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BANKRUPTCY PREDICTION MODELS: CASE STUDY OF AS TERE

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CONTENTS

Abstract 4
Introduction 5
1. Definition of bankruptcy 7
1.1. History of bankruptcy and bankruptcy law 7
1.2. Bankruptcy law development in Estonia 8
1.3. Law and processes of bankruptcy in Estonia 9
1.4. Reorganization process 11
1.5. Definition of bankruptcy conclusions 12
2. Evolution of bankruptcy prediction models 13
2.1. Univariate Analysis 13
2.1.1. Limitations of univariate analysis 14
2.2. Multiple discriminant analysis 15
2.2.1. Altman Z-Scores 15
2.2.2. Limitations of MDA 19
2.3. Logit and Probit models 19
2.3.1. Ohlson O-Score 20
2.3.2. Martin Grünberg Logit model based on Estonian manufacturing firms. 20
2.3.3. Zmijewski probit score 21
2.3.4. Limitations of Logit and Probit models 23
2.4. Neural Networks 23
2.4.1. Odom and Sharda 1990 24
2.4.2. Limitations of Neural networks 24
2.5. Discussion on models used for analysis of AS Tere and reasons of their selection 25
3. Analysis of Tere AS 27
3.1. History of Tere AS 27
3.1.1. Overview of Tere AS 27
3.3. Tere AS reorganization plan 30
3.4. Analysis of accounting data 32
4. Conclusions of accounting data analysis 42
Conclusion 43
LIST OF REFERENCES 45

Abstract

The aim of this research is to find out if bankruptcy prediction models could have predicted insolvency for AS Tere, the models used are Altman Z”-Score, Zmijewski-score and Martin Grünberg Logit model, and if so than which of the models has the most accurate prediction ability. The models were selected on the basis of previous research results and the time period used for data is 1 January 2011 up to 30 June 2016. The first part of the research is theoretical and literature review is used for its compilation. The first part researches the meaning of bankruptcy and its substance in Estonian law, illustrates the development of bankruptcy prediction models, and investigates the most suitable model to be used for an Estonian company. Second part of the research introduces the insolvent AS Tere, quantitative research methods are applied in order to analyse the accounting data collected from its annual reports with the selected bankruptcy prediction models. The accounting data analysis resulted in Altman Z"-Score being the most accurate predictor of distress, as the Z"-score implied clear distress for AS Tere on the both fiscal years leading up to insolvency. Zmijewski- score had mixed results as distress was predicted two years prior to insolvency but failed to do so in the year leading up to insolvency. Although as the closer research suggests this might have been due to some irregular financial reorganization by AS Tere during that period. Martin Grünberg Logit model failed to show any signs of distress.

Keywords: Bankruptcy prediction models, Altman Z"-score, AS Tere, insolvency

Introduction

Detection of financial difficulties in a company has been a subject of research for a long time. Before the development of bankruptcy prediction models in the 1960s and other quantitative measures of company performance like ratio analysis, qualitative type of information was assessed in order to determine the credit-worthiness of a certain company (Altman 2000).

I find that conducting previously mentioned analysis on a company is vital, even with the current economic climate being stable. Because, as the previous financial crisis of 2008 showed us that many companies with good financial health can survive even in the toughest of times. Bankruptcy prediction models often classify firms as either bankrupt or distressed or non bankrupt and not distressed, but this prediction is not a death sentence and lessons can be learned and changes made by analysing the findings of the models.

While bankruptcy prediction models are recommended to be used by managers to analyse the well being of their company, it is just as important for potential investors, business partners, creditors or even job-seekers in order to assess the risks related to a certain company.

The research problems to solve are: why did a very popular brand like "TERE" encounter financial difficulties, especially given the fairly good current economic climate and which bankruptcy prediction model would have been the best indicator of possible trouble ahead. In order to find answers to those problems this paper researches the meaning of bankruptcy and its substance in Estonian Bankruptcy Law along with the development of bankruptcy prediction models. The research into the development of bankruptcy prediction models is aimed at trying to find the models that are most applicable for the Estonian economic environment. In the lead up to the quantitative part of the research the insolvent case subject AS Tere and the ongoing restructuring process is investigated. The final research task is the quantitative analysis of accounting data from annual reports of AS Tere from 2011-2016 by the use of bankruptcy prediction models previously selected.

The theoretical part of the research paper consists of three chapters, compiled by reviewing various books, scientific journals and other sources. The first chapter considers the history and definition of bankruptcy and the law related to bankruptcy and the processes relating to it in Estonia. Second chapter provides an overview of the evolution of bankruptcy prediction

models. Third chapter analyses the models used in this research more specifically and illustrates the reasons behind their usage.

The fourth chapter provides a short overview of the company under analysis and investigates the data collected from its annual reports with the chosen bankruptcy prediction models. This chapter also analyses each of the models used in detail, and how each individual ratio used in a particular model possibly affects its final result.

The conclusion will restate the aim of this research and briefly describe the main results. List of conclusions and assessments will be stated along with a discussion of possible areas of further research.

1. Definition of bankruptcy

It is difficult to define bankruptcy as it applies differently in various systems, but in general bankruptcy is a legal proceeding, involving a person or business that has become insolvent (Segal 2017).

From this we come to the importance of bankruptcy law, which has three objects in mind. Firstly, it aims to protect the creditors from each other and to secure a proportional division of the insolvent debtor's property among all his creditors. Secondly to prevent the insolvent debtor to act detrimental to the interest of the creditors. The third objective is to protect the debtor from its creditors, by cancellation or discharge of debt to some degree, but this is not a fundamental feature of the law (Levinthal 1918, 225).

According to bankruptcy law on its basis can be divided into two distinct groups depending on if the main goal of the law is to protect the interests of the debtor or the creditors. In the U.S.A and France the main goal of the laws is to give the insolvent debtor a chance for redemption, elsewhere the creditors interests are more primary (Varul 1994).

1.1. History of bankruptcy and bankruptcy law

The history of bankruptcy runs parallel to the history of credit, which most likely dates back as long as the history of humanity (Kilborn 2012, 1). Although there were instances of good intentions towards the debtor before the sixteenth century, most insolvency related laws were still very basic and involved some brutal punishments towards the insolvent entity. Bondage, corporal punishment, debt slavery and debtor's prisons were used. The debtor becoming insolvent was considered as theft, and the roman notion of "insolvent thus a swindler" worked like a distorting shadow to explain how insolvency had occurred (Gratzer, Stiefel 2008, 6). It was also very common in a rural society that debt enforcement lead to the transfer of debtor's family land rights to a creditor (Kilborn 2012, 1).

The need for some rules to help the debtors was seen as early as by the rulers of ancient Sumer and Babylon, who saw the need to impose periodic debt amnesties to to maintain social stability (Kilborn 2012, 1). In Roman law *Cessio bonorum* (Latin: a cession of goods) was the Roman equivalent and the historical ancestor of modern bankruptcy. While its roots are in antiquity, at

the end of the middle ages (13th-15th century) *Cessio bonorum* became a common remedy for urban insolvents (Linehan 1984, 488).

The emergence of bankruptcy as a debtors right, not subject to waiver, with a primitive discharge and exemptions for after-acquired assets as well as the distribution of assets preferring secured creditors, was the creation of fourteenth- century Italian Commentators (or Post-glossators) in the fourteenth century (Linehan 1984, 486). The commentators introduced several important features, the most important being that the mere stoppage of payment constitutes as an act of bankruptcy. Second one being that the bankruptcy was dated back for a certain length of time, and all acts done by the debtor while on the verge of insolvency were rendered void or voidable (Levinthal 1919, 242).

In the following years, many countries in Europe adopted those principals, and one of the first modern bankruptcy legislation was adopted by Henry the 8th in England in 1542, it was called the "Statute of Bankrupts 1542" (BankruptcyData 2015).

In the United States, the first federal law regarding bankruptcy was passed by the congress in 1800, it was called "The Bankruptcy Act of 1800" (Haynes 2016). The Bankruptcy Act of 1898 was the first to give companies in distress an option of being protected from creditors (Bankruptcy Data 2015). Voluntary bankruptcy was authorized in England in 1849 (Knight 2010). Multiple other acts proceeded all around the world, improving the law one by one. To continue we will look at the Bankruptcy law in Estonia, as it is more relevant to the analysis of AS Tere.

1.2. Bankruptcy law development in Estonia

Estonian Bankruptcy Law (EBL) has been modelled on the bankruptcy laws of multiple countries. Mainly the Swedish bankruptcy law, but also the German, US, French, Finnish and other bankruptcy laws have been taken into account, also the laws that were in force before 1940 in Estonia (Varul 1994).
During the development of the EBL in Estonia the interests of creditors were considered more important, because the lawmakers were hoping the laws would strengthen the credit system and give outside creditors more confidence (Varul 1994).

Estonian Dictionary 2013, explains bankruptcy as hopeless insolvency. According to the Estonian Bankruptcy law an insolvent person is one who has been recognised so by the court. The person or in this case the debtor is insolvent when he cannot satisfy the rightful claims of the creditor and that inability is not temporary due to the economic situation of the debtor The terms insolvency and bankruptcy are often confused as not all insolvencies lead to bankruptcy (Raudsepp 1999).

