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PERFORMANCE EVALUATION OF BANKRUPTCY PREDICTION METHODS: A COMPARISON WITH FINNISH CONSTRUCTION COMPANIES

Bachelor's thesis

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I declare that I have compiled the paper independently

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TABLE OF CONTENTS

ABSTRACT

The purpose of this thesis is to evaluate the accuracy and reliability of Altman, Laitinen, Ohlson and Beaver's bankruptcy prediction methods. In addition, the aim is to examine how early the methods succeed in predicting bankruptcy.

Information is gathered from original articles of the studies conducted by all four researchers in the accounting field. Other information such as literature, legislation and text books are used for this thesis. Three similar bankrupt Finnish construction companies are used to test the hypotheses. Financial statements from five years prior to bankruptcy are used to compute the values needed to test the methods.

The results show that Beaver's first ratio is proved to be the most accurate correct prediction out of all models. In addition, Ohlson's model is considered the most reliable with consistent positive results. Altman's model is according to this study the least reliable and accurate.

Keywords: bankruptcy prediction, Altman, Laitinen, Ohlson, Beaver

INTRODUCTION

Forecasting a company's future financial position can be characterized as challenging with many associated uncertainties. Over the years there are numerous models and methods that have been composed in attempting to predict possible upcoming bankruptcies. The strategy the most frequently used for composing the descriptive variables for the final predictive model have mostly been financial indicators derived from accounting.

Corporate activity can in practice end in two different ways. Bankruptcy can be brought up on itself controllably and voluntarily, or alternatively, it may be by court order forced to end its activity due to financial difficulties. Bankruptcy is a legal process where a company is given a "second chance" by liquidating its business in order to pay its debts, as result of not being able to fulfil the payments through its existing assets. Although bankruptcy is meant for the debtor to be able to reach its payment obligations, shareholders and creditors in general may experience losses.

Many researchers have through-out the years attempted to develop the most universally applicable and efficient predictive bankruptcy model. The most well-known model is Altman's Z- score model composed in 1968. Altman's (1968) model has since been revised and developed, which has led to it being suitable for different industries. Another Z-score model was later on composed by Laitinen (1990). Differences between these two models were that Laitinen used only three explanatory variables in his model, when Altman had used five in his original model. One of the first person to criticize Altman's model was James Ohlson, who came up with a logistic regression model called the O-score model. Ohlson's model consists of a combination of nine coefficient-weighted ratios which can directly be obtained from financial statements. The last method used in this thesis is Beaver's method that had not been yet presented by other researchers. Beaver (1966) attempted to used individual financial ratios to predict bankruptcy. His primary goal was to examine which ratios were capable of giving a warning of the possible impending bankruptcy.

The purpose of this thesis is to examine the accuracy and performance of different bankruptcy prediction models. Four different models have been used in this thesis. The main aim of this research can be presented below in terms of:

- Can bankruptcy truly be predicted using Altman, Laitinen, Ohlson and Beaver's predictive models?

In addition to the research question above, two following sub questions can also be presented to illustrate the purpose of this thesis:

- How early can the models predict bankruptcy?
- How accurate and efficient are the models for predicting bankruptcy for Finnish construction companies?

In the first chapter of this thesis the concept of bankruptcy itself will be addressed. Bankruptcy causes, and overall process will be discussed, following by subchapters containing bankruptcy early and late warnings. Bankruptcy is one of the most seriously taken procedure in financial crises. In the second chapter the four predictive methods will be introduced along with their history of how Altman, Laitinen, Ohlson and Beaver have been able to come up with such models. Criticism of each model will also be found in the second chapter's subchapters. In the third chapter the author has wanted firstly to clarify which type of companies are used for this thesis. After having selected three Finnish construction companies gone bankrupt and the predictive models being introduced, the testing of these models begins. For all three companies selected, the author has applied the each predictive model to each company for five years prior of the bankruptcy occurring. For the first three models where, multiple variables have been used the author has presented the result through tables. For the last model, Beaver's model, the author has presented results using figures, to illustrate clearly the changes in the ratios throughout the years. For the final chapter the author has gathered the results to answer the research questions.

1. BANKRUPTCY AND ITS CAUSES

When companies and consumer can't afford to pay their debts due to owing creditors so much money relative to their income, bankruptcy allows the debtors to have a fresh new start. Even though it may eliminate all or some debts, this event will stay on the debtor's credit report and might in the future cause problem for the debtor to obtain a loan. (Koulu, Lindforss, 2016, 85). Bankruptcy can be set on an individual, estate, company or on other legal entities. The debtor may or may not be a corporate operator.

Bankruptcy is one of the most seriously taken procedure of a financial crisis. Bankruptcy is defined as a statuary insolvency procedure, in which the debtor's debts are all settled at once. The debtor's property and assets are used for the payments owed to the creditors. Properties are not as such, suitable for settling debts, in these cases all assets used are converted into cash. For the creditors to be able to obtain the right to bankruptcy, a trustee assigned by court will be held responsible for managing sales of the debtor's whole bankruptcy estate. The main goal in the entire bankruptcy procedure is to equally and fairly divide the debtor's assets owed among all creditors in accordance with the order of payment. (Ventura 2004). Although, this is not always the case as various creditors are in different positions in bankruptcy. For the bankruptcy process to commence, an application is filled either by the debtor itself or a creditor. As the bankruptcy process officially begins, and is set into bankruptcy by court decision, the debtor will lose all rights to the property assigned to the bankruptcy estate.

