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Characteristics and likelihood of dairy processing companies to get in a financial distressed situation

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LIST OF ACRONYMS

CAP	Common Agricultural Policy
CI	Capital intensity
CR	Current ratio
CV	Coefficient of Variation
EBITDA	Earnings before Interest, Taxes, Depreciation and Amortization
FD	financial distress
FDL	financial distress likelihood
FE	financial expenses
FZ	firm size
GAAP	Generally Accepted Accounting Principles
GHG	Greenhouse Gases
IFRS	International Financial Reporting Standards
IOF	Investor-owned Company
LP	Labour Productivity
ML	Maximum Likelihood
NCM	non-cattle milk
PR	Profitability
ROA	Return of Assets
SME	Small and medium-sized enterprise
TA	Total Assets
VIF	Variance inflation factor

ABSTARCT

The need for technological innovation, increasingly volatile milk prices, environmental impacts of milk production and possible change in consumer behavior are suggesting an unsecure future of the European dairy processing industry and the need to assess their financial performance appropriately. Until now, well-known models of financial assessment and bankruptcy prediction were specifically designed for banks and manufacturing industries, but no model covers the particular characteristics of the dairy sector. Therefore, the study uses a binary regression model with respect to characteristic explanatory variables to explain and assess financial distress of this sector. The results are proving a stable financial performance of the sector and reveal the universality of previous models. The study recommends that an appropriate model needs to cover the special characteristics of an industry.

1. INTRODUCTION

1.1.Background

Previous research on the dairy processing industry was focused on growth dynamics (GARDEBROEK et al. 2010) and persistence of firm-level profitability (HIRSCH and HARTMANN, 2014), but no recent study has analysed financial distress of dairy processing companies. This gap could suggest the need for further research because the industry has an unusual market structure (MAHON, 2005), why previous findings are not applicable. To make matters even worse, the sector is also facing environmental concerns of consumers (MILANI et al. 2011) and a tremendous market liberalization with unforeseeable outcomes (LIPS and RIEDER, 2005; BEKKUM V. and NILSSON, 2000). As the future of the industry is currently unsure, it is important to get a better understanding of the financial structure of a changing industry. In this way it can prevent companies from disturbing situations and helps to save costs (JOHN, 1993).

Several particular features explain the special characteristics of the dairy processing industry. Firstly, it is characterized by cooperatives. In comparison to Investor-owned companies (IOF), cooperatives have different financial objectives and face different types of constraints (SOBOH et al. 2012; SOBOH et al. 2011). Secondly, the Common Agricultural Policy (CAP) and other European reforms are influencing the financial and non-financial structures of dairy processing companies (BATOWSKA et al. 2009). The dairy market is highly regulated and protected by milk quota and other significant trade restrictions (CAP). In addition to that, the regulated market includes price stabilisation policies which lead to a poor risk management by dairy processing companies. This development could be a drawback for further challenges because the price volatility will increase after the quota abolition (JONGENEEL and TONINI, 2008; O'CONNOR et al. 2008). Thirdly, the consumer awareness regarding the environmental impact of dairy products is increasing, too (GEBREZGABHER et al. 2010). In the future, companies need to invest in innovations and sustainable technologies to challenge these problems (MILANI et al. 2011). Finally, companies in this sector need stable financial conditions to overcome future difficulties.

To assess the financial performance of a company, previous studies have used and Altman Z-score (ALTMAN, 1968), or a similar modification (ZMIJEWSKI, 1984; OHLSON, 1980) to analyse financial distress and reasons of bankruptcy. Later approaches used a binary logistic regression to estimate the likelihood and significant variables of financial distress (PINDADO

et al. 2008). Adapting these approaches to the special conditions of the dairy industry, would lead to a model, which can do an appropriate assessment of dairy processing companies.

1.2.Problem statement

As explained before, the dairy processing industry is facing an unstable future, which explains the importance of a healthy financial performance. Research on this topic has been carried out, but the findings were based on a comparison between cooperatives and investor-owned companies (SOBOH et al. 2011). Therefore this study will add to the significance of the mentioned findings. Finally, a stable model which takes into consideration the characteristics of the dairy processing sector is useful and necessary to assess the financial performance. To generate reliable results, the main task will be the implementation of financial distress research with the special mentioned characteristics of the dairy sector.

1.3.Research objectives

- To use a quantitative approach to analyze the characteristics and likelihood of financial distress for dairy processing companies in Europe
- Implementing a financial shock to assess the financial performance with respect to future tasks
- To extend and assess the set of explanatory variables to model the special characteristics of a special manufacturing sector.

1.4.Outline of the report

Chapter 2 is going to present future tasks as well as special characteristics of the dairy processing industry. Furthermore, it will also shed light on the research, which was done by previous studies concerning economic topics related to the sector as well as financial distress in general. After that, the third chapter will explain the underlying methodology and the data availability for the study. Finally, the results are part of the fourth chapter and the discussion of them will be done in chapter 5. In the end, the outcome as well as recommendation for further research will be mentioned in chapter 6.

2. EUROPEAN DAIRY PROCESSING INDUSTRY

2.1.Future challenges of the dairy processing industry

The development of the dairy processing sector in the European Union is characterized by a significant structural change. A small share of companies in this sector are explaining a large and growing share of collecting milk and production of dairy products (MAHON, 2005). The validity of this statement differs across the European Union, because the industry is more concentrated in the northern countries (Germany and the Netherlands) than in the southern and eastern countries of the European Union (GARDEBROEK et al., 2010). Beyond this heterogeneous and well-known market structure, the sector is facing an increasing number of future challenges.

Firstly, the sector is protected by policy instruments and market interventions of the European Union. The abolition of the milk quota system will provide new challenges for the whole sector. In contrast to the volatile milk prices in other regions, the European dairy prices are kept stable and isolated (O´CONNOR et al. 2008). The current unimportance of price oscillation and changes for players in the market tend to discourage the development of price risk management tools (O´CONNOR et al. 2008). This poor development could lead to significant financial challenges, because the abolition of the quota system will increase price volatility (O´CONNOR et al. 2008; JONGENEEL and TONINI, 2008) and lead to an overall decreasing milk price (LIPS and RIEDER, 2005). JONGENEEL and TONINI (2008) are going even one step further and issue a warning. The high price volatility of milk could threaten the solvency of industries because overinvestment as well as underinvestment can occur. This development is probably and need to be rectified with additional adjustment costs. In the end, adjustments and awareness of risk assessment tools will be necessary for companies to challenge these tasks efficiently.

Secondly, the public awareness of the environmental impacts of dairy processing and the respective products is increasing as there are several environmental concerns associated with dairy production. Compared to most foods of similar nutritive contents, dairy products are associated with large amounts of Greenhouse Gases (GHG). Especially cheese and whey products are well-known for high levels of GHG and significant wastewater challenges (MILANI et al., 2011). FAYE and KONUSPAYEVA (2012) argue already, that the importance of non-cattle milk (NCM) is increasing globally with respect to cultural, economic and ecological aspects.

One opportunity to address the concerns of consumers regarding environmental issues could be the energy-neutral production of dairy products (GEBREZGABHER et al. 2010). However, this is difficult to implement. The challenge of companies to produce energy-neutrally[1] is more complex than expected. To finance this technology, additional government funding is needed and the uncertainty in relation to the provision of funds can lead to additional risks in production and financing.

Finally, to tackle these environmental concerns, innovations in the dairy processing sector are needed and investments are necessary to improve current technologies with respect to environmental and consumer concerns (MILANI et al., 2011).

2.2.Economic characteristics of dairy processing industry

Need for technological innovations, increase of volatile prices, environmental impacts and possible change in consumer behavior are maintaining an unsecure future of the industry and the need to focus on the economic situation of European dairy processing companies. In this segment, GARDEBROEK et al. (2010) started to shed light on economic growth of dairy processing companies. They used a GMM estimator to quantify the impact of several explanatory variables on growth in terms of assets and employees. With respect to financial variables, they came to the conclusion that financial variables don't play a role in explaining any case of growth dynamics. But nevertheless, this study cannot reveal the importance of financial issues in this sector, because HIRSCH and HARTMANN (2014) used financial and non-financial variables to figure out the persistence of firm-level profitability. Starting to calculate the persistence of profits, they used a GMM estimator and the Return of Assets (ROA) as dependent variable to describe the impact of different explanatory variables on firm profits. Their research revealed that financial requirements matter in terms of risk reduction because firms of sufficient scale should keep liabilities and assets in balance to reduce their risk exposure. Furthermore SOBOH et al. (2011) also listed several challenges of the dairy processing industry and assume that the financial structure of companies will play a major role in this sector to solve future tasks. They suggest that the dairy processing companies are well prepared for future tasks, but their methodology leaves room for further improvements and sophisticated results. The initial idea of their research proved that it is possible to distinguish dairy cooperatives from investor-owned firms (IOF) with respect to financial indicators. The applied binary logistic regression shows that IOFs could be well prepared

[1] Energy- neutral production is part of a broader Dutch sustainable Dairy Chain initiative which focuses on making the entire chain sustainable in the context of three major themes: Energy and Climate, Animal Welfare, and Biodiversity.

because they produce more profitable goods, have lower costs, or have higher production efficiency. In addition to that, their research suggests a strong financial position of cooperatives because those companies have a lower ratio of total debt to total assets, and a higher turnover to fixed assets than IOFs. However, the mentioned characteristics could be important for future tasks, but it is not clear if they matter because they are only ensued from comparison. Therefore, a gap in literature and research becomes apparent. A more sophisticated approach could lead to a better assessment and understanding of the overall financial situation. In this case, knowledge about the likelihood and characteristics of financial distress in this sector can help to address this knowledge gap. Modeling financial distress reflects the financial performance in a better way and simplifies the overall assessment of the financial situation. Finally, describing the reasons for financial distress will deliver significant variables to assess the financial performance of companies (OHLSON, 1980; ALTMAN, 1968).