Insolvency as a concept is known in economics and legal sciences with two different meanings:

- Cash flow insolvency, this represents a situation where the debtor is not able to fulfil the creditors claims for the agreed upon date;
- Balance sheet insolvency, which represents a situation where the debtor's liabilities exceed their assets (Fletcher 1999).

Insolvency for a natural person or a juridical person is different. A juridical person is insolvent if the entrepreneur cannot repay for the goods or services from their business partners in the correct time, or fill their obligations to the banks or the tax office (Piiroja 2009). Juridical person debtor is insolvent also if the debtor's assets do not cover their liabilities and that financial state is not temporary from the debtor's point of view (Pankrotiseadus).

There are two exceptions regarding the application of EBL, as a state or a local government organisation cannot be declared insolvent and in case of insolvency for a credit or an insurance company EBL is enforced together with other special provisions (Varul 1994).

1.3. Law and processes of bankruptcy in Estonia

Due to the Estonian Bankruptcy law the goal of a bankruptcy proceeding is to satisfy the claims of creditors with the debtor's assets according to the procedure prescribed in the law, or through reorganization of the debtor's firm. During the bankruptcy proceedings the reasons of the debtor's insolvency are determined (Pankrotiseadus, §2).

Bankruptcy proceedings can be held as an out of court or regular court proceeding. A Bankruptcy proceeding is applied civil court proceeding laws, unless it is stated differently in the laws. Disputes over claims, including recognizing claims, reclaiming of assets and disputing the decisions made in the creditors general meetings are done in the action proceedings. Naming

the temporary manager (trustee), announcing bankruptcy and other bankruptcy proceeding related matters are solved during a actionless proceeding (Pankrotiseadus).

Bankruptcy manager is a court appointed trustee who controls the economic activities of the insolvent debtor, defends the bankruptcy estate and defends the rights and interests of all creditors and the debtor. The trustee is the lawful representative of the debtor, and they conduct transactions with the bankruptcy estate and represent the debtor in estate related disputes (Kohtutäiturite ja pankrotihaldurite koda).

Generally the processing of a bankruptcy proceeding belongs in the competence of the county court and the application for bankruptcy is presented to the court according to the debtors jurisdictional location. In the case where several different bankruptcy applications have been made regarding one debtor, they will be processed in one unified proceeding and initially the applications will be reviewed by the court that received the first application. Bankruptcy application can be presented to the court by the debtor or a creditor (Pankrotiseadus). In the bankruptcy application both sides have to explain the debtor's insolvency. If a Limited Liability Company(OÜ) for an example becomes insolvent and the insolvency is not temporary, the board must without delay, but not later than after the passing of 20 days since the occurrence of the insolvency present the court a OÜ bankruptcy application (Äriseadustik).

The bankruptcy application is reviewed during a hearing, where all parties of the proceeding and the temporary manager (trustee) are invited to. During the hearing the court will decide if the application should not be reviewed, the proceeding closed and to leave the bankruptcy undeclared due to languishment or to declare bankruptcy. The bankruptcy application will not be reviewed if the creditor does not show up to the hearing or they have not paid the fee for the temporary manager and the deposit determined for the cover of proceeding costs. Bankruptcy law §29 states the reasons for not declaring bankruptcy. The court will end the bankruptcy proceeding, without declaring bankruptcy due to languishment, despite the debtor’s insolvency: if the debtor has no assets to cover the bankruptcy proceeding costs and there is no possibility to repossess or reclaim assets. The court may also end the bankruptcy proceeding due to languishment despite the debtor’s insolvency, also when the debtor’s assets are mainly compiled of transaction recovery claims, claims against third persons or the bankruptcy application presenter does not pay the court fee (Pankrotiseadus).

According to the Estonian bankruptcy law § 157, there are other ways to close a bankruptcy proceeding (Pankrotiseadus):

1) if the bankruptcy petition is dismissed (subsection 27 (5));
2) in the event of abatement of the bankruptcy proceedings (§ 158);
3) if the basis for bankruptcy ceases to exist (§ 159);
4) with the consent of the creditors (§ 160);
5) by approval of the final report (§ 163);
6) by approval of a compromise (§ 183);
7) on other bases provided by law.

1.4. Reorganization process

This research will also talk about an alternative to bankruptcy called reorganization. Reorganization law has only recently found wider usage in Estonia, the Reorganization law was passed 26th of December 2008. The motivation for the creation of the law was to try and find a way to satisfy a larger amount of creditors claims towards a debtor and to help the insolvent company to avoid bankruptcy proceedings and liquidation. This would be done by enacting various processes to help the insolvent company to continue its activities and pay off its debts in a longer period of time. As in the case of a bankruptcy proceeding the usual outcome involves the liquidation of the insolvent company and inability for a lot of the creditors to claim what they were owed. While in the during a bankruptcy proceeding the survival of the insolvent company is still a possibility, it is a very rare occasion (Piiroja 2009).

Only the insolvent or potentially insolvent company can apply for the reorganisation process to be started. This cannot be done when a bankruptcy application has been filed. When applying for it, the company must present reasons for financial difficulties, proof of future insolvency and/or evidence that the sustainable operating of the company post reorganization is necessary (Ibid).

After the reorganization process has been initiated, the reorganization adviser puts together a reorganisation plan and sends it to the creditors for inspection. The creditors will vote either to refuse or approve the plan, following the vote the court will then approve or refuse the plan (Ibid).

As this is quite a new law in most of Europe, the results of these processes can be unpredictable.

1.5. Definition of bankruptcy conclusions

The Estonian bankruptcy law was developed in a time when building confidence amongst potential investors was vital. For that reason EBL leans towards protecting the creditor, unlike the system in the US or France for an example. But as both laws have their pros and cons, and we can see new laws being introduced in Estonia like the reorganization process law that we encounter in this research. The reorganization process aims to reduce the number of liquidations and this indicates the movement towards the middle ground of the two main bankruptcy law models that focus mainly on protecting the interests of the debtor or the creditor. This is a very welcome step as something that is very important to consider in this process is the interests of the general public as the bankruptcy process also impacts the employee's consumers and other parts of the society.

2. Evolution of bankruptcy prediction models

In this paragraph we will look at the most important forms of bankruptcy prediction models. As we can see in table one, there are three main areas where people have conducted their studies in, MDA analysis, Logit analysis and Neural networks. All three of the methods will be covered by their chronological order of development, which can also be seen by looking at table one, along with the early development of ratio analysis. (Gissel 2007).

Table 1. New bankruptcy prediction studies, 1960-2007

	Discriminant Analysis	Logit Analysis	Probit Analysis	Neural Networks	Other
1960s	2	0	0	0	1
1970s	22	1	1	0	4
1980s	28	16	3	1	7
1990s	9	16	3	35	11
2000-2007	2	3	0	4	3
Overall	63	36	7	40	26

Source: Gissel (2007, 6-7); Model types
Notes: Seven Studies had more than one method which could be considered "primary" thus, the number of studies listed exceeds 165. "Other" methods include linear probability, judgmental, Cusp catastrophe, and Cox proportional hazards models.

2.1. Univariate Analysis

Bankruptcy prediction dates back to the 1930, as the Bureau of Business Research analysed 24 ratios of 29 firms to determine the common characteristics of failing firms. The average ratios of all the firms were compared to ratios of failing firms to identify the indicators of weakness. The study found eight ratios: Working Capital/Total Assets, Surplus and reserves/Total Assets, Net Worth/Fixed Assets, Fixed Assets/Total Assets, the Current Ratio, Net Worth/ Total Assets, Sales/Total Assets, Cash/ Total Assets (Gissel 2007). In 1932 Fitzpatrick conducted a similar paired sample study in the US. A paired sample design is that for each failed firm in the sample, a non failed firm of the same industry and asset size is selected (Beaver 1966). Fitzpatrick matched 19 pairs of firms and found the best discriminators to be net profit/net worth and net worth/debt. These early analyses were mostly done in order to assess the credit worthiness of

borrowers (Morris 1997). Other users outside of credit lenders included credit rating agencies, investors and management (Beaver 1966).

A financial ratio is a quotient of two financial statement numbers. The ultimate motivation of Beavers research was to provide an empirical verification of the usefulness in this case the predictive ability of accounting data. Beaver's argument for the usefulness of ratio analysis was that a firm is a reservoir of liquid assets, which is supplied by inflows and drained by outflows. The reservoir itself serves as a buffer against variations in the flows. Solvency of a firm can be defined in terms of the probability that the reservoir will be exhausted, at which point the firm will be unable to pay its obligations as they come due. On the basis of those concepts all other things being constant he stated four propositions (Beaver 1966):

- The larger the reservoir, the smaller the probability of failure
- The larger the net liquid-asset flow from operations, the smaller the probability of failure
- The larger the amount of debt held, the greater the probability of failure
- The larger the fund expenditures for operations the greater the probability of failure

The four propositions were used to form predictions regarding the mean values of six financial ratios: cash flow/total debt, net income/total assets, working capital/total assets, current ratios and the no-credit interval all predicted as: (non failed>failed) and total debt/total assets as: (failed>non failed) (Beaver 1966).