There are countless reasons that can cause a company, an individual or a debtor to go into bankruptcy. The overall cause of bankruptcy is the lack of money and financial problems. As for companies, the reason why they are drawn to bankruptcy is often due to a lack of an adequate alert system that may give a warning on the impending insolvency issue. (Koulu 2016). When the threat of bankruptcy is detected in early stages, this will give management more time to repair and avoid the dangerous outcome of the financial crisis. Monitoring financial statements frequently by making comparisons between previous years and an overall financial statement analysis is critical,

as it will not only give a warning on the financial problems but help in recognizing where the issue lies. The later the signs of bankruptcy become apparent, the more difficult it becomes to salvage the company and the less there will be means available for the management to use for the process of recovery. There are different actions that may both cause, as well as help avoiding bankruptcy. As for taxpayers the main reason usually lies in the capability of proper financial planning. Excess use of credit is a big factor for an individual to declare bankruptcy. Unexpected expenses, such as natural disasters, theft, casualty floods and many more, for which the owner of any property is not insured, can force some into bankruptcy.

1.1. Bankruptcy process

Each case of bankruptcy can be considered unique, different actions may be taken as to which type of bankruptcy will be filed. Although, in general all bankruptcy processes may be similar to each other. For the bankruptcy procedure to begin, an attorney will assess the debtor's financial situation. The bankruptcy process officially starts when the debtor is declared bankrupt by court decision (Konkurssilaki 20.02.2014/120 4§). Both the debtor, and creditor can fill in a bankruptcy application. In an application filed by the debtor, the debtor must enclose an explanation of his or her property and assets and its value. Information of the total amount of debts and a list of creditors will also be needed.

When the court has examined whether the requirements are fulfilled, the verdict of the bankruptcy will be given. As the bankruptcy process begins, the debtor will lose his/her rights over his/her property. His/her property and assets will be put into administration managed by a trustee appointed by the district court (Konkurssilaki 20.02.2004/120 1§). All assets will be at that time maintained and taken care of by the trustee. The debtor must contribute to the fact that the trustee obtains the debtor's possessions, so that documentation, information and more can be accessed (Konkurssilaki 31.01.2013/86 6§). The debtor will rightfully be the right-holder of the possessions of the bankruptcy estate until the trustee sells the assets in order to make payments towards the creditors. (Koulu, Lindfors 2016, 86; Koulu 2009)

The processing of the creditor's application begins with notifying the debtor of the application, which is handled by the court. The debtor will be given an opportunity to make a written statement by a certain deadline. If the debtor does not provide a written statement in time or does not oppose

to the creditor's application, the court shall examine the application and based on the report, decide whether legal requirements are met for bankruptcy procedures. (Koulu, 2009 135-137). Trustees assigned by the court are under pressure to have as many debtors as possible to reorganize as many debts as possible, and as a result, reconstruction of companies can occur.

Debtors, based on the information he or she has proved the attorney will complete a statement of financial affairs and will prepare schedules of debts and assets. After the attorney has reviewed the assets,, he or she shall make sure the debtor can hold on to as many assets as possible. Based on the evaluation of statements and schedules, the decision of which type of bankruptcy will be executed.

The debtor's attorney will file for the debtor's bankruptcy petition with the court and all the information needed. All creditors must be at this stage contacted as it is considered better that creditors cease all collection against the debtor as soon as possible. After a few months after the bankruptcy being filed, the debtor's attorney will go through debts together with the trustee and creditors. During this period of time, the trustee will provide the debtor alternative options, such as if it is wiser to file for another type of bankruptcy.

When the trustee has liquidated and cleared the bankruptcy estate and reserves are sufficient enough are the creditors able to receive a quota from the claims. Creditors must report at this stage their receiving to the trustee. Subsequently, the trustee will prepare a proposal of distribution, on how the funds of the estate will be distributed among all creditors. A hearing will then be arranged at the courthouse where the judge will officially discharge possible debts, excluding debts that the debtor will carry on with the payments. The court will then examine the possible disputes and approve of the distribution list. The bankruptcy process officially ends with a confirmed distribution list, after the creditors are defined rights to the bankruptcy estate. (*Ibid.,*, 321, 329, 335). The estate being cleared and the property belonging to the estate been liquidated, the trustee must distribute the remaining money among creditors without any delay.

If the bankruptcy estate is not sufficient enough to cover the cover the costs of the bankruptcy proceedings, and none of the creditors will be liable for the costs, the court will base on the trustees' application decide on the lapse of the bankruptcy. The bankruptcy procedure will also lapse when the bankruptcy estate's accumulation of assets to the creditors would be so low that it would not be considered appropriate to continue. (Koulu *et al.* 2005, 47)

1.1.1. Bankruptcy early warnings

In the early stages of bankruptcy, the causes of the financial crisis will emerge. There are numerous researches that have been conducted to find out which factors are driving businesses into bankruptcy. A part of the perceived reasons identified is based on empirical study and some on theoretical assumptions.

The most common theoretical assumptions made is that the company's liquidity crisis is due to an inability from management to get the company to adapt to a changing environment. Changes in the operating environment, such as in legislation, in technology or competition may remain unnoticed by the management or administration, in which no action will be taken in order to improve the company's financial position. Reasons for inactivity may be, due to an error in the effects of changes, overall lack of knowledge or leisureliness in decision-making.