In the end, financial distress is an important issue to be aware of. It threatens the company's ability to survive (WRUCK, 1990) and for small companies it is often leading to bankruptcy (CARTER and AUKEN, 2006).

2.3.Definitions and approaches of financial distress

A broad range of definitions of financial distress exists. Firstly, GILSON (1989) argued, that financial distress occurs if a company cannot meet fixed payment obligations on debt within a given year, files for bankruptcy or when it needs to restructure its debt to avoid bankruptcy. After that, GIAMMARINO (1989) extended the explanation to characterize the period of financial distress. In his study, the company enters financial distress, when it cannot fulfill the debt contract and ends with either a financial reorganization or with the declaration of bankruptcy. Later on, OFEK (1993) used a more technical definition and takes the whole market structure into consideration. Distressed companies are determined by a poor performance and a fast decline in value. Therefore the companies of a sector are ranked according to their annual stock return. Financial distress occurs when a company loses its position within the top 67% to the bottom 10% of all firms. WHITAKER (1999) also argues that financial distress occurs when firm performance has declined from previous years. This means, the cash flow[2] of a company is less than the current maturities of long-term debt. Finally, studies of MADRID-GUIJARRO et al. (2011) generalized the definition as a broken promise to creditors of a company and PINDADO et al. (2008) summarizes previous definitions

[2] Cash flow is defined as net income plus non-cash charges

and assume, that financial distress of companies not only occurs when they are facing bankruptcy but also whenever operational cash flows are lower than financial expenses and the market value of a company is declining persistently.

Beyond the explanation of different definitions, it is also important to highlight the drawbacks and advantages of financial distress situations. Firstly, ALTMAN (1984) focused his study on the empirical investigations of the costs of bankruptcy. Therefore he assumed, that firms in financial distress situations have a lost in earnings and sales, but finally it was not possible to prove if these costs can be attributed to financial distress. Later on, more sophisticated approaches show that it is necessary to distinguish the impact of financial distress between management decision and the overall business economics (WRUCK, 1990; GIAMMARINO, 1989; GILSON, 1989). With respect to business economics, the production costs are increasing, because financial distress deteriorates the firms' condition to negotiate favorable input prices or credit terms. This explains why suppliers often charge an additional risk premium, when they are worried about the company's ability to pay its debts. Furthermore this could also lead to poorer service conditions and a smaller planning horizon, because suppliers want to tighten the payback period (WRUCK, 1990). The assessment is getting even more complex, when costs for management and reorganizations are taken into account. In that case, significant personnel costs are incurred in financial distressed situations (GILSON, 1989) and a significant deadweight loss needs to be considered (GIAMMARINO, 1989). This is due to higher human resource costs as a result of increased amount of time spent, which can be seen as indirect costs (WRUCK, 1990).

Of course, the time could be spent more productively elsewhere, but the restructuring of the company also provides advantages of choosing less risky investment projects and credit management (GILSON, 1989). This is also proved by OFEK (1993) and WHITAKER (1999) in the short-term of financial distress situations. They analyzed the relation between a firm's capital structure and its operational and financial response to distressed situations and concluded that firms in this situation are more efficient in negotiating agreements with debtholders in the short term. However, situations like this can be ambiguous, because on the one hand financial distress can force managers to do significant value-maximizing choices, but on the other hand a new operating strategy can be costly (OPLER and TITMAN, 1994). Completing the overview on costs of financial distress, it is also important to be aware of indirect costs. Research of CHEN and MERVILLE (1999) found out that indirect costs can have

a significant impact because of foregone investment opportunities. This decline of firm value can rely on patterns of financial decay and missed capital opportunities.

Coming back to the business economic point of view of financial distress, it turned out that financial distress is related to costs because it worsens the relationship towards suppliers, customers, employees and creditors (MADRID-GUIJARRO et al. 2011). These partners cannot be sure of whether the company can meet their financial obligations. This leads to costly precautions to diminish the risk of the creditor (WRUCK, 1990). In addition to this, assuming that risk of bankruptcy is equal to financial distress, DICHEV (1998) results predict substantially lower returns for companies in bankruptcy risk than average returns of a sector.

After the circumstances and awareness of financial distress have been examined, especially the dairy processing industry should be interested in financial distress because the sector is characterized by a significant number of small companies (GARDEBROEK et al. 2010). This is an important issue because small firms in financial distress are often in risk of bankruptcy. This was proved by a qualitative approach for small manufacturing companies and the reason for this development are faster liquidity shortages associated with low cash flows (CARTER and AUKEN, 2006).

After all, the definitions, characteristics, drawbacks and advantages of financial distress are clear and dairy processing companies could just apply the findings of previous research to improve their financial situation. This would be the easiest way, but is not appropriate here because the underlying results are based on research for manufacturing industries or banks. The market structure of dairy processing companies is not comparable with previous research. As mentioned before, the dairy processing companies are facing different challenges and the sector is also characterized by a high share of cooperatives. GENTZOGLANIS (1997) stressed, that economic and financial performances are comparable between cooperatives and IOFs, but this result is only based on financial ratios and an insufficient sample size of six cooperatives and six IOFs. Later on, SOBOH et al. (2011) extended the sample size and used a more sophisticated econometric approach to figure out reliable results, which maintain the significant financial differences between production and financial issues of IOFs and cooperatives (SOBOH et al. 2012). Cooperatives are more restricted than IOFs because they are user-owned and need to keep in mind the interests of their members (SOBOH et al. 2012). On the other side, cooperatives can pay a higher milk price (SOBOH et al. 2011) and are not profit oriented because their long-run profits are significantly below the norm (HIRSCH and HARTMANN, 2014). Also BATOWSKA et al. (2009) came to the result, that researcher need to

be aware of different financial statements between cooperatives and IOFs. These are not always comparable across the sector, because they can be biased due to different interests. In addition to that, it is also not possible to compare financial properties of a dairy processing cooperative with firms from different industries, because financial statements like retained earnings are biased and cannot be used to compare the profitability of firms. Cooperatives can increase the price of milk for their members, which is why profits can be close to zero. V. BEKKUM and NILSSON (2000) are even going one step further and disaggregate cooperatives in greater detail with respect to transaction relationships between member and cooperative. Finally, the mentioned research describes the influence of the member on the alignment of the cooperatives and shows the diversity of cooperatives and incomparability with IOFs.

In the end, not only the market regulations imposed by sector policies but also the special market structures with respect to IOFs and cooperatives give reasons to apply an appropriate estimation, which takes into consideration the different characteristics of the industry to achieve reliable results for dairy processing companies.

2.4.Methodology used to estimate financial distress

The origin and awareness of financial distress stated with the well-known Altman Z-score, which was based on the prediction of corporate bankruptcy (ALTMAN, 1968). This study revealed the importance of financial ratios analysis and used a discriminant analysis approach on a small sample size to predict corporate bankruptcy. Later on, OHLSON (1980) extended the sample size and used an econometric methodology of conditional logit analysis to identify basic factors affecting the probability of failure. The study pointed out that the predictive power of ratios is robust across estimation procedures and the probability of failure is dependent on the size, financial structure and the current liquidity of a firm. Focusing on the previous estimations, ZMIJEWSKI (1984) gave methodological advice regarding the estimation of financial distress because it is important to take biased parameter and probability estimates into account. Reasons for biased results are non-random samples, which oversample distressed firms[3]. Besides biased parameters, it is important to consider multicolinearity in the intertemporal and intersectoral development of models and the data should not be pooled across different years without considering different economic circumstances and characteristics (MENSAH, 1984).

[3] Altman (1968) was recommended by this, because the sample was determined by the same amount of companies, who could meet their financial obligations or not.

After these advices, studies applied either the models or regression techniques of ALTMAN (1968), OHLSON (1980) and DICHEV (1998) or they used financial ratios as early-warning signals of financial performance (HOPWOOD et al. 1989). However, the Z-score of ALTMAN (1968) was not becoming the universal tool for financial risk management, because it varies a lot regarding different industry classifications (GRICE and INGRAM, 2001). Therefore, it is more efficient to re-estimate the variables of Altman's model rather than relying on those reported by Altman (GRICE and INGRAM, 2001). However, modern approaches are aware that financial distress is a process (HILL et al. 2011). They use binary logistic models to estimate the likelihood of financial distress (PINDADO et al. 2008) or a even more sophisticated multinomial logit model, (ÅSTEBRO and WINTER, 2012).

3. METHODOLOGY

Table 1: Overview of the methodology

	Purpose	**Requirements**	**Technique**
Likelihood of financial distress	Model estimation to calculate financial distress likelihood	Defining dependent as well as independent variables for the model with respect to financial distress	Binary logistic regression
Modelling financial shock	characterizing the sensitivity of sudden changing circumstances should give deeper insights into financial structures	detecting a reliable variable, which could deliver significant results	binary logistic regression with changing values of the underlying variables
Comparison with further results	analyzing and comparing the results of different techniques	significant and reliable data from Orbis and comparable studies	Comparing the results of creditworthiness from Orbis and further sources

The underlying conceptual framework in table 1 gives a brief overview of the following methodological aspects with respect to purpose, requirements and techniques of the different steps.