2.1.1. Limitations of univariate analysis

Ratio analysis shows that accounting data can be evaluated in their utility and that utility can be defined in terms of predictive ability (Beaver 1966).

But there are limitations as well, as the usage of matched pairs which is biased. As the chances of a company failing in the time window studied is probably not 50%, but more nearly between 2% and 10%, with a 20% upper boundary. The second issue that is also related to sample selection refers to the fact that ratios differ from industry to industry, this results in the assumption of homogeneity in the data which is not very likely. If instead there is a degree of heterogeneity than ratios that represent the lowest common denominator will be the best discriminators. These are likely to be general indicators like profitability and indebtedness as they will reflect on symptoms rather than causes and those will probably not tell analysts much

they don't already know (Morris 1997,109). This was checked by William Beaver in 1968, he researched the price behaviour of failing companies and his results suggested that the markets were picking up on distress signals at least as early as his best performing rations were indicating potential problems (Beaver 1968). Also the early univariate studies did not use a constant for ratios, as they assumed changes should be proportionate. While this may not be an issue for single industry studies, it seems likely to create problems when data for companies operating in different sectors are pooled (Morris 1997).

2.2. Multiple discriminant analysis

MDA or multiple discriminant analysis refers to the analysis of two or more independent variables are analysed in order to assess how together they appear to be able to distinguish between companies which go bankrupt and those which survive (Morris 1997).

The first MDA study was published by Edward I. Altman who used multiple discriminant analysis to develop a five factor model predict bankruptcy of manufacturing firms, he called the model “Z-score” (Gissel 2007).

2.2.1. Altman Z-Scores

Altman's theory was that ratios, if analysed within a MDA framework, will provide more meaningful results than the technique of sequential ratio comparisons and the results proved his theory. The model predicted bankruptcy correctly in 94% of the initial sample. A limitation of the study was that the firms examined were all publicly held manufacturing corporations, for which comprehensive financial data was obtainable, including market price quotations. Also the models predictive ability dropped off considerably from there with only 72% accuracy 2 years before failure, down to 48%, 29%, 36% accuracy three, four, and five years before failure, respectively (Altman 1968).

The initial Z-score model was composed on the basis of investigating 66 firms with the firms split into 2 groups of 33. Group 1 were manufacturers that had filed for bankruptcy and group two was chosen on a stratified random basis. The group two firms were stratified by industry and size, all firms in group 2 were still in existence at the time of the analysis. The very small firms (under $1 million in total assets) and the very large companies from the initial sample

were eliminated. Than data was collected and a list of 22 relevant variables (ratios) based on past research and studies was compiled for evaluation. The variables were classified into liquidity, profitability, leverage, solvency and activity. From the original variables five were selected as performing the best job together. And the final version of the model can be seen below (Altman 2000).

$$Z = 0.012X1 + 0.014X2 + 0.033X3 + 0.006X4 + 0.999X5$$

X1 = working capital/total assets,
X2 = retained earnings/total assets,
X3 = earnings before interest and taxes/total assets,
X4 = market value equity/book value of total liabilities
X5 = sales/total assets

Z = overall index.

In the model X1= Working Capital/Total Assets ratio is a measure of the liquid assets of a firm relative to the total capitalization, where working capital is the difference between current assets and current liabilities. This ratio is frequently found in studies of corporate issues and a firm having consistent operating losses will have shrinking current assets in relation to total assets. If the value of the ratio is negative than the company might have problems covering its short term liabilities (Altman 2000).

X2=Retained Earnings/Total Assets

Retained earnings are also referred to as earned surplus and it is important to know that the account could be "manipulated" via corporate quasi-reorganizations (a firm eliminating its retained earnings deficit by restating assets, liabilities and equity in a manner similar to bankruptcy) and stock dividend declarations (Segal 2017). This ratio slightly discriminates against younger firms who have not had a chance to build up its cumulative profits, but that is not a problem as most of the failing firms are relatively new as stated by Bloomberg 80% of entrepreneurs who start a business fail within the first 18 months (Altman 2000; Wagner 2013).

RE/TA ratio also measures the leverage of a firm, firms with a high RE relative to TA, have financed their assets through retention of profits, and have not utilized that much debt. Ideal RE/TA ratio would be 1:1 but that is almost impossible to accomplish, so a high ratio is what companies are looking for as that suggests a history of profitability and the ability to hold up when a bad year occurs (Altman 2000).

X3=Earnings Before Interest and Taxes/Total Assets

This ratio is the best measure of the productivity of the firm's assets, the greater the earnings in proportion to assets, the more effectively the company is making use of its assets. What makes it even more useful is that if liabilities exceed a fair valuation of the firm's assets with value determined by the earning power of the assets, that is when insolvency in a bankrupt sense usually occurs (Altman 2000).

X4= Market Value of Equity/Book Value of Total Liabilities

Equity is the market value of all shares of stock and liabilities include both current and long term. The ratio shows how much firms assets can decline in value (measured by equity plus debt) before the liabilities exceed the assets and the firm becomes insolvent (Altman 2000).

X5=Sales/Total Assets

This ratio illustrates the firm’s assets ability to generate sales. This is an important variable due to its unique relationship with other variables in the model, but as there is a wide variation of asset turnover among industries, an alternative model Z”, without X5 was later introduced (Altman 2000).

Table 2. The overall index score classifications for Z-Score

Non bankrupt zone	Z- score >2.99
Zone of ignorance	1.81<Z-score<2.99
Distress Zone	Z-score<1.8

Source: Altman (2005, 6)

The next development for Altman’s Z-Score which was originally meant for publicly traded firms was its adoption for private firm’s application. In the original model X4 required stock price data an adjustment like just replacing the book value of equity for the market value were not scientifically valid. The revised Z-Score model (Z’) actually did the same by replacing the

book value of equity for Market Value in X4, but along with that change all of the coefficients changed as well. Along with the coefficients all of the classification criterion and relative cut-off scores changes as well.
The revised Z-Score models with a new X4 can be seen below:

$Z' = 0.717(X1) + 0.847(X2) + 3.107(X3) + 0.420(X4) + 0.998(X5)$

And the ignorance zone for this model is wider with the lower boundary at 1.23 as opposed to 1.81 and the top boundary at 2.9, see table three below:

Table 3. The overall index score classifications for Z'-Score

Non bankrupt Zone	Z-score>2.9
Ignorance Zone	1.23<Z-Score<2.9
Distress Zone	Z-Score<1.23

Source: Altman (2005, 14)

The third and final modification to Altman's original model was made the adaptation of the model to non-manufacturers. This model is also useful within an industry where the type of financing of assets differs greatly among firms. This model denoted as Z" will be used in the analysis of AS Tere. The modification investigated the characteristics and accuracy of the model without X5-Sales/Total Assets. This was done in order to minimize potential industry effect which is more likely to occur when such an industry- sensitive variable like turnover is included. As happened with the previous modification, changing or removing 1 variable changed the coefficients of all other variables as well as the classification criterion and relative cut-off scores (Altman 2000).

The new Z"-Score model is:
$Z'' = 6.56 (X1) + 3.26 (X2) + 6.72 (X3) + 1.05 (X4)$

For application to emerging markets a constant of +3.25 was added in order to standardize the scores with a score of (0) to a D (default) rated bond (Altman 2000).

Both of these models had the same discrimination zones:

Table 4. The overall index score classifications for Z"-Score

Non Bankrupt Zone	Z”-score>2.6
Ignorance Zone	1.1<Z”-score<2.6
Distress Zone	Z”-score<1.1

Source: Altman (2005, 15)

Besides Altman Z-Scores there are multiple other MDA conducted, most notably: Blum,1 974; Deakin, 1972; Diamond, 1976; Edminster, 1972; Taffler 1983; Taffler and Tisshaw, 1977; Laitinen, 1990 (Jackson, Wood 2013).

2.2.2. Limitations of MDA

Some of the limitations that are associated with univariate analysis correlate with MDA. As the sample selection process is still biased although more recent works have recognised the effect of such bias. A further issue is that the model is sample specific. As the models are estimated on the basis of a specific set of data form a certain time period across a number of industries. This helps to explain why researchers have generated multiple discriminatory models that work well in terms of the estimation sample but often less effectively on hold out samples (Morris 1997).

Since Altman Z-score the number and complexity of bankruptcy prediction models has increased dramatically. Next to multiple discriminant analysis like the Z- score multiple other models emerged like: logit analysis, probit analysis, and neural networks (Gissel 2007, 4).

2.3. Logit and Probit models

The logistic and probit models are a direct probability model, so the study finds the probability of a company going bankrupt or not going bankrupt in the next period that is being estimated. As in any case of probability the score can be maximum 1 and minimum 0. In this case 1 would represent a certain bankruptcy, and a score of 0 no chance of bankruptcy (Alyhr 2012, 24). The difference between the two is the usage of a different link function, as the models do not use

the result of the function as the outcome. They use a function of the mean of the result (The Analysis Factor).