Causes of bankruptcy may either be internal or external. They can be due to the general environment, such as the economic, technological or political factors, which can affect motivation and opportunities to their management skills. The immediate factors coming from the environment includes owners, suppliers, and competitors who all have an impact on business operations. Management of a company, its motivation, skills and personal qualities as the company's strategic and operational factors are all included in the internal features. The overall management of a company is considered to be the main cause of financial crises in companies. Insufficient management skills are a definite threat to a company's survival. Problems can also be found in operational signals such as high employee turnover, the board of manager's resignation and changes in senior management. Major on-time events may become devastating for a company. Strikes, uninsured thefts, and fires, changes in the market area or quality control problems such as pricing issues in products or a decline in employees' performances can be at some point an early warning for the impending bankruptcy. In such severe cases, actions must be taken; room for improvement can be found in a company's operational area.

1.1.2. Bankruptcy late warnings

As for late warnings of the impending bankruptcy, the economic state of the company will weaken, which will lead to more severe consequences. Financial symptoms, caused by insolvency is when critical boundaries are crossed, leading the company to the commencement of the insolvency

procedure. The severity of the financial situation is often reflected in the financial process, initially as a decline in profitability. If the decline in profitability is due to a decrease in sales revenue, it will have an effect on the company's cash flow. (Laitinen, Laitinen 2014, 144). As for a decline in cash flow may, on the other hand, be due to an uneven or rapid growth. If the situation had gotten up to this point, management should address the deteriorating development and redirect the company's operations in order to improve and control the situation.

When a company is going through the start of the insolvency process and the cash flow situation has weakened, the company may be obliged to finance their activities through foreign capital, which in general generates a gap within the financial structure in the corporation. Low cash flow and an increase in debt will arise problems in the reimbursement process. Coming to this stage, the company may have, and often have to rely on current liabilities as well as assets to be deducted from financial assets just to be able to finance the ongoing operations. When the company's capital buffer diminishes sufficiently, insolvency of the company is becoming an actual threat. Cutting costs, such as payroll and overall restructuring operations of a company may at this stage help in salvaging and possibly recovering the company. If any actions are not taken, the company will be over indebted, resulting in the stop of market-based financing. As a result, the company will be drawn into a position where the company has to finance its operation independently. Payment periods will need to be extended to their payables. Provided the insolvency enlargement persist, the company will have no other option than postpone spending and put an end to expansion altogether. At this point, this is the last opportunity for the company to arrange and restructure operations and cut off the most unprofitable sectors. If the company is despite the restructuring of the firm is not able to manage payment obligations and accumulate unpaid invoices, is the insolvency apparent. (Laitinen, Laitinen 2014, 144-145; Laitinen 1990, 187; Thesis author's previous work)

The company will receive eventually payment defaults, which will become progressively serious. As payment defaults continue to flow in, the company is at this stage in an extremely poor situation and business restructuring will become rather challenging. (Laitinen, Laitinen 2014, 144-145; Laitinen 1990, 188). Not only will the financial structure have to improve, but the company's operations must be profitable as well.

2. BANKRUPTCY PREDICTION MODELS

2.1. Edward I. Altman's Z-Score (1968)

Edward I. Altman (1968) was able to compose perhaps one of the most well-known forecasting studies. He was knowingly the first person to use statistical computational methods in forecasting the probability of companies of the impending bankruptcy within two years through financial statements. The statistical method used by Edward I. Altman (1968) was a linear discriminant analysis. In the event of bankruptcy, it is a method in which the observation unit (corporation) is to be explained by the variable (a company gone bankrupt/ a company still in operations) that is categorized. The explanatory variable (the key indicators derived from a company's financial statement), which are numeric. The information contains in several explanatory variables is combined into a single key value which defines in which group the observation unit is classified. (Laitinen, Laitinen, 2004, 84; Altman 1968, 590-591; authors previous work.)

Edward Altman's research material consisted of 66 companies, which were divided into two separate groups. The first group, consisted of 33 companies, had gone bankrupt between the time 1946 and 1965. The second group also consisted of 33 companies but were companies that maintained operations. All 66 companies were categorized as manufacturing industrial companies. The companies belonging to the second group were chosen so, as they matched the companies gone bankrupt in the first group. Edward Altman matched the companies based on the size of the balance sheet. The material used for the research was limited based on the financial statements, smallest and largest companies were excluded from his research. (Altman 1968, 593)

When all material for the research was collected, and companies selected, the next in the process was finding and selecting financial ratios weighted by coefficient. Studies conducted earlier provided clear indications oh such indicators which are capable of predicting financial distress in a company that can, later on, lead to the company going bankrupt. Initially, the study focused on 22 financial ratios, which were then compiled for further evaluation. These financial ratios were

divided into five groups as follows: 1) liquidity, 2) profitability, 3) activity ratios, 4) leverage and 5) solvency. Two criteria, which were based on the potential relevance to the study, influenced Edward Altman to select the five ratios. (Altman 1968, 593-594). After numerous statistical analyses were performed, the following best-performing discriminant function was formed, called the Z-score model

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 0.999X_5 \qquad (1)$$

where,

X_1 − working capital/total assets

X_2 − retained earnings/total assets

X_3 − earnings before interest and taxes/total assets

X_4 − market value of equity/book value of total liabilities

X_5 − sales/total sales

Table 1. Classification of companies based on Z-score results (overall index)

$Z > 2{,}99$	Safe zone
$1{,}81 < Z < 2{,}99$	Grey zone
$Z < 1{,}81$	Bankrupt zone

Source: Altman (1689, 606-607)

By obtaining the Z-score value, the company can be interpreted and categorized into three separate groups. The cut-off scores for Altman's original model are found in the table above (Table 1).