3.1.Model specification

After several definitions of financial distress have already been discussed, the most appropriate and logical definition is based on PINDADO et al. (2008) because it summarizes definitions of previous research (OFEK, 1993; GIAMMARINO, 1989). In this case, financial distress of a company occurs, if two criteria are fulfilled. Firstly, the EBITDA (Earnings before interest, taxes, depreciation and amortization) must be lower, than financial expenses for two consecutive years. This implies that a company has to find new sources to meet his financial obligations. However, this doesn't imply an unfavorable situation in general, because it is still possible to generate liquidity from short-term loans for example. The liquidity constraint is getting even more dramatically if an additional decline in total assets occurs for two consecutive years. PINDADO et al. (2008) used a decline in market value for two consecutive years as second criteria, but as the definition of market value remained unclear, the second criteria in this study is based on total asset decline for two consecutive years.

However, the previous mentioned definition of financial distress is reliable because it reflects also the findings of WRUCK (1990). She found out, that financial distress leads to higher interest of loans, because creditors recognize the unfavorable financial situation of a company and need an additional risk premium to lower the risk of non-payback. The situation is also reflected by the definition of PINDADO et al. (2008). It implies that, the costs of generating liquidity by loans or other sources are higher than selling assets. This led to asset liquidity and is a well-known characteristic of financial distressed companies (DEANGELO et al. 2002). Finally, an unfavorable situation and asset liquidity is captured by the previous definition and determines financial distress. A handy approach to model this situation will be based on binary variables that determine whether or not a company is in financial distress.

3.2.Binary logistic regression

Binary logistic regression is constructed to model the choice between two discrete alternatives (VERBEEK 2008, p.200). In the case of financial distress, it helps to find empirical evidences of financial differences between companies, who are or are not in financial distress. This latter element is described by the binary variable y_i defined as

$y_i = 1$ if company *i* is in financial distress

$y_i = 0$ if company *i* is not in financial distress.

Finally, a binary logistic model describes the likelihood of financial distress for each company *i* and it allows to shed light on the influence and impact of different financial and non-financial independent variables on the dependent variable y_i. Therefore the model can be written as the following

$$y_i = x_i'\beta + \varepsilon_i. \quad (1)$$

In this equation, x_i describes the influence of observed characteristics and the error term ε_i explains the impact of variables, which were not taken into account for the model estimation. The parameters of the model are estimated by the method of maximum likelihood and the distribution between dependent binary variable and explanatory independent variables is assumed to be linear (VERBEEK 2008, p. 202). To calculate the likelihood, that $y_i = 1$ occurs; equation 1 needs to be rewritten to deliver a probability as outcome. For a logit model, this leads to the following equation

$$\text{Ln}\left(\frac{\theta_i}{1-\theta_i}\right) = x_i'\beta \quad (2)$$

where $\theta_i = P\{y_i=1|x_i\}$ is the probability of observing outcome 1 (VERBEEK 2008, p. 202)

3.3.Independent explanatory variables

The underlying table shows a brief description and expected outcome of the explanatory variables for the binary model. A positive hypothesis implies that an increase of this variable/ratio reduces the likelihood of financial distress. For instance, in the case of profitability, an increase in “profitability” should have a positive impact on tackling financial distress by reducing the FDL.

Table 2: Description of the explanatory variables

Variables	Description	Hypothesis
Profitability	EBITDA margin to measure profitability. It is appropriate because it reflects the firm's objective to maximize profit	positive
Current ratio	Ability of a firm to meet financial obligations	positive
Capital intensity	Determines the influence of variable costs	positive
Labour productivity	Ratio of operating revenue and number of employees to describe the growth and input efficiency of companies	positive
Firm size	Ability to finance investments with respect to the size of a company	positive
Financial expenses	Financial expenses is an important variable because it determines the dependent variable and was a significant variable in recent studies	negative

After the dependent variable is defined, appropriate explanatory variables are needed to describe the conditions of financial distress. The right choice has to consider the multicolinearity of financial variables (MENSAH, 1984) and the special economic characteristics of the industry regarding IOFs and cooperatives (SOBOH et al. 2011). The recommendation of MENSAH (1984) and the revision of previous models imply that efficient models don't require a huge set of explanatory variables (PINDADO and RODRIGUES, 2004; ZMIJEWSKI, 1984). However, the model needs to be aware of the economic obligations of

cooperatives. This led to the conclusion, that financial variables are not comparable across the sample and explanatory variables with respect to profits could have biased explanatory meanings. Cooperatives are often adjusting the milk price of their members to distribute the profits (SOBOH et al. 2011; BATOWSKA et al. 2009, p. 56). Therefore BATOWSKA et al. (2009) recommend using the EBITDA margin to measure the profitability of dairy processing companies. On the one hand it is an appropriate measure of profitability across IOFs and cooperatives because it reflects the firm's objective to maximize profit and on the other hand the EBITDA margin offsets a biased picture of profitability due to different tax and capital structure across European member states.

$$\text{Profitability (PR)} = \left(\frac{\text{EBITDA}}{\text{total assets}}\right) \tag{3}$$

In addition to profitability, liquidity, described by the current ratio, could have a significant impact on financial distress, because it reflects the ability of a firm to meet current financial obligations (BATOWSKA et al. 2009) and also determines the persistence of profitability in this sector (HIRSCH and HARTMANN, 2014).

$$\text{Current ratio (CR)} = \frac{\text{current assets}}{\text{current liabilities}} \tag{4}$$

A further important explanatory variable with respect to financial issues is capital intensity. GARDEBROEK et al. (2010) used this variable already to determine growth of dairy processing companies.

$$\text{Capital intensity (CI)} = \ln\left(\frac{\text{fixed assets}}{\text{number of employees}}\right) \tag{5}$$

The reason for the importance of this variable is based on the assumption, that companies with a high capital intensity ratio may have a lower ratio of variable to fixed costs. This can have an influence on the likelihood of financial distress, because firms are able to stay in business if they can cover variable costs. This is much easier if variable costs are low and because of that, a firm with high capital intensity should have a low probability of financial distress.

Also the following explanatory variable, the labor productivity, is based on the growth model of GARDEBROEK et al. (2010)

$$\text{Labour productivity (LP)} = \ln\left(\frac{\text{operating revenue}}{\text{number of employees}}\right) \tag{6}$$

Firstly, it determines the growth of companies. Firms with an increasing value of operational revenue can be seen as growing companies and more resistant against financial distress. Secondly, the ratio of operating revenue and number of employments also reflects the efficiency of using input factors like labour. It makes sense to assume that a high value of labour productivity prevent companies from financial distress.

In contrary, the size of a firm can also have an impact on the financial performance, because the study of HESHMATI (2001) revealed, that in relation to the size, companies are facing different constraints to finance investments. Finally, the firm size is reflected by the value of total assets.

$$\text{Firm size (FZ)} = \ln(\text{total assets}) \qquad (7)$$

In the end, the model will also include the natural logarithm of the financial expenses (FE)[4], because the definition of financial distress is based on financial expenses and previous research of financial distress always used a variable to measure the impact of financial expenses on financial distress (OHLSON, 1980; ALTMAN, 1964). To achieve a reliable model, the assessment of multicollinearity is a step forward (FARRAR and GLAUBER, 1967). Firstly, the correlation of independent variables towards the size of the firm shows a high correlation between financial expenses and firm size during the entire time period (see Appendix table 11). But nevertheless, the correlation between two independent variables is not an appropriate measure of multicollinearity because the explanatory variables can be redefined in a number of different ways, which can influence the individual correlation but not the level of multicollinearity (MADDALA and LAHIRI, 2009, p.287). Therefore, the variance inflation factor (VIF) was calculated to assess multicollinearity (see Appendix table 12). The intention of the VIF is based on the squared multiple correlation coefficient between a x_i and the other independent variables (MADDALA and LAHIRI, 2009, p.284). To calculate the VIFs for each variable, an OLS (Ordinary Least Squares) regression were done for each x_i as dependent variable with respect to the remaining explanatory variables on the right hand side of the model estimation. The results in table 10 support a low level of multicollinearity because the VIF ratio is determined by a low level (MADDALA and LAHIRI, 2009, p.284).

[4] In the sample, a few observations of financial expenses were negative and therefore it was not possible to include them for the model estimation because the natural logarithm doesn't offer any value for such observations.

After all, the whole model can be specified by the following equation

$$\ln\left(\frac{\theta_i}{1-\theta_i}\right) = \alpha_i + \beta_1 CR_i + \beta_2 lnCI_i + \beta_3 lnLP_i + \beta_4 lnFE_i + \beta_5 PR_i + \beta_6 lnFZ_i. \qquad (8)$$

The model will be estimated for IOFs as well as for cooperatives separately because the financial structures are different and SOBH et al. (2012) recommend, that the performance of the cooperatives to IOFs are facing different objectives and this cannot be challenged by the same model.

3.4.Data

The necessary data is from Orbis (Orbis, 2015). Orbis is a database provided by Bureau van Dijk and contains annual report data from the last 10 years of 79 million public and companies worldwide. In Orbis, the two most common annual financial reports are the GAAP (Generally Accepted Accounting Principles) and the IFRS (International Financial Reporting Standards). The financial information is provided by the local chambers of commerce, where the companies are required to report. Furthermore, Orbis has a team of quality controllers, who are solely checking the quality of the data and make sure, that possible updates take place.