2.3.1. Ohlson O-Score

Logit and probit analysis appeared in late 1970s, James A. Ohlson was one of the pioneers in this field. He looked to solve three main issues he saw with MDA technique. Firstly the statistical requirements imposed on the distributional properties of the ratio, secondly that the score found through MDA models was had little intuitive interpretation and thirdly he did not think it was useful to match failed and non- failed firms. Instead Ohlson's study relied on observations from 105 bankrupt firms and 2058 non bankrupt firms. The major finding of his study was the identification of four basic factors being statistically significant in affecting the probability of failure within one year. These are: the size of the company, a measure of current liquidity. The ratios he used were: the log of a price-level deflated measure of total assets, net income/total assets, flow of funds/total liabilities, and a dummy where total assets were greater than total liabilities (Ohlson 1980, 207).

The model did not predict failure and non- failure as well as MDA models reported in previous studies, but this may have been because the methodology used was different, like the usage of unbiased sampling, which suggest that previous researchers might have overstated the discrimination powers of their models.

2.3.2. Martin Grünberg Logit model based on Estonian manufacturing firms.

The model was generated on the basis of companies that are involved with the processing of materials, substances or components in Estonia. The sector is composed of about 5500 firms. The research examined data from the annual reports of manufacturing firms that went bankrupt during 2005-2008, while looking at the annual reports from 2003-2007. Data for the still active firms was selected form the same years as the firms that have gone bankrupt. (Grünberg 2013)

The variables have been selected based on analysis of past literature. The variables chosen include profitability, solvency, capital structure and size. The final model is as follows:

$$Y = -0{,}920 - 1{,}815 \times \frac{equity}{total\ assets} - +0{,}869 \times \frac{liquid\ assets}{total\ assets} + 0{,}046 \times ln(turnover)$$

Figure 1. Final model
Source: Grünberg (2013, 58)

Y= the relationship of the chances of failure and success in an link function: $\frac{e^Y}{(1+e^Y)}$,
Where the breaking point is noted at 0.5 with one being the value for bankrupt firms and zero for successful firms (Grünberg 2013).

The increase of the equity and total assets ratio implies a stronger capital structure thus it has been placed in the formula with a negative multiplier in order to lower the value of the models result as the bankrupt companies are represented with the value of one. On the other hand, the ratio of liquid assets (working capital) to total assets has a positive effect on the result, as the rising value of this ratio could point to the lessening of the share of total assets, for example due to the sale of main assets. The difference in LN of turnover between bankrupt and non bankrupt firms in Grünberg's research was quite small, so he assumes that this could point to companies with insolvency issues trying to maintain turnover at the expense of profitability and increase of liabilities (Grünberg 2013).

The model resulted in a classification accuracy of 72% on bankrupt firms and 88% on successful firms. Two and three years pre bankruptcy the model showed results of 48% accuracy on both accounts, the prediction of successful firms remained on the previous level of 88% (Grünberg 2013).

2.3.3. Zmijewski probit score

Zmijewski's research (1984) was based on the premises that all previous research has bias results from "oversampling" distressed firms similar to (Ohlson 1980). 17 studies he examined showed that only three studies use less than 40% of distressed firms in their sample, and 11 studies using 50%. This shows that the samples were not selected randomly as the population frequency had not exceeded 0.75% since 1934. He did not make the claim that previous research is inappropriate and that using an appropriate estimation technique may not improve overall classification and prediction error rates, it will provide unbiased parameter and probability estimates (Zmijewski 1984, 60).

For his model Zmijewski used 40 bankrupt and 800 non-bankrupt firms, the population consisted of all firms listed on the American and New York Stock Exchanges from 1972-1978, the research excluded finance, service, public administration industries from the research (Avenhuis 2013, 17). His function looked as follows:

Zmijewski=-4.3-4.5X1+5.7X2+0.004X3

Where:
X1= net income/total assets
X2= total liabilities/total assets
X3= current assets/current liabilities

X1 as the NI/TA ratio is also known as Return on assets (ROA), and it gives an indicator of how profitable a company is relative to its total assets, for a company a higher ROA value is better as the company are earning more on less money invested. (Investopedia Return on Assets- ROA)

X2 TL/TA measures the financial risk in the company as the higher the ratio the higher the leverage or risk (Investopedia).

X3 CA/CL also called the "Current Ratio" is a liquidity ratio that helps to determine the company's ability to pay back its liabilities with its assets. The result of the ratio under one indicates that the company would be unable to pay off its obligations if it came due at that point as its liabilities would be greater than its assets. Although in some industries like the retail industry company's may have ratios below 1 and still be in good financial health as they may be able to negotiate long credit periods with suppliers while offering shorter credit periods to customers.

The result is classified with a probability cut-off of 0.5, where firms with probabilities greater than or equal to 0.5 were classified as bankrupt and firms with less than 0.5 were classified as non-bankrupt. Zmijewski defines financial distress(bankrupt) as the act of filing a petition for bankruptcy (Zmijewski 1984, 63).

2.3.4. Limitations of Logit and Probit models

The critics of this Zmijewski's model say that the variables are highly correlated to each other (Avenhuis 2013, 17) and also that. For each size of a sample, Zmijewski reports the results of one regression and calculates the correlation coefficients between the percentage of bankrupt firms in the sample and the various estimated coefficients as well as the constant term. He's findings show significant correlations between the percentage of bankrupt firms in the sample and the estimated coefficient that are consistent with bias. Since he ran only one regression for each sample size, he could not test the individual estimated coefficients for bias against the population parameter, a more direct test of bias. (Platt, Platt 2002, 186).
As stated earlier some of these methods that did not use paired sampling had an inferior discrimination ability to the MDA counterparts, but those results could have been down to the unbiased sampling method selected.

2.4. Neural Networks

Neural Networks appeared in the late 1980s and were the dominant method of study in the 1990s (see table one) (Gissel 2007).

An artificial Neural Network is a parallel, dynamic system of highly interconnected parts based on neurobiological models. The Networks are designed to act in the same manner as a biological neural network, consisting of a number of neurons which are distributed in a number of hierarchical layers. Neural Networks scan for patterns from data inputs and develop nonlinear models (Anandarajan, Anandarajan, Srinivasan 2004).

One typical example of a Neural Network is a Multilayer Perceptions model, where all the neurons or processing elements and layers are arranged hierarchically in a feed-forward manner. The first layer which receives external information is called the input layer and the last layer which produces the model solution is called the output layer. The layers in between have the important role of identifying the patterns in the data and they are referred to as hidden layers (Zhang 1999) (see figure one).
The identification of patterns is done by passing the signals around the network via weighted interconnections, each connection between the neurons has a numerical weight associated with

it with positive weights indicating the reinforcement of a relationship and negative weights a weakening. (Morris 1997)

2.4.1. Odom and Sharda 1990

One of the first NN failure studies was done by Odom and Sharda in 1990 and they used the same five ratios as (Altman1968) The sample they used was from 65 bankrupt and 64 non bankrupt firms which matched on industry and year. Ratios computed from the data for each original subsample were entered into both a conventional discriminant analysis program and a neural network. For their analysis they created a three layered network with five hidden nodes. Convergence was reached after 191400 iterations and the average time for training the system was approximately 24 hours. The neural network model correctly identified all failed and non failed companies compared to 86.8% for the respective discriminant model (Odom, Sharda 1990).

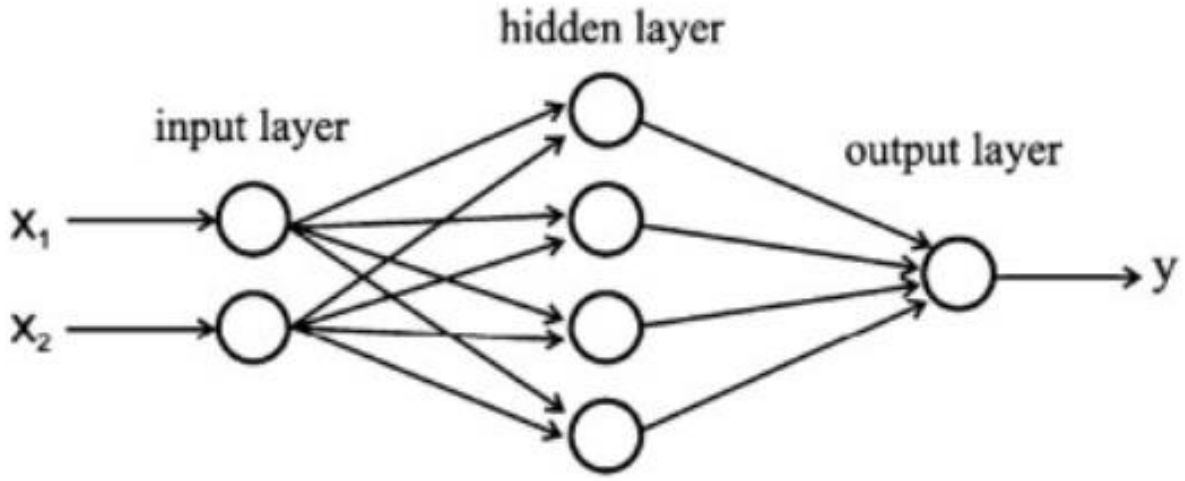

Figure 2. Typical example of a Neural Network
Source: Yildirim (2011, 6386)

2.4.2. Limitations of Neural networks

The studies that have been conducted so far seem to overfit the data, and their performance in discriminating between failing and non-failing firms in hold out samples (especially where no adjustment has been made for sample selection bias) does not seem to be very different from that of other statistically derived models. Also the computation processes appears to be only

able to handle satisfactorily data relating to a relatively small number of independent variables. Also as the neural network is a black box, so it will be hard to derive any insights on how exactly the result is derived and what are the causes for a given result in terms of weights of certain variables and so on (Morris 1997). Application of a neural network also requires hardware, software or knowhow, and the cost of those may be unreasonable if the results are not superior to lower cost methods. While the calculation of a default event is useful, it is also desirable to find the default probability which neural networks do not offer (Atiya 2001).