2.1.1. Edward I. Altman's Z'-Score (1983)

Altman's original Z-score model is only applicable to publicly traded companies, as a certain variable requires data from stock prices. Later on, in 1983 the original Z-score model had to be developed. The major issue focuses on the variable X_4, and modifications are not scientifically correct. The new revised Z'-score model we can see differences in every variable's coefficients, and not only in the X_4 coefficient. Other changes such as changes in the classification criteria and related cut-off scores can be found. After a complete re-estimation of Altman's original model, the

following revised Z'-score model for privately held companies was composed. (Altman 1983 referenced in Altman, Hotchkiss 2006, 245)

$$Z' = 0.717X_1 + 0.847X_2 + 3.107X_3 + 0.420X_{4'} + 0.998X_5 \qquad (2)$$

where,

X_1 − working capital/total assets

X_2 − retained earnings/total assets

X_3 − earnings before interest and taxes/total assets

$X_{4'}$ − book value equity/book value of total liabilities

X_5 − sales/total assets

Table 2. Classification of companies based on Z'-score results (overall index)

Z' > 2,90	Safe zone
1,23 < Z' < 2,90	Grey zone
Z' < 1,23	Bankrupt Zone

Source: Altman (1983) refered in Altman, Hotchkiss (2006, 246)

Classification and cut-off points for private firms, with Altman's revised model, can be found in Table 2 found above.

2.1.2. Edward I. Altman's Z''-Score (1993)

Altman composed the third revision of his original prediction model in 1993. This Z''-score model was also designed for predicting corporate failure. The Z''-score model was utilized for other industrial sectors, such as emerging market companies and for nonmanufacturing companies. The first four previous ratios used in the original Z- and Z'-score models (1968,1983) were kept for his new Z''-model (1993). The last ratio X_5, sales/total assets was entirely excluded from the model, as when included a potential industry effect is more likely to occur. As for X_4, Altman used in this case, book value equity/book value of total liabilities, which was also used in Altman's first revised Z'-model. The final re-revised model was presented as follows (Altman, 1993):

$$Z'' = 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_{4'} \qquad (3)$$

15

where,

X_1 − working capital/total assets

X_2 − retained earnings/total assets

X_3 − earnings before interest and taxes/total assets

$X_{4'}$ − book value equity/book value of total liabilities

Cut-off scores were also adjusted in Altman's latest Z''-score model. The correct cut-off scores for this model can be found in the following table (Table 3).

Table 3. Classification of companies based on Altman's Z''-score model results (overall index)

Z'' > 2,60	Safe zone
1,10 < Z'' < 2,60	Grey zone
Z'' < 1,10	Bankrupt zone

Source: Altman 1993 referenced in Altman, Hotchkiss 2006, 248, 265-266

The first variable X_1, working capital/total assets ratio, used in all three of Altman's models measure the company's liquidity. A study of three different ratios was conducted before finding this one particular ratio proved to be the best performing.

The second variable X_2, retained earnings/total assets ratio, also used all three models gives an idea on the company's long-term profitability. This particular variable can provide information on how long a company has been operating, as for a young company will possibly show a low ratio as it has not overtime had the possibility to build up its cumulative profits. Due to this ratio, the models will estimate newly created companies to be more at risk for financial distress. More precisely retained earnings shows a percentage of how much the company reinvest in its business or pays its debts. (Altman 1968, 107)

The third and last variable used in all three models, X_3, earnings before interest and taxes/total assets, measures the overall profit the company's assets are producing. According to Altman (1968), the ratio is essential when assessing the risk of corporate failure, as the overall existence of the company is based on asset productivity.

The fourth variable is used in Altman's original model. The variable X_4, market value of equity/book value of total liabilities shows how much the company's market value equity may fall

before it becomes less than the company's total liabilities. In general, X_4 measures the solvency of the company, in which equity is measured by the joint market value of all shares of stock. (*Ibid.,107*)

The fourth variable used for Altman's Z'- and Z''-model, is adjusted from the original variable by substituting market value of equity by the book value of equity. (Altman, 1968,1983) As the variable $X_{4'}$ is used for privately held companies, emerging market companies and nonmanufacturing companies, data from stock prices is not available. (Altman 1968, 107-108)

The fifth and last variable X_5, sales/total assets, is used for the first two models, Altman's original model and the revised model for privately held companies. This variable describes how effectively an enterprise uses its capital to create sales. Altman decided to keep this variable in his model due to its relationship with the other variables mentioned above. As for the last model, X_5 is entirely excluded from the model, since when included; a potential industry effect is more likely to occur. (Altman 1993 referenced in Altman, Hotchkiss 2006, 247)

When a company is classified in the safe zone, this means the company is considered healthy and is not in any financial distress. When a company is classified in the grey zone, the company is not considered healthy nor in financial distress. When a company is classified in the bankrupt zone, the company is said to be in financial distress and can be considered as a company, which will go bankrupt.