The sample for this study will be constructed by choosing all European firms active in the NACE Rev.2 classes 1051 (Operation of diaries and cheese making) and 1052 (Manufacture of ice cream) from 2010 to 2013. The sample is constructed with respect to the mentioned advices. It is a random sample, which includes companies with complete balance sheets of the underlying year (ZMIJEWSKI, 1984). Therefore the number of observations can change across the period of time. This is an important issue. If the sample was defined by companies, who have a complete balance sheet across the entire period of time, the number of companies in financial distress would be biased in the early years. For instance, a company, who is in financial distress in the beginning of the period, could be bankrupt in the end of the time period, which means that the company would be excluded and the important information of the company would not be part of the model estimation in the early years. This explains why it is more useful to have a changing sample size across the period of time because a constant sample size would omit important information in the early years.

Finally, the data is complete and chosen randomly, which reduces the probability of biased estimates and likelihood estimates because the sample doesn’t oversample the number of distressed companies (ZMIJEWSKI, 1984).

Table 3: Description of the sample

	2013	**2012**	**2011**	**2010**
Number of observations	1569	1586	1631	1478
Cooperatives	268	265	306	237
%	17.1	16.7	18.8	16.0
IOFs	1301	1321	1325	1241
%	82.9	83.3	81.2	84.0
Number of observations in financial distress				
Cooperatives	7	2	1	2
%	2.6	0.8	0.3	0.8
IOFs	53	45	37	34
%	4.1	3.4	2.8	2.7

The distribution of the data across years and legal forms of a company with respect to financial distress is explained in table 3. Firstly, the table shows that the amount of IOFs is much higher than cooperatives across the years. The share of cooperatives is stable between 16.0% in 2010 and 18.8% in 2011. Secondly, important information is also provided by the share of cooperatives in financial distress. The number of cooperatives in FD is too low to estimate significant coefficients of a reliable model. In some cases, the amount of cooperatives in FD is even lower than the number of explanatory variables. This cannot lead to an appropriate model estimation, which means that the focus of further models and results will be based on estimations with the data of IOFs.

However, based on the information in table 2 it cannot be concluded, that cooperatives are less often in financial distress than IOFs. As mentioned before, the sample only includes observations with complete balance sheets and this could bias the results. This means that cooperatives or IOFs in financial distress are not part of the sample, if they didn't publish their financial data on Orbis. In the end, the table resumes that the model estimation is only appropriate for IOFs.

Table 4: Descriptive statistics of the sample

	2013	2012	2011	2010
Profitability				
Std. Deviation	0.1375	0.1654	-0.1338	0.1396
Mean	0.0768	0.0828	0.0863	0.0909
CV	1.7903	1.9975	-1.5504	1.5357
Maximum	1.2437	2.3890	1.0313	0.8089
Minimum	-2.0156	-2.3923	-1.3170	-1.6947
Financial Expenses				
Std. Deviation	2.6118	2.6245	2.5777	2.5953
Mean	2.9894	3.1263	3.1176	3.0868
CV	0.8736	0.8394	0.8268	0.8407
Maximum	13.0368	12.8104	12.8713	12.9831
Minimum	-7.3108	-8.3961	-7.0821	-9.5670
Current ratio				
Std. Deviation	3.2833	3.2689	2.6330	2.4260
Mean	2.0582	2.0417	1.9100	1.8900
CV	1.5952	1.6010	1.3785	1.2835
Maximum	44.13	50.724	36	37
Minimum	0	0.017	0	0
Capital intensity				
Std. Deviation	1.3625	1.3638	1.3457	1.3662
Mean	3.7410	3.7500	3.7620	3.7760
CV	0.3640	0.3640	0.3580	0.3620
Maximum	9.5725	9.0590	8.3059	12.1974
Minimum	-2.4270	-2.7090	-5.2890	-7.4970
Labour productivity				
Std. Deviation	1.2796	1.2497	1.2178	1.2190
Mean	5.0290	5.0220	5.0230	4.9770
CV	0.2540	0.2490	0.2420	0.2450
Maximum	10.7530	10.4539	10.5188	10.4053
Minimum	-1.0640	-2.4730	-1.8790	-0.6140
Firm Size				
Std. Deviation	2.6689	2.6653	2.6322	2.5958
Mean	7.0291	7.0333	7.0396	7.0422
CV	0.3796	0.3789	0.3739	0.3686
Maximum	17.2471	17.2011	17.1628	17.1484
Minimum	-6.7503	-6.7509	-6.8057	-6.7565

The upper part of table 4 shows the descriptive statistic of the independent explanatory variables with respect to standard deviation, mean, coefficient of variation, as well as the minimum and maximum observation of the sample in recent years. It doesn't exhibit any unfamiliar pattern of the data.

3.5.Modelling financial shock

One initial goal of this study is to assess the financial situation, but the previously mentioned methodology only reflects the status quo. Further assumptions and scenarios are needed to analyze the overall financial stability of the sector. Therefore it is useful to model some scenarios, which reflect an unpredictable situation. In this case, it is helpful to discuss which variables are appropriate in the mentioned model to generate reliable results. Therefore, the focus of this discussion should be on the value of EBITDA or FE because both variables determine the independent variable and are also part of the right hand side of the model. Finally, changing the value of one of these variables will have the greatest impact on the model re-estimation and could deliver more information about the financial structure.

The reason for this stress test is the uncertain future expectations of the industry, which was mentioned already. Actually, it makes more sense to use the EBITDA to generate a shock, because higher expenses for innovations or increasing price volatility could lead to lower earnings. However, it is quite difficult to model the shock on EBITDA, because it is not clear how a change in EBITDA would affect operating revenue, for instance. Therefore it is assumed, that changing economic circumstances are modeled by an increase of financial expenses.

To do the modelling of a shock, the value of financial expenses will be changed during the different scenarios, because the relationship of financial expenses with the underlying variables is clear. First of all, an increase of financial expenses will increase also the number of companies in financial distress because the financial expenses could get higher than the EBITDA or the value of the total assets could decrease. Finally, the shock can be seen as an additional cost and decrease the net income of companies. Secondly, the right hand side of the model will be also affected by the shock. The explanatory variable financial expenses itself as well as the current ratio, firm size and profitability will change in case of deteriorating financial situation.

3.6.Comparison of results from Orbis

In the end, the model estimation needs to be assessed with respect to reliability and accuracy. As explained before, the findings and results of previous research were based on banks, but several special conditions of the dairy processing industry lead to the assumption, that it is not appropriate to use their outcomes for a proper assessment. Therefore it makes sense to look at the database of Orbis again. Orbis provides two different measures to explain the financial performance of a company. The first one is the global credit risk model FALCON score. It describes the potential of a company to payback their credits. Taking into account different industry and country characteristics, the score is determined by Ordinary Least Square (OLS) and Maximum Likelihood (ML) estimation with different financial variables. Although it is a scoring method, Orbis is able to deliver a likelihood of payback with respect to the FALCON score. But nevertheless, the estimation of the FALCON score could lead to inaccurate results regarding the dairy processing industry because it doesn't take into account different legal status of companies. This could be a drawback because the dairy processing industry is characterized by cooperatives and SOBOH et al. (2011) argue that the financial performance between cooperatives and IOFs need to be considered for reliable results.

Secondly, the Orbis database offers the MORE evaluation, which is also a measure to assess the creditworthiness of companies. It grades companies based on how well they can meet their financial commitments. Orbis states, that the measure is based on a unique model that references the company's financial data to establish an indication of the company's financial risk level. However, it also delivers a likelihood value for each company to assess the financial performance, but the information of the MORE evaluation are vague and it is quite difficult to figure out different purposes of both methodologies. In the end, both measures have the same drawback. They are calculating their indicators of dairy processing companies related to general characteristics of manufacturing industries. This means, they are not taking into consideration the special market structures and European trade policies of the dairy sector. On the one hand, this could lead to superficial results, but on the other hand it delivers a reference scenario, which could help to evaluate future performances.

4. RESULTS

4.1. Impact of the explanatory variables

To assess the performance of a binary logistic regression, several indicators and criteria need to be kept in mind. First of all, the measure "goodness of fit" is important to evaluate the

overall performance of the model. The fit of a model is dependent on the error term or distance between the observed dependent variable and the predicted values of the model (HOSMER JR, et al. 2013). In the case of the present model, the goodness of fit is related to the distance between the defined binary variable and the estimated likelihood of financial distress. To find reliable results, the discussion is focusing on the measures, which are provided by the software package SPSS. Firstly, SPSS provides the Hosmer-Lemeshow Test. This test proposed a grouping technique based on the values of the estimated probabilities (LEMESHOW and HOSMER, 1982; HOSMER and LEMESHOW, 1980). Therefore the first group contains observations with the smallest estimated probability and the last one is defined by observations with the largest estimated probabilities. For the present model, the general SPSS setting of 10 groups is used which is also recommended by HOSMER et al. (1988), if many of the estimated probabilities are small. It means, that the first group contains all subjects whose estimated probability is less than or equal to 0.1 and vice versa, the last group captures those subjects whose estimated probability is larger than 0.9. After that, HOSMER and LEMESHOW (1980) pool the data according to the estimated probabilities and calculate the chi-squared-type-statistic. Then the fit of the logistic model is tested by a computed probability from the chi-square distribution. This implies that the significance of this test should be at least higher than 0.05 because it advices to reject the null hypothesis that there is no difference between estimated probabilities and the observed binary values. But nevertheless, critics came up regarding the grouping methodology because LE CESSIE and VAN HOUWELINGEN (1991) argue that the outcome of the measurement is heavily dependent on the "cut points" of the grouping mechanism and the method would be insensitive to differences among the estimated probabilities within the pooled groups.