2.5. Discussion on models used for analysis of AS Tere and reasons of their selection

The analysis of AS Tere looks for Multiple Discriminant Analysis models that should provide the most accurate results. The 3 options found most suitable were Altman 4 variable Revised Z score model noted as Z"-score, Zmijewski probit score for bankruptcy prediction and Martin Grünberg's logit model developed specifically for detecting bankruptcies in Estonian manufacturing sector.

The reasons for finding the Z"-score model suitable for the research are: firstly that Estonian Creditinfo is using the Z"-Score model for their annual report on bankruptcies. See Table two the success rate of the Z"-Score analysis one year prior to bankruptcy when looking at all of the bankruptcies in Estonia in a given year.

Table 5. Model Z-score

Z-score<1,1	Success rate
2016 Z-score<1,1	60,0%
2015 Z-score<1,1	62,0%
2014 Z-score<1,1	65,0%
2013 Z-score<1,1	22,2%
2012 Z-score<1,1	70,1%
2011 Z-score<1,1	74,5%
2010 Z-score<1,1	51,4%

Source: Creditinfo Eesti AS (2017, 26)

Secondly "Bankruptcy prediction models: A comparative study of the Baltic listed companies" investigated different models for suitableness in the Baltics and the research suggested that

Altman Z”-Score was one of the more suitable ones for Latvia and Estonia, especially during years of economic upturn, which is what the period under investigation was experiencing (Berzkalne 2013, 81). Also two bachelor theses that set out to find which is the most suitable version of Altman Z- Score for use in Estonia, found the Z”-score to be the most suitable (Gudinova 2015; Pesur…2015).

Secondly Zmijewski’s model was chosen because it was rated the most suitable for use in the Baltics by “Bankruptcy prediction models: A comparative study of the Baltic listed companies” Zmijewski-score showed a type II error smaller than 20% in the Baltics for the entire research period and for Estonia specifically only 15% (Berzkalne 2013).

Martin Grünberg's logit model was chosen purely as it was created specifically for implementation in the manufacturing sector in Estonia, which is exactly where the company under investigation in this research AS Tere lies.

The reasons for neglecting ratio analysis models was mainly due to superiority of MDA models results in previous studies. Neural networks on the other hand were too complicated for me to apply in this research.

3. Analysis of Tere AS

3.1. History of Tere AS

The history of Tere AS began on 1893 when a steam dairy was founded by Daniel Callisen, the given steam dairy was the predecessor of Tallinna Piimatööstus. The dairy expanded on 1904, merging with a yeast factory transformed into a milk processing facility. The enlarged milk processing enterprise was called Keskmeierei or Zentralmeierei. During the soviet occupation the Keskmeierei continued its work as Tallinna Piimatoodete Kombinaat (hereinafter “TPK”). On 1962 TPK moved to a new production facility on Pärnu mnt. On 1970 the firm started an extensive expansion during which multiple new facilities including a laboratory were built and much of the old equipment were replaced with more powerful alternatives (Tere AS History).

The firm moved into private hands on 1994, when the national plant became Tallinna Piimatööstuse AS, with this change the firm added a sales department and started product development. In 1996 the “Tere” trademark was created, it became the first milk brand of the post soviet Estonia and in 19.06.2006 Tallinna Piimatööstus was rebranded as Tere AS. In 2007 Tere AS founded a new subsidiary in order to tidy up the structural arrangements, where the stockpiling, processing and sale of milk milk related products was concentrated to as well as the production of "kohuke". The name of Tere AS was assigned to the subsidiary which Ülo Kivine became the manager of (Tere AS History).

In the spring of 2008 the Paide Production Unit was merged with Tere AS and AS Põlva Piim merged on January 2009 and continued its operation as Tere AS Põlva Production Unit. In the beginning of 2012 production was discontinued in the Paide and on 2013 production stopped in the Tallinn production facility as well, currently all of the production is being done in Viljandi and Põlva (Tere AS History).

3.1.1. Overview of Tere AS

Currently the main fields of activity for Tere AS are buying up and producing goods from raw milk and selling those goods. Tere AS has over 420 employees, 150 high quality products, and production facilities located in Viljandi and Põlva. One of the biggest subsidiaries of AS Tere is Meieri Transport and in figure 3 below are all of the subsidiaries for Tere AS with percentages of ownership (Stadnik 2016).

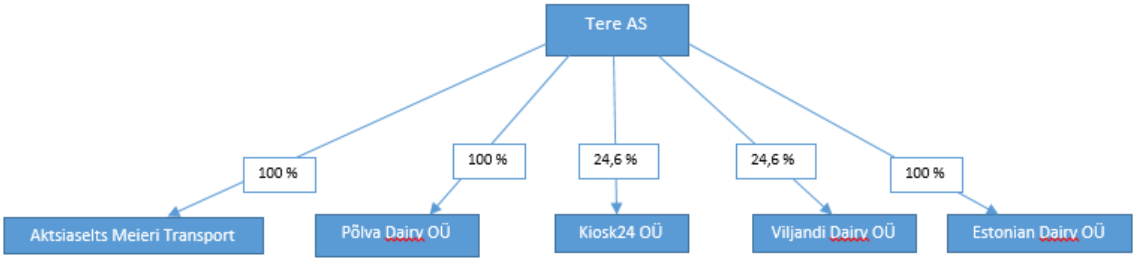

Figure 3. Procentual overview of Tere AS subsidiaries.
Source: Tere AS Auditeeritud konsolideeritud kaheksateistkuuline majandusaasta aruanded (2016)

The main brand names owned by AS Tere are Tere La Crema, LaFresca, LaBudino, LaMore, JogUrt, Hellus, Emma, Meloodia, Merevaik ja Tere Natural. In the 2015 rankings for Estonian food and essential good brands Tere AS ranked at second place (Figure 4) (Tere AS auditeeritud 2016).

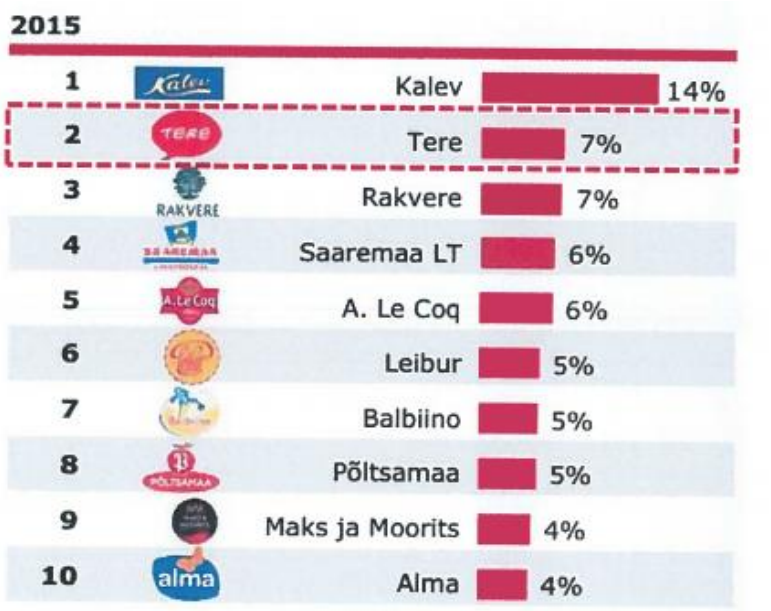

Figure 4. Annual report for Estonians regarding food and essential good brands 2015.
Source: Tere AS Auditeeritud konsolideeritud kaheksateistkuuline majandusaasta aruanne (2016, 6)

Tere AS with a capital base of 5,112,931 €, the long time chairman of the board and majority owner was Oliver Kruuda (Äriregister Tere AS...). On the current day the members of the board for Tere AS are Katre Kõvask and Valdis Noppel. In the assessment of credit reports, the sales revenue of Tere AS in 2014 (consolidated) was 86,486,678 €. Tere AS sales revenue has increased compared to 2013 and the profit margin is 1.59% which has increased in comparison to 2013 as well (Creditinfo Tere AS...2017). The total revenue for the firm in an 18 month-period (1 January 2015 - 30 June 2016) was 91.3 million €, from which export made up 24.5% or 20 million €. The consolidated revenue was 86.5 million € from which export within the EU and elsewhere was 21.9%, or 21,2 million euros (Figure 4) (Tere AS Auditeeritud konsolideeritud kaheksateistkuuline majandusaasta aruanded 2016).