2.2. Erkki K. Laitinen's Z-score (1990)

Following the footsteps of Altman, another remarkable name in predicting bankruptcy, Erkki K. Laitinen developed multivariable for predicting impending bankruptcies in businesses. The purpose of Laitinen's research was to develop an accurate model for an adequate bankruptcy alert system (Laitinen 1990, 194-223). As Altman, Laitinen's observation material mainly consisted of industrial companies, categorized as small and medium-sized companies. Laitinen's research data consisted of 40 bankrupt companies for which he then found counterpart companies, which continued to operate. All counterpart companies were chosen so that they match the bankrupt companies based on the size of the balance sheet.

Financial statements of the companies were reviewed for seven to eight years before the bankruptcy occurred. Companies which continued its operations were also reviewed for the same period of time. The material was limited and restricted so that smaller companies were left out of the study as their share of bankruptcy cases are statistically greater than that of bigger companies. The material Laitinen used for the research was also restricted so that all companies that had been operating for less than ten years were left out.

The statistically best model in Laitinen's research was formed, a classification statistic function which consisted of variables that measure, liquidity, solvency, companies' profitability, and other factors such as the company size and growth. Its weakness was instability, which made the optimal critical value to vary significantly when going back in time. To increase the credibility and predictability, payment periods for payables were left out as well as the growth rate. (Laitinen, Laitinen, 2017). Eventually, some ratios were left out from the following final three-variable model to obtain the Z-score.

$$Z = 1.77X_1 + 14.14X_2 + 0.54X_3 \qquad\qquad (4)$$

where,
X_1 − Net income + Depreciation and Amortization / Operating revenue
X_2 − Quick ratio
X_3 − Equity ratio

The critical cut-off value for Laitinen's model is 18. When the z-score value obtained exceeds 18, the company is classified as a healthy company and is in no financial distress. (Laitinen 1990, 223)

The first key indicator used in the multivariate model is a profitability ratio, which highlights the usage of its income and shows how much can be funded to cover short-term expenses and profit sharing. (Laitinen, Laitinen 2004, 249-250; Thesis author's previous work)

The second indicator, quick ratio, shows the company's ability to cope with short-term debt through financial assets. This key indicator is essential in anticipation of bankruptcy because of the continuous delays in payments of debts, which the leads to interest expenses and additional expensive funding.

The third and last indicator used in Laitinen's Z-score model is the equity ratio, a solvency ratio. It measures the amount of assets that are financed by the owner's investments. The equity ratio is calculated by dividing total equity by total assets. (*Ibid., 249-250*)

2.3. James Ohlson's O-Score (1980)

James Ohlson (1980) was one of the first person to criticize Edward Altman's Z-score model, in which Altman used the multiple discriminant analysis, also known as MDA. One of Ohlson's concerns was that Altman collected financial statements from different sources for companies that had gone bankrupt and companies, which continued to operate. As a result, Altman was able to obtain financial statements of bankrupt companies, which were published only after the bankruptcy had occurred. (*Ibid., 112*). Therefore, this factor could have artificially improved the prediction model, as it would make forecasting easier. Also, the output of the multiple discriminant analysis can be served as an ordinal ranking device.

For Ohlson (*Ibid.*) being able to come up with his own model, he analysed just over 2000 US industrial companies in total. However, only 105 companies were bankrupt and 2058 were companies, which still operated. Criteria for the selected companies were that they had to have been traded on a stock exchange and they had to be classified as industrial companies between the period of 1970 and 1976. Ohlson collected data three years prior the bankruptcy had occurred.

Ohlson's O-score model, is based on a statistical method, logistic regression. The O-Score model consists of nine factor linear combination of coefficient-weighted ratios which can be directly obtained from financial statements. Ohlson has designed three models which have different level of accuracy. His first model (Equation 5) predicts the probability of a company's failure within one year. The accuracy rate of this model is 96%, which is based on companies he used in his study. The second model, was designed to predict bankruptcy within two years, with an accuracy rate of 95.5%. The model maintained same ratios but different coefficients and constant $(Y^1_{coefficient}, V^1_{constant})$ must be inserted into the model. Ohlson's third mode was designed to predict bankruptcy within one or two years, with a lower accuracy rate of 93%. To use this model coefficient and constant must also be substituted by $(Y^2_{coefficient}, V^2_{constant})$. (*Ibid., 120-121*)

$$O = -1.32 - 0.407X_1 + 6.03X_2 - 1.43X_3 + 0.0757X_4 - 2.37X_5 - 1.83X_6 + 0.285X_7 - 1.72X_8 - 0.521X_9 \tag{5}$$

where,

X_1 − Log (Total assets / GNP price-level index)

X_2 − Total liabilities / Total assets

X_3 − Working capital / Total assets

X_4 − Current liabilities / Current assets

X_5 − 1, if total liabilities > Total assets, 0 otherwise

X_6 −Net income / Total assets

X_7 − Funds provided by operations / Total liabilities

X_8 − 1, if net income is negative for the last two years. Otherwise 0

X_9 − (NI_t -NI_{t-1}) / ($|NI_t|$ + $|NI_{t-1}|$), where NI_t is net income for recent period.

$V^1_{constant}$=1.84

$Y^1_{coefficient}$= -0.519; 4.76; -1.71; -0.297; -2.74; -2.18; -0.780; -1.96; 0.4218

$V^2_{constant}$= 1.13

$Y^2_{coefficient}$= -0.478; 5.29; -0.990; 0.062; -4.62; -2.25; -0.521; -1.91; 0.212

The cut-off point for classification of companies for Ohlson's O-score model is as shown below (*Ibid.*):

$$O - Score \begin{cases} \leq 0.5 & \textit{"Safe zone"} \\ > 0.5 & \textit{"Bankrupt zone"} \end{cases}$$

The indicators X_1 to X_6 were selected for similar reasons as Altman's. The predictors were most regularly mentioned in accounting literature. The first indicator, X_1, measures the companies size as its total assets adjusted for inflation, as small companies tend to be more at risk for bankruptcy.