Besides the Hosmer-Lemeshow test, a measure of R square is also used to provide additional information. In this case, the Nagelkerke R Square for each year will be added (NAGELKERKE, 1991). Usually, the R square can be interpreted as the percentage of uncertainty, which can be explained by the model. This is only true for the conventional calculation and interpretation of R Square, which cannot be used for non-linear models because it could lead to uninterpretable performances and biased results by adding insignificant variables to increase the value of R square (CAMERON and WINDMIJER, 1997). To deal with binary logistic constraints and relationships, the Nagelkerke R square is used to challenge the limitations of previous R squares. Finally, the Nagelkerke R square is a well-known and often used measure in many

fields of research when binary logistic regressions are used to estimate models (STEYERBERG et al. 2010).

Table 5: Outcome of the model estimation

	2013 Coefficient (B)	2012 Coefficient (B)	2011 Coefficient (B)	2010 Coefficient (B)
Variable (denotation)				
Constant	-2.233	-0.876	-0.401	0.401
Current ratio	0.001	-0.015	-0.11	-0.156
p-value	0.984	0.774	0.378	0.281
exp(B)	1.001	0.985	0.896	0.856
Labour productivity	-0.424	-0.578	-0.97	-0.542
p-value	0.007	0.000	0.000	0.006
exp(B)	0.654	0.561	0.379	0.582
Capital intensity	0.741	0.561	0.555	0.383
p-value	0.000	0.000	0.002	0.036
exp(B)	2.098	1.753	1.741	1.467
Financial expenses	0.107	0.227	0.317	0.408
p-value	0.305	0.061	0.046	0.026
exp(B)	1.113	1.255	1.374	1.504
Profitability	-9.016	-5.836	-6.576	-4.898
p-value	0.000	0.000	0.000	0.000
exp(B)	0.000	0.003	0.001	0.007
Firm Size	-0.268	-0.318	-0.214	-0.519
p-value	0.081	0.059	0.300	0.024
exp(B)	0.765	0.728	0.807	0.595
Number of observations	1301	1321	1325	1241
Nagelkerke R-Square	0.326	0.212	0.323	0.269
LR	314.599	318.513	237.723	235.131
Hosmer Lemeshow Test	0.264	0.217	0.824	0.461

In the table 5, the results of the binary logistic regression are presented for European dairy processing companies from 2010 to 2013. First of all, the results show that the goodness of fit is acceptable because the Hosmer and Lemeshow test proposes to reject the null hypothesis that no difference between estimated probabilities and the observed values exist. In addition to that, the values of R square are also acceptable with previous findings of financial distress for manufacturing industries (PINDADO et al. 2008).

After the overall goodness of fit is described, the significance of the explanatory variables needs to be analysed to shed more light on the reasons of financial distress. Firstly, it is surprising that the financial variable "current ratio" is insignificant. It doesn't deliver any additional information to describe the outcome of financial distress. This is unexpected, because the definition of financial distress is based on financial variables and previous studies for different sectors have already shown that the current ratio is a significant coefficient to explain the financial performance of a company because it gives insights of the financial structure of companies (PINDADO et al. 2008; OHLSON, 1980; ALTMAN, 1968). On the other hand, this outcome is in line with findings of GARDEBROEK et al. (2010), because they proved that financial variables have no impact on the growth of dairy processing companies. Therefore it is appropriate to assume, that the "current ratio" of the dairy processing companies is not an appropriate ratio to assess financial issues. In addition to that, this outcome maintains also the special characteristics of this sector and reveals the universality of models that don't differentiate between sectors or industries. For instance, the results show that it cannot be appropriate to use an Altman Z score to assess the financial performance of companies across different sectors, because the "current ratio" was a significant variable of the mentioned model (ALTMAN, 1968).

To assess the impact and performance of the significant explanatory variables it makes sense to analyse the variables with respect to their odds ratio. For example, the variable "labour productivity" in 2013 has an odds ratio of 0.654 which implies that a 1 unit increase of "labour productivity" increases the estimated likelihood of financial distress by 0.654. This means that a company with a high labour productivity is not in financial distress and it holds also for later years. Besides "labour productivity", "profitability" and "firm size" are also significant variables with an odds ratio smaller than 1 across the period of time. This implies that a company has to increase the value of these variables if it wants to meet its financial obligations. For the explanatory variables "financial expenses" and "capital intensity" it is vice versa, because they have an odds ratio higher, than 1. In the case of financial expenses it

seems to be obvious, but the results of “capital intensity” are unexpected because it was assumed that a company should face a high ratio of “capital intensity, but this odds ratios show that a lower ratio is more appropriate to challenge financial distress.

After characteristic variables of financial distress are clear, it is useful to calculate the likelihood of financial distress to assess the overall financial performance of the industry. Therefore, formula (2) and the estimated coefficients are used to calculate the FDL for every single company. After the FDLs were calculated, descriptive statistics in table 6 were carried out to provide a better overview of the complete industry structure.

Table 6: Distribution of FDL

	Minimum	Maximum	Mean	Std. Deviation
FDL_2013	.000	100.000	3.930	8.969
FDL_2012	.000	99.999	3.237	6.153
FDL_2011	.000	99.609	2.59	7.224
FDL_2010	.003	99.832	2.492	6.499

The descriptive statistic shows, that the financial performance of European dairy processing companies deteriorated, because the mean and standard deviation of FDL increased during the period of time.

4.2.Assessment of the financial shock

The previous chapter provided basic results of financial distress, but it is not possible to assess how the industry will deal with different financial circumstances. Therefore, it is assumed to construct a “stress test”, which reflects higher expenses for financial obligations. As mentioned in the methodology part, different variables were modified with respect to higher financial expenses and the model in (8) was estimated again. The number of observations in the upcoming model is slightly lower, due to the fact that some values for the logarithm naturalist became negative.

Table 7: Financial shock 50% increase of FE

	2013 Coefficient (B)	2012 Coefficient (B)	2011 Coefficient (B)	2010 Coefficient (B)
Variable (denotation)				
Constant	-0.374	0.020	-0.550	1.759
Current ratio	0.052	0.017	-0.172	-0.28
p-value	0.084	0.783	0.293	0.16
exp(B)	1.053	1.017	0.842	0.756
Labour productivity	-0.350	-0.533	-0.837	-0.339
p-value	0.015	0.000	0.000	0.102
exp(B)	0.705	0.587	0.433	0.712
capital intensity	0.625	0.598	0.54	0.241
p-value	0.000	0.000	0.002	0.167
exp(B)	1.868	1.819	1.717	1.272
Financial expenses	0.309	0.394	0.415	0.867
p-value	0.007	0.002	0.011	0.000
exp(B)	1.362	1.482	1.515	2.379
Profitability	-5.751	-5.73	-6.835	-4.073
p-value	0.000	0.000	0.000	0.000
exp(B)	0.003	0.003	0.001	0.017
Firm size	-0.581	-0.547	-0.305	-0.969
p-value	0.000	0.001	0.135	0.000
exp(B)	0.559	0.578	0.737	0.379
Number of observations	1296	1311	1322	1235
Companies in FD	63	58	42	43
%	0.0490	0.0442	0.0320	0.0350
Nagelkerke R-Square	0.254	0.229	0.329	0.278
LR	393.288	380.704	261.073	280.212
Hosmer Lemeshow Test	0.008	0.099	0.853	0.000

In the estimation in the model above, it is assumed, that the financial expenses increase by 50%. First of all, it can be seen, that the goodness of fit for each model deteriorated across the board with the exception of 2011. For the years 2013 and 2010, it is not possible to reject the Null-hypothesis that no differences between estimated values and observed ones exist. Finally, it makes no sense to explain additional performances of explanatory variables, because the overall model is insignificant.

Table 8: Financial shock 75% increase of FE

	2013 Coefficient (B)	**2012 Coefficient (B)**	**2011 Coefficient (B)**	**2010 Coefficient (B)**
Variable (denotation)				
Constant	-0.221	0.118	-1.076	1.706
Current ratio	0.049	0.010	-0.250	-0.396
p-value	0.171	0.892	0.193	0.090
exp(B)	1.050	1.010	0.778	0.673
Labour productivity	-0.371	-0.395	-0.648	-0.213
p-value	0.005	0.006	0.000	0.270
exp(B)	0.690	0.674	0.523	0.808
capital intensity	0.559	0.482	0.429	0.000
p-value	0.000	0.000	0.006	0.218
exp(B)	1.748	1.619	1.536	1.221
Financial expenses	0.360	0.442	0.506	0.948
p-value	0.001	0.001	0.002	0.000
exp(B)	1.433	1.555	1.658	2.581
Profitability	-4.861	-5.107	-6.977	-3.931
p-value	0.000	0.000	0.000	0.000
exp(B)	0.008	0.006	0.001	0.020
Firm Size	-0.563	-0.609	-0.312	-1.049
p-value	0.000	0.000	0.110	0.000
exp(B)	0.570	0.544	0.732	0.350
Number of observations	1296	1311	1321	1235
Companies in FD	71	61	49	49
%	0.055	0.0465	0.037	0.040

Nagelkerke R-Square	0.221	0.201	0.300	0.281
LR	447.11	407.954	306.791	309.623
Hosmer Lemeshow Test	0.005	0.241	0.740	0.000

The same holds also for this model. In this model estimation, the financial expenses were increased by 75% and the main intention is close to the previous model. The "goodness of fit" of the model is comparatively low in two cases, but the model performs very well for the years 2012 and 2011 again. In the end, it is still not possible to assume a reliable pattern of the independent variables. Therefore, this methodology part doesn't deliver any insights concerning explanatory variables. However, there are nevertheless some insights to be obtained from this chapter because the increase of companies in FD delivers additional information. Even in the worst case in 2013, it is only possible to increase the share of companies in FD by 1.6% which seems to be quite low.