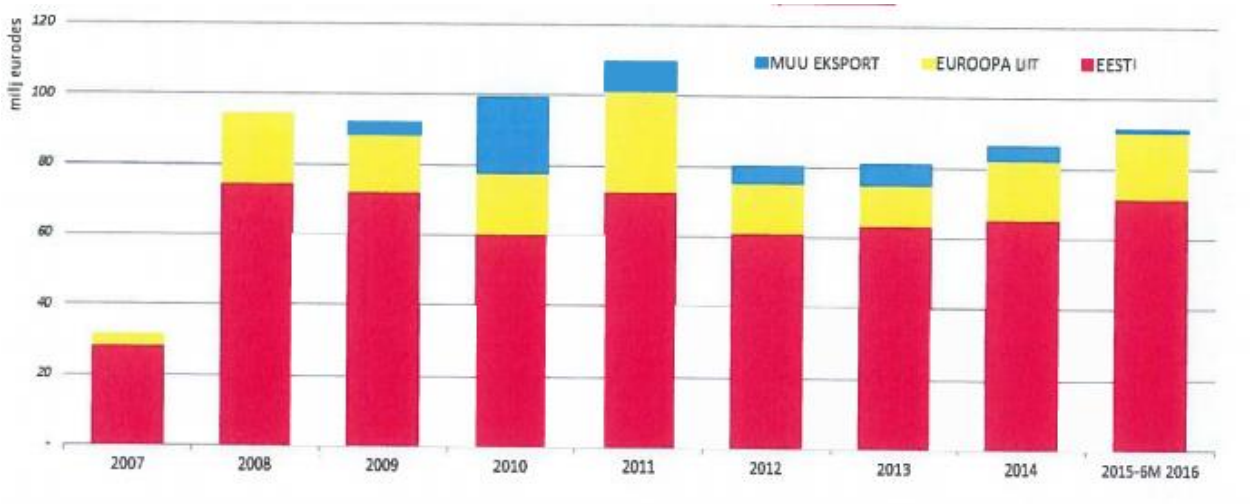

Figure 4. Annual report for Estonians regarding food and essential good brands 2015.
Source: Tere AS Auditeeritud konsolideeritud kaheksateistkuuline majandusaasta aruanded (2016, 6)

Tere AS has been the subsidiary company of AS Luterma (bankrupt 2011) (Äriregister Luterma AS registrikaart) and formerly known as AS Kalev and later on Elveda OÜ (bankrupt 2016) (Äriregister Elveda OÜ registrikaart). Both companies were owned by Oliver Kruuda. AS Luterma was founded on 1995, and was involved with handling of multiple subsidiaries in various fields such as food production, whole- and retail- sale businesses. According to the Estonian Business Register AS Luterma had share capital of 15,103,920€, the shares were registered in Estonian Central Register of Securities (Äriregister Luterma AS registrikaart).

The main reasons for the bankruptcy of AS Luterma according to various sources referenced post claim were:

- The economic crisis that began on 2008, had a significant negative effect on their economic activity (HaMaKm 2-10-64424).
- The tax office assigned a fine to AS Luterma regarding overstocking sugar in the sum of 135.6 milj. kroon (approx. 9 million euros), this brought on a situation where financial institutions were not inclined to provide resources to finance the operation of AS Luterma (HaMaKm 2-10-64424).
- Luterma had assets of 53 million euros but 40 million of that were claims against Alta Foods that had itself gone bankrupt in 2010, thus the claims were very unlikely to realize into real assets. The claims came from a deal that Luterma made with Alta foods for the sale of their assets, and a prepayment of 6 million euros was made, but currently Alta Foods has itself filed a lawsuit against Luterma to reclaim the 6 million prepayment (Eesti Rahvusringhääling 2011; HaMaKm 2-10-64424).

Elveda OÜ (bankrupt 2016) became owner of Tere AS on 2011 by acquiring the shares of Tere AS in the amount of 5115432, when the last owner AS Luterma went bankrupt. Elveda OÜ´s main field of activity was operating holding companies (Stadnik 2016). The bankruptcy of Elveda OÜ is somewhat connected to AS Tere because the two companies that later on joined Tere(in 2009) took a loan of 45.6 million euros on 2008 from Nordea Bank and DNB Pank. In 2012 after acquiring Tere AS Elveda OÜ became a guarantor of all the liabilities of Tere AS. In 2016 Nordea bank filed a claim against Elveda OÜ after refusing to extend the deadlines on their loan portfolio (Stadnik 2016).

Elveda OÜ (bankrupt 2016) became owner of Tere AS on 2011 by acquiring the shares of Tere AS in the amount of 5,115,432 €, when the last owner AS Luterma went bankrupt. Elveda OÜ´s main field of activity was operating holding companies (Ibid).

3.3. Tere AS reorganization plan

According to the 2016 annual report of TERE AS the prime reason for compiling a reorganization plan was the unwillingness to extend the loan portfolio that expired in December 2015 by two of the main creditors AS DNB Pank and Nordea Bank (currently known as Luminor Bank AS). In order to extend liquidity the board of Tere AS were required to cooperate

with reorganization advisers to compile a reorganization plan and to apply for reorganization protection from the court. On 18 February 2016 with the ruling of Harju Maakohus, the reorganization proceeding of AS Tere was started (Tere AS Auditeeritud konsolideeritud kaheksateistkuuline majandusaasta aruanded 2016).

The sum of the creditors claims reorganized with the reorganization plan was 45 million €, from which loan commitments amount to 31.5 million €. 18 April 2016 Tere AS presented the court with a reorganization plan that was rejected by the creditors, which was not approved by the court because the votes of the creditors that favoured the reorganization plan did not amount up to the required ⅔ of the votes. The two main banks who did not extend the expired loan portfolio were also opposed to the reorganization plan proposal (Ibid).

On 7 March 2017 AS Maag Grupp acquired the loan portfolios Tere AS and the parent company of Tere AS, OÜ Elveda (now bankrupt) from Nordea and DNB and made an agreement for the purchasing of Tere AS shares belonging to Elveda OÜ. On the 15th of March Maag Grupp presented the Competition Department an application for the unification of AS Maag Grupp and Elveda OÜ and the Department approved the application on 4 July 2017. From 18 July 2017 AS Farmi Piimatööstus a subsidiary of AS Maag Grupp is the sole shareholder of AS Tere. 05 March 2017 AS Maag Grupp announced the court dealing with the reorganization process that they give up the objections made by the banks regarding the reorganization plan (Ibid).

19 July 2017 the court made a ruling deciding to reject the reorganisation plan approval application and to end the reorganization proceeding. This result came as a surprise for both of the sides involved in the process, as the objections made by the creditors were withdrawn. The court findings were based on the situation that was present at the time when the reorganisation plan was presented, not taking into account the changes that took place during the proceeding. By the assessment of Tere AS the process of making the ruling has corrupted the procedural rules and that the ruling does not meet the standards of legitimacy and justification. Therefore Tere AS on 03.08.2017 submitted a statutory complaint on their behalf in order to cancel the ruling and approve the reorganization plan. At the moment the courts have not made a verdict on this matter (Ibid).

3.4. Analysis of accounting data

The goal of this subchapter is to analyze the economic indicators of AS Tere in the period of 31st of December 2011 until June 31 2016, by using the following bankruptcy prediction models: Edward I. Altman Z"-Score, Mark E. Zmijewski probit score and Martin Grünberg logit model. To conduct the following analysis the annual reports of AS Tere have been used, which have been acquired by inquiry from äriregister. The period of December 31 2011 up to June 31 2016 was chosen, because 2011 was the year when AS Tere went under new ownership after the bankruptcy of its previous parent company and also the previous years are were strongly affected by the financial crisis of 2008 and June 31st 2016 was the end of the last fiscal year with available data. The financial period 5. is abnormal in its length as it lasts 18 months from 31.12.2015- 31.06. 2016, this is because the reorganization plan process that began on 18.02.2016 due to AS DNB Pank and Nordea Bank AB not extending the loan portfolio that expired on December 2015.

The calculations made are based on the models presented in chapter **3**. One alteration was made to the original Z"-Score in which the X3 ratio uses a variable EBIT (earnings before interest and taxes), but as there is no corporate tax in Estonia than for this analysis EBITDA (earnings before interest, taxes, depreciation and amortization) is used. Also in Zmijewski-score for net profit "Aruandlusperioodi puhaskasum (-kahjum)" was used. The financial reports on which the used data is based on are accessible electronically.