The second indicator, X_2, total liabilities to total assets, measures the company's leverage. As the more the company is leveraged the company is, the more it is as risk of failure.

The third indicator X_3, working capital to total assets is designed to measure the company's overall working capital. A company must have enough liquidity to cover short-term debts and other upcoming unexpected expenses.

The fourth factor, X_4, current liabilities to current assets, is an inverse current ratio. This is another ratio which measures a company's liquidity situation.

The fifth indicator, X_5, is said to be a "dummy variable". As Ohlson felt the need to correct a company's extreme leverage position of total liabilities exceeding total assets with this additional variable. (*Ibid.*)

The sixth factor, X_6, net income to total assets, also known as return on assets, is a profitability ratio. It measures how profitable a company is, as when a company is on the bridge of failure, it is assumed to be negative.

The seventh factor, X_7, funds to debt ratio, show the ability of a company to finance its debts by only using income from operations, as it does not include any other cash resources. When this ratio is less than one, the company may be in serious financial difficulties. Funds from operations can be computed by summing income before tax, and depreciation.

The eighth indicator X_8, is also considered a 'dummy variable', as this variable takes in consideration whether a company has had a negative income for the last two years. Ohlson considered this variable as a discontinuity correction for return on assets.

Th last factor in Ohlson's model, X_9, the change in net income is taken into account. By using information from the last two most recent years, potential losses can be detected.

2.4. William H. Beaver's method (1966)

Beaver (1966, 71-72) conducted a study in 1966, where he tested individual indicators for predicting bankruptcy, which had not been presented in other researches before. Beaver's primary goal was not to only find the best performing individual financial ratios for predicting bankruptcy but rather explore different financial ratios' overall ability to predict bankruptcy.

Beaver began his research by collecting publicly listed companies that had gone bankrupt, with financial statements available from the first year prior the bankruptcy had occurred. He was able to find 79 suitable companies, which represented 38 different industry. The most frequently included industry was manufacturing of electronic equipment. Beaver also used a counterpart strategy to find companies that were still operating to match companies that had gone bankrupt. Counterpart companies were chosen based on the size of the balance sheet, and companies operated within the same industry. Therefore, the impact of the size and industry could be eliminated from the results obtained. (*Ibid., 73-75*)

The study initially focused on 30 financial ratios that could be attained from financial statements. All ratios were monitored for a five-year period in both bankrupt and non-bankrupt companies before any financial crises were detected. Three criteria found below were met for selecting the initial financial ratios (*Ibid.,75-79*)

• The frequency of the ratio mentioned in accounting literature
• The functionality of the ratio in earlier studies
• The ratio's connection to cash flow.

The next step in the study was to divide the 30 initial ratios into six separate categories, in which one ratio from each category was chosen for further analysis. The average of each ratio was calculated for both bankrupt and non-bankrupt companies. It was found that the ratios' averages of the bankrupt companies had significant differences when comparing them with the companies that had continued its operations. The differences were noticeable even five years prior the bankruptcy had occurred.

In addition to the profile analysis, the study tested the ability of an individual ratio to classify companies as bankrupt or non-bankrupt. Two types of error were found in the classification process. When a company in financial distress was classified as a healthy company, it is said to be a type I error. If a healthy company was classified as a company in financial distress, this was said to be a type II error. (*Ibid., 84-85*). In Table 5, the percentage of incorrect predictions can be found, with the best performing ratio's.

Table 4. Percentage of incorrect prediction based. on type I and type II errors. (%)

Ratio	Year before Failure				
	1	2	3	4	5
$\dfrac{Cash\ flow}{Total\ debt}$	13	21	23	24	22
$\dfrac{Net\ income}{Total\ assets}$	13	20	23	29	28
$\dfrac{Total\ debts}{Total\ assets}$	19	25	34	27	28
$\dfrac{Working\ capital}{Total\ assets}$	24	34	33	45	41
$Current\ ratio$	20	32	36	38	45

Source: Beaver (1966, 85)

Based on Beaver's profile analysis and analysis of the error rates, the two best performing single ratios for predicting bankruptcy is cash flow to total debt and net income to total debt. With an accuracy rate of 87%, these ratios have had the ability to predict bankruptcy one year before bankruptcy had occurred. As for cash flow to total debt ratio, has been the most successful in predicting bankruptcy five years prior the occurring bankruptcy, with an accuracy rate of 78%. (*Ibid., 85*). Cash flow to debt measures the company's payment capability of total debt through its cash flow.

3. EMPIRICAL TESTING OF PREDICTIVE MODELS

3.1. Data collection

For this thesis, the author has wanted to compare how predictive models perform on Finnish construction companies. The author has, through the Amadeus database, been able to collect financial statements of three companies that have gone bankrupt. The database contains comparable financial information such as balance sheets, income statements, and other commonly used financial keys for public and private companies across Europe. By selecting different criterion, the author was able to limit the search for selecting companies within the same industry and size, based on their operating revenue.