4.3.Comparison of different creditworthiness measures

After modelling the financial shock, it is important to assess the present financial performances with different manufacturing industries and risk measures. Therefore the credit risk measures of Orbis were used to construct a reference scenario which provides values of creditworthiness for dairy processing companies. It can be assumed, that the Orbis values do not consider special market structures of the underlying dairy sector because Orbis treats all manufacturing companies in the same way. To compare the outcome of the different measures, a normal distribution of the measures is assumed. Furthermore, the data was plotted and descriptive statistics were carried out. Figure 1 (s. appendix) shows the distribution of the FALCON risk model. As mentioned before, this measure is a score model and the different score level were translated into a likelihood to assess the creditworthiness of companies. This drawback of score measure leads to six different values, which means that the distribution is not sophisticated enough and it is difficult to assess the free space between the pillars of the histogram. Beyond this, the distribution is limited by the low level of the last score. All in all, it doesn't make sense to use the score model as an appropriate measure, because categorizing the performance of different companies can lead to biased results. In comparison to that, the MORE evaluation is more sophisticated than the FALCON scores (s. appendix figure 2). For instance, the histogram is determined by more pillars than the FALCON scores, because the

MORE evaluation provides individual values for each company. Therefore the comparison will be made between the MORE evaluation and the FDL model of this study.

After the different likelihoods of financial distress for each dairy processing company were calculated, the results for 2013 were plotted in Figure 3 (s. appendix). Furthermore, the table below with descriptive statistics helps to explain different normal distributions. Firstly, it must be taken into account that the number of observations is different across the measures. The number of the FDL is the lowest because it dropped observations with missing values. This is not always the case for the measure of the Orbis database because it uses different techniques to estimate missing observations. However, it makes sense to have different sizes of samples because a reduction of the Orbis measures would imply a loss of information and the results of the descriptive statistics are still comparable across different sample sizes. Secondly, the table shows also the limitations of the FALCON scores because the maximum possible value of this measure is only 19.86, which maintains that the FALCON scores cannot be used for an appropriate comparison.

Table 9: Distribution of Creditworthiness measures

	Number of observations	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
FDL 2013	1301	0.000	100	3.929	8.862
FALCON scores	2074	0.00	19.86	5.961	7.365
MORE evaluation	2173	0.1	99.0	12.453	21.457

In comparison to the MORE evaluation, the FDL in 2013 is more conservative because it is based on a lower mean and standard deviation. Both have in common, that the first pillar of the histogram shows the most observations. This means, that a significant share of companies can meet the financial obligations and is not affected by financial distress. But after all, it also helpful to compare the findings of the FDL model with the results of PINDADO et al. (2008) because both approaches are calculating the FDL. The similarities occur concerning the definition of financial distress for the binary regression. But nevertheless, both studies are

using different explanatory variables. The present study tried to cover typical variables of the dairy processing industry and the underlying study of PINDADO et al. (2008) was focusing on financial companies in the USA and other G7 states. Their share of financial distressed companies is ranging from 4.1% in the U.S. to 7.6% in the other G7 states. Therefore the percentage of financial distressed companies in this study is in line with previous findings (PINDADO, 2008; ZMIJEWSKI, 1984; OHLSON, 1980). In contrary to that, it can be concluded that the dairy processing industry reflects a stable financial performance because the mentioned finding of the U.S. market are higher for the mean (7.5%) as well as for the standard deviation (15.09%).

In the end, the results of the study were compared with financial performance measures with differences regarding sample size, methodology and sample definition and it can be resumed, that dairy processing companies in Europe are well performing in meeting their financial obligations.

5. DISCUSSION

5.1. Interpretation of explanatory variables

The first highly significant explanatory variable is "profitability". This one is based on the EBITDA, because it is a comparable variable of the dairy sector across the European industry. On the one hand, it seems to be an appropriate variable because it cannot be influenced by different tax regimes (BATOWSKA et al. 2009), but on the other hand it is also well-known, that the EBITDA can have misleading characteristics in the agribusiness regarding cash flows (OMAR TREJO-PECH et al. 2008). However, the overall goal should be the increase of profitability to encounter financial distress. In this case, HIRSCH and HARTMANN (2014) deliver useful recommendations to generate profitability[5]. Their studies were looking for reasons of persistent profits in the dairy sector. Profit persistence was determined as abnormal profits and modelled by financial and non-financial variables. They highlighted that profit persistence is higher for young and large companies, which keep their liabilities and assets in balance to minimize the risk exposure. In addition to that, profit persistence is also increasing in industries with low levels of competition and R&D expenses.

However, two factors influencing profitability in HIRSCH and HARTMANN (2014) cannot be used as a recommendation with respect to financial distress and future developments. Firstly, they concluded, that the risk exposure concerning liabilities and assets is an important factor.

[5] Profitability in HIRSCH & HARTMANN (2014) is defined as return on assets

This cannot be confirmed with the results of the financial distress model, because the estimation has shown, that the variable "current ratio" is not significant. Therefore it can be recommended that the FDL of dairy processing companies cannot be reduced by the "current ratio" with respect to profitability. Finally, the finding is not only based on this study because the insignificance of financial variables was already proved by GARDEBROEK et al. (2010) in this sector.

Secondly, it is questionable if the overall goal of this sector should be the reduction of R&D expenses to achieve profitability because present studies recommend the opposite for the dairy sector (MILANI et al. 2011). To challenge future tasks regarding environmental concerns and changing consumer behaviour, the sector has to invest in innovations and technologies. Therefore, it is not clear if it is helpful to increase profitability by reducing the R&D expenses. In the end, it is obvious, that the increase of profitability can prevent the dairy sector from future difficulties, but it is not clear, how an increase in profitability can be achieved efficiently. This leaves room for further research and becomes even more complex with respect to the following explanatory variable "capital intensity".

Across the entire period of time, the independent variable "capital intensity" is also significant. For instance, the odds ratio in 2013 shows, that an increase of the ratio by 1 unit would increase the likelihood of FD by 1.748%. The odds ratio of the variable is always higher than 1. This implies that companies with a low FDL have a low capital intensity ratio and the expected mentioned outcome of a high ratio to challenge financial distress is not fulfilled. The easiest way to reach a low level of capital intensity would include fewer investments in fixed assets. This development is in line with positive effects for future tasks because SURAS et al. (2008) highlighted, that innovative activities and investments in fixed assets are competitive processes. Of course, the findings of SKURAS et al. (2008) are limited to SMEs (small and medium-sized enterprises), but nevertheless, it shows the ambiguity of investments in fixed assets and innovative developments. Fewer investments in fixed assets would increase innovative activities to challenge future tasks. In that case, a low ratio of capital intensity is appropriate.

The next significant explanatory variable is "labour productivity". This one is also highly significant across the period of time. The results show, that a high ratio is preferable, because the odds ratio is below 1. Finally it means that high productivity prevents companies from getting into financial distress.

In the end, the last variable “firm size” is also in line with previous findings. It confirms the outcome of HESHMATI (2001) that larger companies have advantages in financing because they have different sources to generate liquidity. It can be concluded, that the size of companies influences not only the profitability of companies (HIRSCH and HARTMANN 2014) but also their financial performance positively.

Summarizing the findings of the model estimation, the discussion shows that typical variables for “growth” are determining the financial performance of companies. This was not expected, because the definition of financial distress was based on financial expenses and previous research has proved the importance of financial variables like the “current ratio”. The results are proving that the universality of Altman’s Z-score can be rejected because one of his explanatory variables was insignificant for the dairy processing sector. In addition to that, the underlying research maintains that an appropriate financial assessment has to include characteristic variables of an industry because they led to significant model coefficients.

Finally, the discussion and the findings are also explaining a mismatch between financial security and innovative developments. Both issues are important for this sector, but it is not possible to challenge both topics in the same way. Following the recommendations of HIRSCH and HARTMANN (2014) means to reduce the R&D expenses to force profitability but the results and discussion of “capital intensity” maintains that reduced investment in fixed assets are characterized by higher innovative activities.

5.2.Reliability of financial shock

In this part of the study, the variable financial expenses and related variables of the model were changed to model a less secure future. It was assumed, that the financial environment of dairy processing industries is becoming increasingly less secure as recent studies have shown, that price volatility is expected to increase. This could be a significant challenge because techniques of risk assessment and prevention are poorly established in the dairy processing industry. Although the model estimation is not appropriate, the applied methodology delivers a few more insights and relationships of the companies regarding financial disturbances. The increase of the financial expenses influences the amount of companies in financial distress. The financial shock shows, those even extreme cases of a 50% or 75% increase have only a comparatively small impact on the number of companies in financial distress. Finally, higher financial expenses or increasing interest rates will only have a comparatively low impact on the financial performance of dairy processing companies.