Firstly we will look at each ratio of a given model individually and analyze what the results could tell us, secondly we will look at if the models predicted insolvency correctly and if so than how far ahead. For the first variable a theoretical financial period six is analyzed for 31.12.2014-30.06.2016, that should show what the financial state of the company according to Altman's formula if the reorganization plan would have not been initiated during that period. Each financial period has also been numbered in order to make the discussion easier to follow.

Thirdly we will compare each of the three models results to each other to see which of them performed better for this current situation.

Altman Z”-score

Table 6. X1= Working capital/Total Assets

Time period	Working Capital	Total Assets	X1=WC/TA
6.)Theoretical 31.12.2014-30.06.2016	-43,485,144	70,763,145	-0.615
5.) 31.12.2014-30.06.2016	1,538,545	70,763,145	0.217
4.) 01.01.2014-31.12.2014	-44,217,428	81,341,737	-0.544
3.) 01.01.2013-31.12.2013	-18,948,348	79,182,369	-0.239
2.) 01.01.2012-31-12.2012	-11,797,247	100,634,824	-0.117
1.) 01.01.2011-31.12.2011	-14,109,183	107,008,457	-0.132

Source: Tere AS Auditeeritud konsolideeritud kaheksateistkuuline majandusaasta aruanded 2016; author's calculations

Table 7. Working Capital calculations

Time period	Current Assets	Current Liabilities	WC=CA-CL
6.) Theoretical 31.12.2014-30.06.2016	6,809,227	50,294,371	-43,485,144
5.) 31.12.2014-30.06.2016	6,809,227	5,270,682	1,538,545
4.) 01.01.2014-31.12.2014	6,110,958	50,328,386	-44,217,428
3.) 01.01.2013-31.12.2013	9,823,901	28,772,249	-18,948,348
2.) 01.01.2012-31-12.2012	14,221,362	26,018,609	-11,797,247
1.) 01.01.2011-31.12.2011	21,427,734	35,536,917	-14,109,183

Source: Tere AS Auditeeritud konsolideeritud kaheksateistkuuline majandusaasta aruanded 2016; author's calculations

When looking at table six and ignoring the final year with abnormal length than we can see a negative trend in the WC/TA ratio. The ratio also has a negative sign until the fifth financial

period, which shows the company might have problems covering its short term liabilities. Those numbers are skewed for the current liabilities section in period five as the debts to suppliers, short term liabilities for long term loans and other debts have been moved to long term liabilities under Reorganization plan liabilities. This can be seen by looking at appendix one.

The theoretical last fiscal period six in tables six and seven gives all of the debts that were due and were added to long term liabilities under reorganization plan as short term liabilities as they were due to be paid in that period. In this case we can see a similar picture as in period four. with the company in trouble of covering its short term liabilities, which led to insolvency and a reorganization plan being applied for.

Table 8. X2= Retained Earnings/Total Assets

Time period	Retained Earnings	Total Assets	X2=RE/TA
5.) 31.12.2014-30.06.2016	2,065,111	70,763,145	0.029
4.) 01.01.2014-31.12.2014	11,758,210	81,341,737	0.145
3.) 01.01.2013-31.12.2013	9,538,445	79,182,369	0.120
2.) 01.01.2012-31-12.2012	33,825,713	100,634,824	0.336
1.) 01.01.2011-31.12.2011	32,095,677	107,008,457	0.2999

Source: Tere AS Auditeeritud konsolideeritud kaheksateistkuuline majandusaasta aruanded 2016; author's calculations

From table eight we can see a relatively low and declining RE/TA ratio and in the case of AS Tere we are not dealing with a new company or a company that is expanding its operations in any significant manner then this is a worrying sign. This is because a low RE in relation to TA suggests that AS Tere has financed a lot of its assets from debt not from retention of profits which is not ideal for an established company.

Table 9. X3=Earnings Before Interest and Taxes/ Total Assets

Time period	EBITDA	Total Assets	X3=EBITDA/TA
5.) 31.12.2014-30.06.2016	8,800,000	70,763,145	0.124
4.) 01.01.2014-31.12.2014	8,271,744	81,341,737	0.102
3.) 01.01.2013-31.12.2013	977,381	79,182,369	0.012
2.) 01.01.2012-31-12.2012	7,987,666	100,634,824	0.079
1.) 01.01.2011-31.12.2011	4,870,000	107,008,457	0.046

Source: Tere AS Auditeeritud konsolideeritud kaheksateistkuuline majandusaasta aruanded 2016; author's calculations

As noted earlier in the current work EBITDA has been used instead of Earnings Before Interest and Taxes.

Investigation of table nine is not very informative for us, as there is a large fall of asset usage effectiveness in period three, but in period 4 the period prior to insolvency the ratio has the best result of the past four years. This ratio also has the highest weight in Altman Z"-score, so these changes could be impactful for the final result.

Table 10. X4=Book Value of Equity/Book Value of Total Liabilities

Time period	Book Value of Equity	Total Liabilities	X4=BV/TL
5.) 31.12.2014-30.06.2016	19,326,235	51,436,910	0.376
4.) 01.01.2014-31.12.2014	27,784,030	53,557,707	0.519
3.) 01.01.2013-31.12.2013	24,578,555	54,603,814	0.450
2.) 01.01.2012-31-12.2012	47,338,739	53,296,085	0.888
1.) 01.01.2011-31.12.2011	43,429,280	63,579,177	0.683

Source: Tere AS Auditeeritud konsolideeritud kaheksateistkuuline majandusaasta aruanded 2016; author's calculations

In table 10 we can see a decline of the book value of equity and as the level of total liabilities remains stable, this results in a declining BV/ TL ratio. This has a lowering effect on the Z"-Score and as we can see in table 11, which makes a result in the distress zone more likely.

Table 11. Altman Z”-score

Time period	Altman Z"-Score	Z"-Score Classification
6.) Theoretical 31.12.2014-30.06.2016	-2.706	distress
5.) 31.12.2014-30.06.2016	1.468	ignorance
4.) 01.01.2014-31.12.2014	-1.867	distress
3.)01.01.2013-31.12.2013	-0.622	distress
2.)01.01.2012-31-12.2012	1.793	ignorance
1.)01.01.2011-31.12.2011	1.136	ignorance

Source: Tere AS Auditeeritud konsolideeritud kaheksateistkuuline majandusaasta aruanded 2016; author's calculations

Firstly we should look at period five since the firm is insolvent at the end of that period and the reorganization application has been filed, but the Z-score does not show clear distress, that is because all of the debt claims that were due to be paid in that period were moved long term liabilities under reorganization plan liabilities as can be seen in appendix one. As Altman Z”-score does not use a long term liabilities variable in the formula, and total liabilities remain unchanged, thus no clear signs of distress for the formula. The theoretical period with all of the debts that came due in period five moved to short term liabilities on the other hand shows clear distress.

Taking all of this to account Altman Z”- score has predicted insolvency well, not showing a clear positive outcome in any of the five periods before insolvency and signs of distress for the two years leading up to the period when insolvency occurred.

Looking at how the influence of individual ratios and their weights on the final Z"-Score we can see X1 being very impactful due to the negative sign of its result and the second highest weight of 6,56 placed on the variable. The impact is clear as all of the other variables produced

a result with a plus sign and still the final Z"-Score was negative in periods where X1 was over negative 0.2. Surprisingly X3 variable had a very low impact on the final result, as the period prior to insolvency it showed the second best result out of all of the years investigated as can be seen in table eight. Despite the high result in period four and while the X3 variable had the highest weight of any variable in the Z"-score, the result of the respective formula in period four still showed overwhelming distress. The inability of X3 to impact the final result was also affected by variables X2 and X4 despite of their lower weights in comparison to X1 and X4 as can be seen in table 11. As both X2 and X4 had significantly lower results in periods three and four, than in previous years, as can be seen in tables eight and ten respectively.

Zmijewski- score

Table 13. X1=Net Income/Total assets

Time period	Net Income	Total Assets	X1=NI/TA
5.) 31.12.2014-30.06.2016	-11,073,122	70,763,145	-0.156
4.) 01.01.2014-31.12.2014	1,377,517	81,341,737	0.017
3.) 01.01.2013-31.12.2013	-25,118,078	79,182,369	-0.317
2.) 01.01.2012-31-12.2012	972,443	100,634,824	0.010
1.) 01.01.2011-31.12.2011	-2,436,410	107,008,457	-0.023

Source: Tere AS Auditeeritud konsolideeritud kaheksateistkuuline majandusaasta aruanded 2016; author's calculations

The X1 variable shows how profitable the company is in relation to its assets, from table 13 we can see that in most years the profitability is negative and in the positive years it is very low. Huge fluctuation can be seen in the case of Net Income, some of the cause for this can be seen in appendixes one, two and three, as the company has devalued its company valuation and real estate investment by -6,540,000 in period five, only -782,269 in period four, and by -17,904,359 in period three. These deductions show in the consolidated profit and loss statements under “other business costs”.