The final three companies selected for this thesis were Finnish private limited companies. All companies were according to the European Union (User…2015,12) classified as small-sized companies, with their last accounted for operating revenue, averaging 6,115,000 Euros. All companies operated in the same industry classification, which is construction. In this thesis the companies used will be referred to, as company A, company B and company C. Where, company A will be Rakennus MI & RE Oy, company B will be Eteläkaaren Rakennus Oy, and company C will be Suoko Oy. All companies practiced construction of residential and non-residential buildings. All companies have gone bankrupt between the time period of 2017 and 2018. Financial statements of five years prior the occurring bankruptcies are used in the following study.

The author has presented result for the models in a way where, the results of all individual variables can be seen, and in the last column the final overall index results, following by the classification. As for Beaver's model, as his strategy was to predict bankruptcy by using single ratios. Due to this case in chapter 4.5, the author has illustrated the result by using graphs.

3.2. Applying Edward I. Altman's Z''-Score model (1993)

As the companies selected for this empirical study are private limited companies which do not operate in the manufacturing field, Altman's second Z''-model will be used. To be able to compute the Z''-score for this model, the following financial figures will be needed from the financial statements: net working capital, total assets, retained earnings, earnings before interest and tax, the book value of equity, and book value of liabilities.

With the required variables obtained, the author has been able to proceed with finding the Z-score value. In Table 5, results can be found for company A. Altman's model has in this case been able to predict bankruptcy two and three years before bankruptcy occurring.

Table 5. Results for company A

Years to bankruptcy	X_1	X_2	X_3	X_4	Z-Score	Classification
1	2.27	-0.06	1.65	0.29	4.15	safe zone
2	0.18	-0.01	-0.32	0.05	-0.10	bankrupt
3	1.79	-0.22	0.00	-0.49	1.07	bankrupt
4	1.70	0.00	0.00	-0.40	1.30	grey zone
5	1.95	-0.66	0.21	-0.36	1.14	grey zone

Source: Author's own calculations based on appendix 1

Although, it has not managed to do so in the previous year. Reasons for this lie by most in variables X_1, working capital to total assets and X_3, earnings before interest and tax to total assets. As the net working capital ratio is designed to measure liquid assets of a business based on its total assets, company A has had a positive value of 2.27, exceeding all previous years. This, however should have been decreasing the closer we get to the period of bankruptcy. Company A has had the financial strength and ability to cover short-term responsibilities. As for return on assets ratio, it is meant to measure a company's earnings over total assets before any payment responsibilities are deducted. During the last year, the company has been able to use effectively its assets to generate earnings before interest and tax. Both of these ratios have had an impact on the overall index. Other than this, Altman's model has been successful for company A, first giving a slight warning with the 'grey zone' in year five and four as it is said to not be considered healthy nor bankrupt.

Table 6. Results for company B

Years to bankruptcy	X_1	X_2	X_3	X_4	Z-Score	Classification
1	1.52	1.34	1.95	1.44	6.25	safe zone
2	3.01	0.20	4.27	3.65	11.13	safe zone
3	0.54	0.22	1.93	1.35	4.04	safe zone
4	0.15	0.84	1.61	0.93	3.53	safe zone
5	1.16	0.26	2.66	0.60	4.68	safe zone

Source: Author's own calculations based on appendix 2

Looking at the results for company B in Table 6, it is seen that Altman's predictive model has failed. No warning has been given about the impending bankruptcy. The Z''- scores obtained are high above the cut-off point of 1.1,especially in the second year, being 11.13. Here again, the ratios which have had the most impact on the overall index have been net working capital ratio, X_1, and return on assets, X_3. Company B has also, in this case, had financial strength of generating liquid earnings based on its total assets before any interest and tax being deducted.

Table 7. Results for company C

Years to bankruptcy	X_1	X_2	X_3	X_4	Z-Score	Classification
1	-2.23	-0.77	-0.13	-0.33	-3.45	bankrupt
2	-1.40	0.64	-2.84	-0.49	-4.09	bankrupt
3	-0.15	-1.32	0.88	-0.20	-0.79	bankrupt
4	-3.34	-0.66	-2.10	-0.24	-6.35	bankrupt
5	-2.01	-0.83	-0.75	0.07	-3.53	bankrupt

Source: Author's own calculations based on appendix 3

For company C, as it can be seen from Table 7, Altman's model has been extremely successful in predicting bankruptcy even five years prior of it occurring. With the overall index being much lower than the cut-off point of 1.1. Company C has in year two and four, financially performed poorly. In the second year, the two variables which have had the most effect on the overall index were X_3, return on assets ratio and X_4 book value equity over book value of total liabilities. As mentioned above, return on assets measures the strength of a company to generate earnings before any other payment responsibilities. In the second year, company C has performed the worst, with the return on assets ratio being negative at 2.84. Looking at Table 8, it is seen that over the five years the company has had financial difficulties, it is mostly seen that all ratios are negative, except for few, such as X_2, X_3, X_4 in years two, three and four.

3.3. Applying Erkki K. Laitinen's Z-Score model (1990)

Laitinen's model only consists of three variables, which include two liquidity ratios and one leverage ratio. These variables, however are not used in Altman's model. Laitinen found that equity ratio is the most well-performing ratio in predicting insolvency in a company. The cut-off point for Laitinen's model is 18, where when the overall index exceeds, the company is considered healthy. Unlike Altman, this model does not have a classification, which classifies the company in between healthy and distressed, and this model should be able to predict bankruptcy five years prior bankruptcy.