5.3.Comparison of results

The underlying table 9 gives a brief comparison of relevant measure of creditworthiness.

Table 10: Comparison of Creditworthiness measures and previous results

	sample	similarities	differences
MORE evaluation	dairy processing industry in Europe	measuring creditworthiness for the same sample	the estimation technique is not clear and the size of the sample differs
PINDADO et al. 2008	banks and manufacturing industries in the U.S. and G7 states	the definition of the dependent variable is quite similar	different sample and the underlying study is using different explanatory variables for the model estimation

To analyse the present performance and the future development of the dairy processing industry, different studies and measures regarding estimation technique and sample definition were used. All of them have in common, that they deliver a measure which assess the financial performance of companies. Firstly, the present study used a binary logistic regression model to assess the performance of dairy processing companies. Therefore important explanatory variables were determined by literature review and different characteristics of cooperatives and IOFs were taken into account. Secondly, the MORE evaluation of Orbis was used. This measure delivered also values of creditworthiness for the dairy processing sector, but the dairy companies were classified as usual manufacturing companies and the measure did not differentiate between the legal statuses. Furthermore, the MORE evaluation also used a different methodology to estimate the financial measure. Thirdly the findings of PINDADO et al. (2008) were used to compare the results. Their methodology also uses a binary logistic regression and the definition of the dependent variable is quite similar to the underlying estimation. But nevertheless, the study of PINDADO et al. (2008) was focused on manufacturing companies in the U.S and the G7 states and the independent variables are also different from the underlying research. In the end, the comparison of the different measures proves, that the underlying model estimates lower

values with respect to the MORE evaluation. Finally, the dairy processing industry is maintained by stable financial structures because the descriptive values of the sample are proving a better performance than other manufacturing sectors.

According to PINDADO et al. (2008), an appropriate model has to be based on a fewer explanatory financial variables as financial variables are generally highly correlated with each other and fewer variables diminish the risk of multicollinearity. However, reducing the number of variables is not the only way to challenge mulitcollinearity, because this study has shown, that an increase of diversity with respect to explanatory variables can challenge multicollinearity and delivers an appropriate model to assess financial issues (s. Appendix table 10). Furthermore, the used methodology of PINDADO et al. (2008) shows the same limitations as Altmans Z-score and confirms the findings of the underlying study: It is not possible to use the same model specification for each industry, because it doesn't reflect special characteristics. For instance, it is also true for PINDADO et al. (2008), because they used "retained earnings" as explanatory variable and the use of this variable for the dairy processing industry could lead to biased results with respect to cooperatives (BATOWSKA et al. 2009).

5.4.Definition of the dependent variable

On the one hand, the definition of the dependent variable was easy to apply and delivered interesting insides on IOFs in the dairy processing industry in Europe, but on the other side it was not possible to model the financial performance of cooperatives. In addition to that, it shows that cooperatives and IOFs are characterized by different financial structures. The underlying definition of financial distress is based on financial expenses of companies and this could be the drawback of the definition with respect to cooperatives. Cooperatives have different sources to finance their investments. As mentioned before, the members of cooperatives or the adjustments of the milk price are additional opportunities for cooperatives to finance investments and this is not reflected by financial expenses. This confirms the results of SOBOH et al. (2012) and is an additional evidence for the incomparability of financial statements of IOFs and cooperatives. For further research, it is important to consider different model specification for IOFs and cooperatives.

To complete and finalize the discussion concerning the dependent variable and the model specification, it is important to discuss the findings of ÅSTEBRO and WINTER (2012). They used in their studies a multinomial logistic regression to model the process of financial

distress and finally they recommend either a multinomial coding than a binary coding for financial distress. After the literature review, this was also the initial idea of the underlying research, but the observations couldn´t fulfil the requirements of a multinomial coding. Therefore the simpler binary coding of PINDADO et al. (2008) was chosen.

6. CONCLUSION

The study throughout the report analysed the financial performance of dairy processing companies with respect to financial distress, because the sector is facing an unsecure future development and financial stability. A binary logistic regression model was used to figure out significant explanatory variables to assess the financial situation of companies. After that, the coefficients of the model were used to calculate the likelihood of financial distress for each company. Initially, the explanatory variables were based on the famous Altman Z-Score (ALTMANN, 1968) and other studies (OHLSON, 1980) who dealt already with financial distress. In addition to that, the right hand side of the model was extended by specific "growth" and "profit" variables of the dairy sector to cover the special characteristics of the sector (HIRSCH and HARTMANN, 2014; GARDEBROEK et al. 2010). This combination of variables delivered valuable results and significant coefficients of the model.

First of all, it can be stated, that the overall financial performance of the examined sector is well prepared for future tasks, because the significant variables of the model are demonstrating a low financial distress likelihood of the sector. After having carried out a comparison of different measures of creditworthiness and research results, it can be concluded that the sector is doing well. Even sudden financial shocks, which were characterized by an extreme increase of financial expenses, couldn't change the amount of financial distressed companies tremendously. What was already suspected by SOBOH et al. (2011) has now been confirmed by a significant model. The European dairy processing sector has a good starting point for further challenges,

Secondly, the significant explanatory variables show that an efficient financial assessment of companies has to include financial as well as non-financial measures. The most efficient companies with respect to financial distress are large companies with high profitability and labour productivity and a low amount of financial expenses as well as a low capital intensity ratio. Furthermore, the outcome of a low "capital intensity" ratio was unexpected because it recommends either a reduction of fixed assets or an increase of employees to challenge financial distress. In contrary, the results of this study are going even beyond the outcome of

GRICE and INGRAM (2001). They recommend only a re-estimation of the Altman Z-score variables, but this study shows that the Altman-Z score variables are not always significant. This means that a complete model specification with different variables can be more efficient because it reflects the special characteristics of a sector. In the end, the different model specification should not only be based on different manufacturing sectors but also differentiate between different statuses of companies.

Further research required to address the mismatch of financial performance and R&D expenses. What could be the best balance between financial stability and R&D expenses for a dairy processing company in Europe to tackle future challenges? This is an interesting topic for dairy companies because their decision regarding future performance will be driven by both variables. Furthermore, it would be interesting to specify a model, which can assess the financial performance of cooperatives. The available definition of financial distress was not appropriate to model the performance of cooperatives. This particular finding proves the different opportunities existent for IOFs and cooperatives to finance investments and the need to use different models to assess their creditworthiness. This also lays out possibilities for further research in this field.

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8. APPENDIX

Table 11: Correlation of "Firm size" with the remaining explanatory variables

	Firm size			
	2013	**2012**	**2011**	**2010**
Profitability	-0.2	-0.098	-0.083	-0.056
Current ratio	-0.007	-0.069	-0.026	-0.059
Capital Intensity	-0.309	-0.345	-0.332	-0.268
Labour productivity	-0.236	-0.18	-0.1	-0.32
Financial expenses	-0.649	-0.737	-0.807	-0.817

Table 12: VIF of the different OLS estimations

		FZ	PR	FZ	CI	CR	LP
2013	FZ		1.021	1.319	1.57	1.049	1.533
	PR	3.316		2.377	1.631	1.055	1.849
	FE	1.844	1.023		1.645	1.015	1.826
	CI	3.173	1.014	2.378		1.054	1.667
	CR	3.309	1.025	2.291	1.647		1.865
	LP	2.736	1.016	2.332	1.473	1.055	
2012	FZ		1.028	1.292	1.61	1.052	1.607
	PR	3.486		2.465	1.682	1.05	1.907
	FE	1.827	1.028		1.695	1.025	1.893
	CI	3.311	1.019	2.465		1.058	1.691
	CR	3.465	1.019	2.388	1.695		1.93
	LP	2.893	1.012	2.41	1.48	1.055	
2011	FZ		1.02	1.282	1.58	1.06	1.552
	PR	3.59		2.635	1.63	1.066	1.885
	FE	1.747	1.02		1.634	1.026	1.836
	CI	3.468	1.017	2.632		1.072	1.658
	CR	3.545	1.013	2.518	1.633		1.9
	LP	2.923	1.01	2.539	1.424	1.07	
2010	FZ		1.028	1.244	1.556	1.079	1.524
	PR	3.522		2.64	1.585	1.076	1.899
	FE	1.662	1.029		1.583	1.041	1.81
	CI	3.462	1.029	2.637		1.087	1.632
	CR	3.493	1.016	2.522	1.581		1.905
	LP	2.818	1.025	2.506	1.356	1.088	

Note: The vertical axis describes the single dependent variable of the OLS estimation and the horizontal axis describes the remaining explanatory variables with respect to the underlying year