Table 14. X2=Total Liabilities/Total Assets

Time period	Total Liabilities	Total Assets	X2=TL/TA
5.) 31.12.2014-30.06.2016	51,436,910	70,763,145	0.727
4.) 01.01.2014-31.12.2014	53,557,707	81341737	0.658
3.) 01.01.2013-31.12.2013	54,603,814	79,182,369	0.690
2.) 01.01.2012-31-12.2012	53,296,085	100,634,824	0.530
1.) 01.01.2011-31.12.2011	63,579,177	107,008,457	0.594

Source: Tere AS Auditeeritud konsolideeritud kaheksateistkuuline majandusaasta aruanded 2016; author's calculations

The X2 variable in table 14 shows the financial risk in the company and the higher the ratio is the higher the leverage. In table 14 we can see the leverage rising as assets decrease, which can be seen as a negative sign for the financial health of a company.

Table 15. X3=Current Assets/Current Liabilities

Time period	Current Assets	Current Liabilities	WC=CA/CL
6.) Theoretical 31.12.2014-30.06.2016	6,809,227	50,294,371	0.001
5.) 31.12.2014-30.06.2016	6,809,227	5,270,682	1.292
4.) 01.01.2014-31.12.2014	6,110,958	50,328,386	0.121
3.) 01.01.2013-31.12.2013	9,823,901	28,772,249	0.341
2.) 01.01.2012-31-12.2012	14,221,362	26,018,609	0.547
1.) 01.01.2011-31.12.2011	21,427,734	35,536,917	0.603

Source: Tere AS Auditeeritud konsolideeritud kaheksateistkuuline majandusaasta aruanded 2016; author's calculations

Table 15 shows a liquidity ratio and a ratio of under one indicates that the company would be unable to pay back its obligations. In this case we can again see the irregularity being caused in

period five with most of the short term liabilities that came due in that period being moved to long term liabilities under reorganization plan liabilities. As was the case in table six and seven.

Although it is normal for such an industry to have a ratio of under one with the ability to negotiate long credit periods, but the lowering of this rate is not a good indicator of financial well being for a company.

Table 16 Zmijewski- score

Time period	Zmijewski-score	Zmijewski-score classification
6.)Theoretical 31.12.2014-30.06.2016	0.634	bankrupt
5.) 31.12.2014-30.06.2016	0.635	bankrupt
4.) 01.01.2014-31.12.2014	0.349	Non bankrupt
3.) 01.01.2013-31.12.2013	0.743	bankrupt
2.) 01.01.2012-31-12.2012	0.210	Non bankrupt
1.) 01.01.2011-31.12.2011	0.362	Non bankrupt

Source: Tere AS Auditeeritud konsolideeritud kaheksateistkuuline majandusaasta aruanded 2016; author's calculations

Zmijewski's model is showing bankruptcy in the period two years before insolvency and during the period when insolvency occurred but not in the period leading up to the period in which insolvency occurred. The reasons to why the formula has acted in such a manner can be seen in the analysis of X1 in table 13, as the deduction of value that affects the net income plays big a factor in the result of the formula. It is possible that the large deduction in period 3 in the sum of -17,904,359 was done in order to appear in better financial state in the following period 4 as the main debt portfolio to Nordea and DNB banks was due in period 5.

The changes in Current liabilities were a non factor in the given model as can be seen in table 15, since the coefficient of that variable is very low (0.004)

Martin Grünberg Logit model

Table 17. Variables and ratios

Time period	Equity	Total assets	Current assets	Turnover	EQ/TA	CA/TA
5.) 31.12.2014-30.06.2016	19,326,235	70,763,145	6,809,227	91,312,958	0.273	0.096
4.) 01.01.2014-31.12.2014	27,784,030	81,341,737	6,110,958	86,486,678	0.341	0.075
3.) 01.01.2013-31.12.2013	24,578,555	79,182,369	9,823,901	80,892,611	0.310	0.124
2.) 01.01.2012-31-12.2012	47,338,739	100,634,824	14,221,362	80,294,127	0.470	0.141
1.) 01.01.2011-31.12.2011	43,429,280	107,008,457	21,427,734	109,862,485	0.406	0.200

Source: Tere AS Auditeeritud konsolideeritud kaheksateistkuuline majandusaasta aruanded 2016; author's calculations

Table 18. Grünberg score

Time period	Grünberg-score	Grünberg-score classification
5.) 31.12.2014-30.06.2016	0.380	Non bankrupt
4.) 01.01.2014-31.12.2014	0.347	Non bankrupt
3.) 01.01.2013-31.12.2013	0.369	Non bankrupt
2.) 01.01.2012-31-12.2012	0.307	Non bankrupt
1.) 01.01.2011-31.12.2011	0.347	Non bankrupt

Source: Tere AS Auditeeritud konsolideeritud kaheksateistkuuline majandusaasta aruanded 2016; author's calculations

As can be seen in table 18 this particular model did not predict bankruptcy in any of the periods investigated, this may be due to the ratios that were used, as they don't reflect enough on the

liabilities side of the operation. The falling EQ to TA ratio is a sign of problems, but as other ratios did not indicate issues its effect was not big enough to give a result of bankruptcy for the model. Maybe this is something to investigate further, as the company may have not encountered insolvency if there had not been poor financing decisions made in the past.

4. Conclusions of accounting data analysis

Logit model of Grünberg did not predict any distress for AS Tere. A deeper look gives us an indication of what may be the reasons for no accurate prediction in any period analyzed. The falling equity to total assets ratio was an indicator of less than ideal capital structure, but other ratios did not show negative signs for the company. Grünberg's model did not include any ratios involving liabilities, which proved to be the main issue for AS Tere which was most likely the reason for inaccurate predictions.

Although Zmijewski's model resulted in a non bankrupt reading a year before insolvency, but a bankrupt reading for the year in which insolvency occurred and two years before that period. A deeper look inside the model shows a negative trend along most of the ratios. Net income to total assets was either negative or very low in all of the years investigated. Total liabilities to total assets indicated a rise of leverage as assets decreased, although with a slight recovery a year before insolvency. Current assets to current liabilities ratio had a showing of under 1 with a decreasing pattern for all of the periods leading up to insolvency showing that the company would have troubles paying back debt if it came due.

Altman Z"-score provided an excellent reading of distress for the periods one and two years before insolvency. Individual look at ratios shows increasing difficulties of covering its short term liabilities in the working capital to total assets ratio. Retained earnings to total assets ratio shows us a problem with the overall leverage in the firm as a ratio of 0.145 in the final year before insolvency is clearly not good for an established company. EBIT to total assets ratio shows us a very low productivity of overall assets. Book value of equity to total liabilities shows us a decline in the book value of equity and as the liabilities remain almost unchanged, there is a clear rise for the risk of insolvency.

Conclusion

The aim of this research was to find out whether bankruptcy prediction models could have predicted insolvency for AS Tere, the models used were Altman Z”-Score, Zmijewski-score and Martin Grünberg Logit model, and if so then which of those models has the most accurate prediction ability. The models were selected based on the analysis in chapter two which considered previously conducted bankruptcy prediction studies. The time period used for the analysis was 1 January 2011 until 30 June 2016.

Insolvency for AS Tere could have been predicted as early as two years before insolvency occurred. Two of the three models selected showed signs of insolvency with Martin Grünberg logit model failing to do so. Altman Z”-Score providing the most accurate prediction with the result pointing towards insolvency on two of the years leading up to insolvency and the model did not show great financial health in any of the years investigated. Zmijewski- score provided mixed results as distress was predicted two years prior to insolvency, but failed to do so in the year leading up to insolvency. Although closer investigation suggests this might have been due to some irregular financial reorganization by AS Tere during that period. This research showed that when conducting financial analysis with bankruptcy prediction models, it is useful to use more that one model, as different models may prioritize different ratios. The fact that no ratios correlated in this research provided some insight into some of the factors that led to the insolvency of AS Tere, which seemed to be poor financing decisions. This was evident in the use of Martin Grünbergs logit model, which did not include any ratios including short or long term liabilities and evidently failed to predict insolvency in the periods investigated.

The main findings of the research were following:

- Altman Z”-score proved its value as an effective predictor of insolvency in the Estonian market
- Insolvency for AS Tere could have been predicted, but what could have been done about it is a different matter, as it seems that those decisions that ultimately led to application of reorganization plan were done already in 2008 when a large loan in the sum of 45,5 million € was taken and poor investment choices made with that money.
- It also seems that the willingness to cooperate with creditors was lacking in the years leading up to insolvency, which led to the current situation. As the brand of “TERE” seems

viable, considering its assets were thought to be a viable investment by MAAG Grupp, despite the large amount of standing liabilities.

In order to research this subject further it would make sense to apply a neural network system to determine the most effective bankruptcy prediction tool.

Regarding the future of AS Tere if the reorganization process at hand does not result in bankruptcy, it would be intriguing to investigate the changes Maag Grupp AS will implement in order to make the acquisition worthwhile and if those steps could have been taken by AS Tere earlier in order to avoid insolvency.

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