the number of true positives and the number of true negatives, divided by the total number of cases (Fawcett, 2006, p. 862). The results provided are valid for the standard cut-off value of 0.5.

	insolvent vs. healthy				recovered vs. healthy
	Model I	**Model II**	**Model III**	**Model IV**	**Model V**
Statistical values:					
R^2 (%)	12.767	15.806	12.767	15.806	9.484
Sign. Chi-Square	0.057	0.629	0.057	0.629	0.930
Variables:					
AGE	0.029**	0.030**	0.029**	0.030**	0.017*
NITA	6.595**	6.066**	-	-	-
$NITA_{infl.}$	-	-	6.813**	6.267**	-
CFTD	-	-	-	-	2.812
$GDP_{growthind.}$	-	0.913*	-	0.913*	-
const.	0.222	-0.499	0.439	-0.299	0.565
Classification accuracy based on data for the period (t-1) - Initial sample:					
Accuracy (%)	79.530	79.866	79.530	79.866	82.686
Type I (%)	95.313	89.063	95.313	89.063	100.000
Type II (%)	0.000	1.282	0.000	1.282	0.000
Classification accuracy based on data for the period (t-1) - validation sample:					
Accuracy (%)	87.324	90.000	87.324	90.000	85.915
Type I (%)	90.000	70.000	90.000	70.000	100.000
Type II (%)	0.000	0.000	0.000	0.000	0.000

**) statistical significance on the 1 percent level; *) statistical significance on the 5 percent level

Main results (Part II)

- Firms with higher **age** (AGE) are more likely to be assigned as healthy (Bates, 1990; Chava & Jarrow, 2004) [statistically significant, but low weighting]

- **Profitability** (NITA) as indicator for management efficiency (Dambolena & Khouri, 1980; Edum-Fotwe, Price & Thorpe, 1996) shows that insolvent firms are less well managed than healthy firms (deterioration of profitability over time)

- The consideration of **inflation** was **not** beneficial for model improvement: Insolvent firms may show a positive „nominal" profitability; when it turns **negative** in **real values**, then the probability of insolvency increases → REJECTION OF RESEARCH HYPOTHESIS

- The inclusion of **GDP_{growth}** (proxy for insolvency rate of the industry) was beneficial for model building (increase in R^2); firms operating in an industry **positively** influencing GDP growth of the economy are more likely to be healthy; firms in shrinking industries show a higher probability of insolvency (Lennox, 1999a; Lennox, 1999b; Thornhill & Amit 2003; Chava & Jarrow, 2004)

- Firms with higher **CFTD** are more likely to be healthy

Limitations

- Relatively **low sample size**, but higher compared to other published studies (Poston, Harmon & Gramlich, 1994; Whitaker, 1999; Sudarsanam & Lai, 2001)

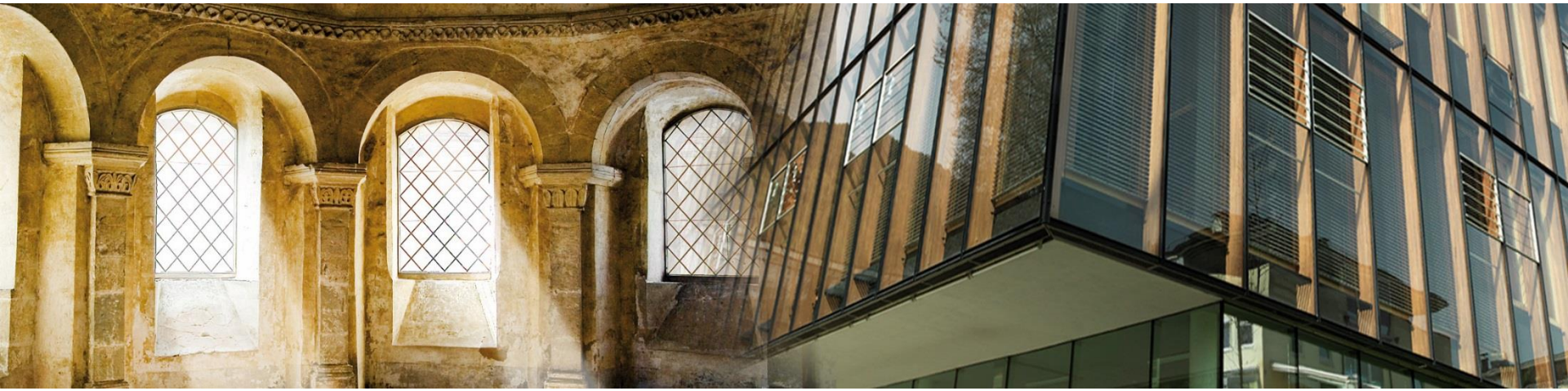
- **Non-normality of data** (even if winsorization was applied); not that relevant for logistic regression (Burns & Burns, 2008, p. 569), but can affect model accuracy (Hopwood, McKeown & Mutchler, 1988)

- **Different proportions** of companies per class were used, which can affect classification accuracy due to sub-optimal estimation (Tufféry, 2011, p. 478)

- Classification valid for standard **cut-off point** 0.5 and research could be extended to check for other cut-off points in order to improve model quality

- **Understanding** about the different stages remains **low** and needs much more research attempts

Contact data



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