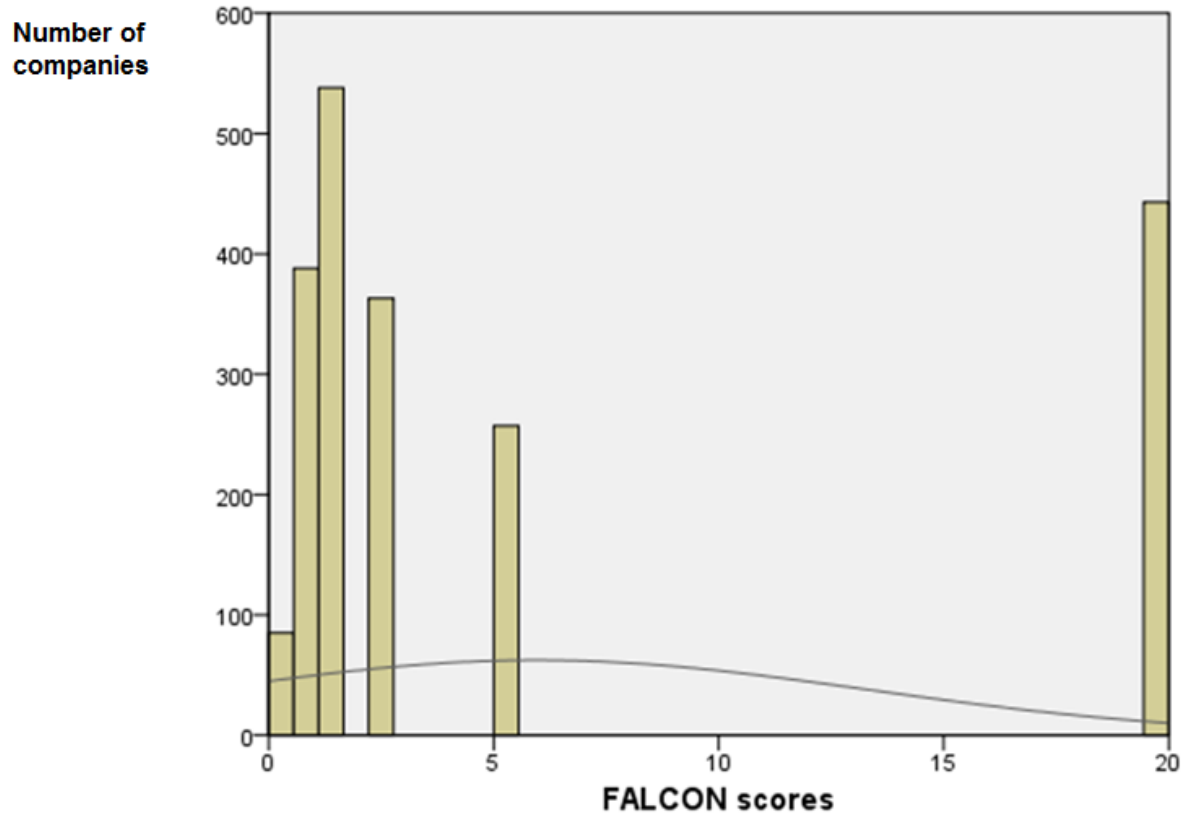

Figure 1: FALCON scores

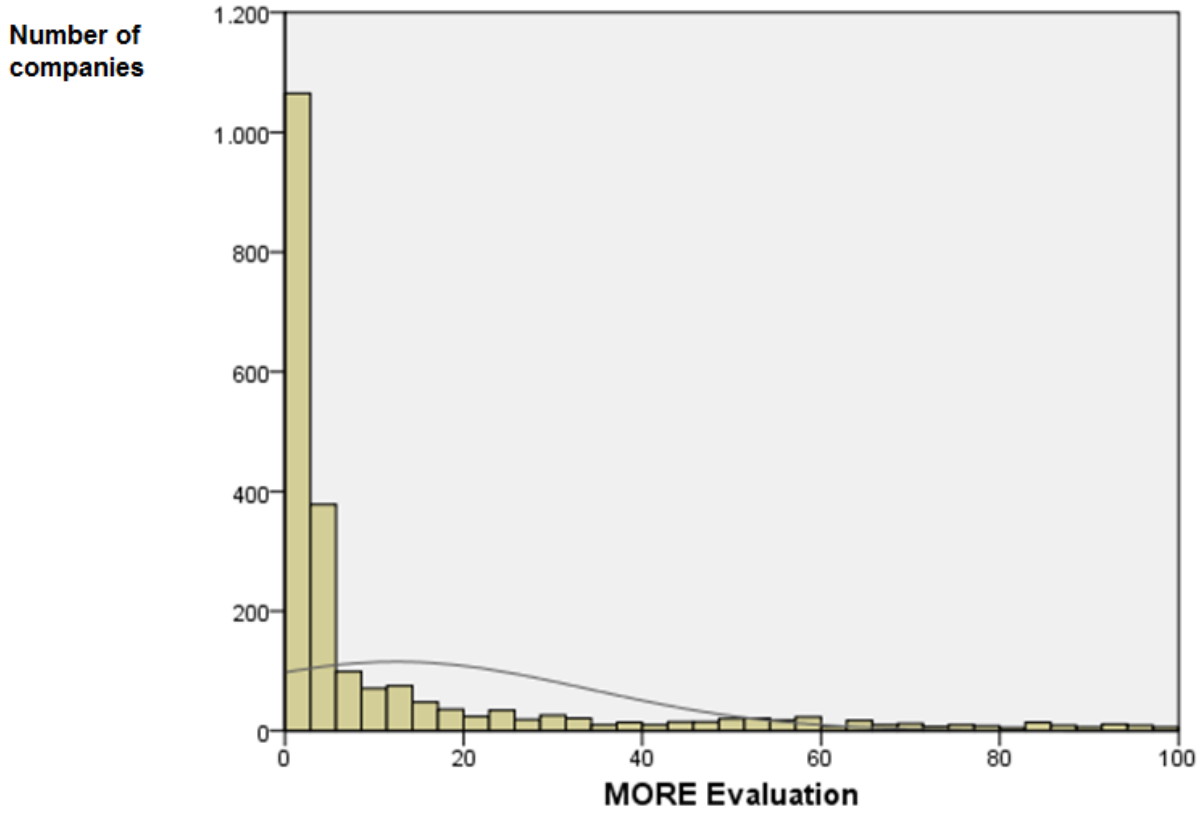

Figure 2: MORE Evaluation

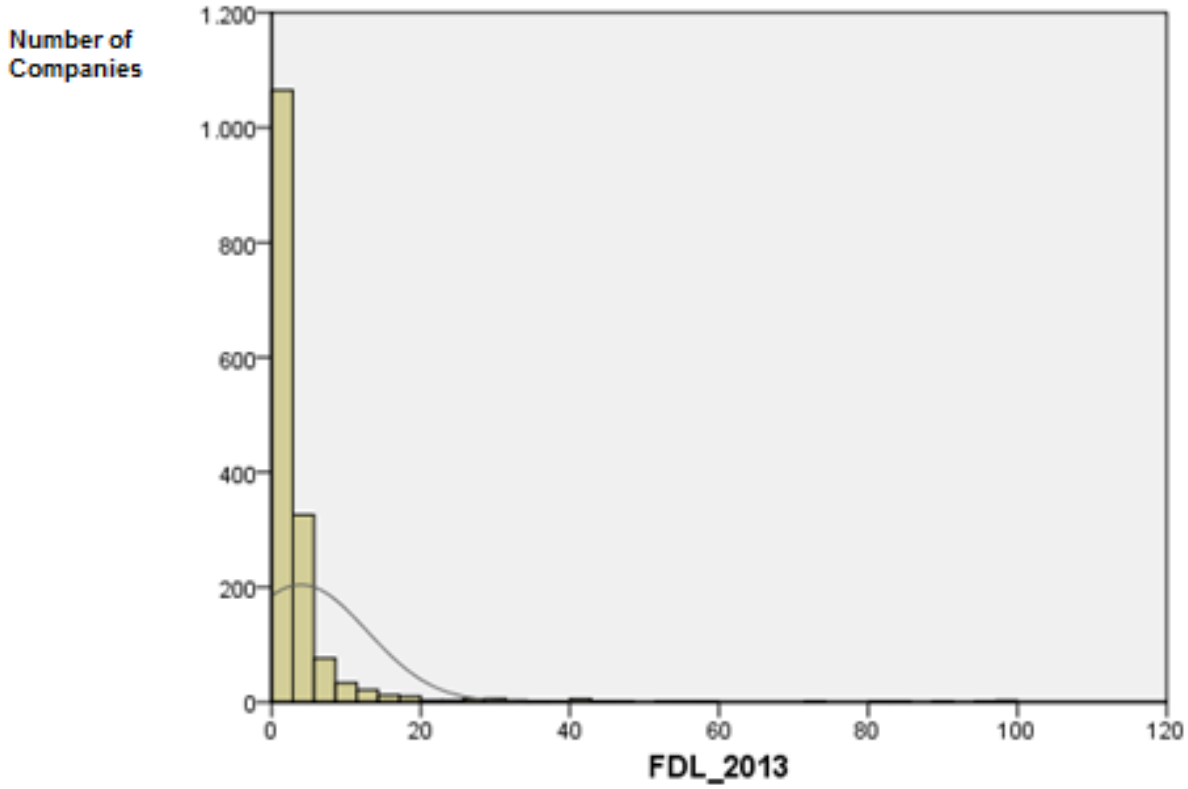

Figure 3: FDL distribution in 2013

APPENDIX II – Personal Declaration

PERSONAL DECLARATION

I hereby affirm that I have prepared the present paper self-dependently, and without the use of any other tools, than the ones indicated. All parts of the text, having been taken over verbatim or analogously from published or not published scripts, are indicated as such. The thesis hasn't yet been submitted in the same or similar form, or in extracts within the context of another examination.

Place,

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Student's signature