Table 8. Results for company A

Years to bankruptcy	X_1	X_2	X_3	Z-Score	Classification
1	0.11	14.76	0.12	14.99	bankrupt
2	-0.09	3.51	0.03	3.45	bankrupt
3	0.13	8.59	-0.45	8.26	bankrupt
4	0.18	11.21	-0.33	11.07	bankrupt
5	0.23	11.11	-0.27	11.07	bankrupt

Source: Author's own calculations based on appendix 1

In Table 8, it can be seen that this model has proven to be successful for company A in predicting bankruptcy starting from the fifth year. Looking at the results, the second year prior the impending bankruptcy has shown that company A has financially performed the worst, with the overall index being 14.55 lower than the cut-off point of 18. The quick ratio has been shown to be the lowest ratio comparing to other years. As this liquidity ratio measures how a company can with its quick assets cover current debts, we can presume the company has had more assets which cannot be converted into cash in short period of time. As the company has had the most financial difficulties the second year prior the bankruptcy with the quick ratio being 3.51, it is seen that in the last year before bankruptcy, the company has tried to generate more quick assets with a growth of approximately 11 to cover its debts. This, however has not helped the company of avoiding bankruptcy, even when comparing five years, the last year has proven to be the most successful year.

Table 9. Results for company B

Years to bankruptcy	X_1	X_2	X_3	Z-Score	Classification
1	0.05	0.00	0.31	0.37	bankrupt
2	0.23	71.15	0.42	71.80	safe zone
3	0.07	30.07	0.30	30.44	safe zone
4	0.04	26.63	0.25	26.92	safe zone
5	0.08	21.43	0.20	21.71	safe zone

Source: Author's own calculations based on appendix 2

Company B's results, found in Table 9, shows that Laitinen's model has been successful in predicting bankruptcy only one year prior bankruptcy. Looking at two to five years prior bankruptcy the company has on a financial point of view done extremely well. The most successful year has been again, in this case, the second year prior bankruptcy, with its overall index being almost 56 over the cut-off point for Laitinen's model. Company B has shown in the second year prior bankruptcy better performance in all three variables than other years. The first ratio, designed to measure a company's profitability, highlighting the ability of internal financing usage to cover short-term debts and distribution of profit, has been 0.23 whereas all other years' ratio is under 0.08. For the second ratio, quick ratio has had the greatest impact on the overall index, with a positive value of 71.15, meaning company B has been able to cover their short-term liabilities sufficiently and the company has been able to convert receivable efficiently into cash. For the last variable in the model, again the second year prior bankruptcy, has had the highest equity ratio comparing all five years. This solvency ratio shows, how much of the assets are financed by the shareholders' investments. In this case, as the ratio has increased in the second year prior bankruptcy, it can be assumed that company B had new investments. The reason for the company performing financially poorly is that the company had a sudden growth in its debts, which at the end could be covered.

Table 10. Results for company C

Years to bankruptcy	X_1	X_2	X_3	Z-Score	Classification
1	0.03	10.20	-0.25	9.99	bankrupt
2	-0.15	3.65	-0.48	3.02	bankrupt
3	0.29	20.09	-0.13	20.25	safe zone
4	-0.15	4.25	-0.16	3.94	bankrupt
5	0.07	6.24	0.03	6.34	bankrupt

Source: Author's own calculation based on appendix 3

Company C's result, found from Table 10, show that again this predictive model is reliable. The only exception is found when going back three years before the bankruptcy, as it is classified at this point as a healthy company. In this case, the first two variables have shown to have a great impact on the overall index. The first ratio, again, designed to measure a company's profitability, has proven to be higher than in other years. The second ratio that affected the overall index during the second year is the quick ratio. Even though company C was able to increase its financial performance during the second, it was not enough to avoid the company's financial difficulties, leading to insolvency.

3.4. Applying James Ohlson's O-Score model (1980)

As Ohlson's model was not designed to predict bankruptcy five years prior to it occurring, result from years three four and five may be inaccurate. The author has still wanted to take into account this model as it is said to be one of the most accurate bankruptcy predictive models. The author has for the last year prior bankruptcy used Ohlson's model 1 explained in chapter 3.3, with an accuracy rate of 96%. For the second year, the author has used Ohlson's second model, also explained in chapter 3.3, with the accuracy rate being 95.5%. For the remaining three years, the author has wanted to use his third model, which is designed to predict bankruptcy within one or two years prior the bankruptcy year, as Ohlson's does not have a model which is meant for predicting bankruptcy five years prior a company's failure.

Table 11. Results for company A

	Con-stant	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	O-Score	Classification
1	-1.32	-2.55	4.72	-0.50	0.07	0.00	-0.33	0.08	0.00	-0.52	-0.35	bankrupt
2	1.84	-3.01	4.52	-0.05	-1.20	0.00	0.12	0.04	-1.96	-6.12	-5.81	bankrupt
3	1.13	-2.23	9.98	-0.27	0.10	-4.62	0.10	0.01	-1.91	0.04	2.33	safe zone
4	1.13	-2.29	8.48	-0.26	0.08	-4.62	0.12	0.02	0.00	-0.21	2.44	safe zone
5	1.13	-2.31	8.02	-0.29	0.08	-4.62	0.00	0.00	0.00	0.21	2.21	safe zone

Source: Author's own calculations based on appendix 1

In Table 11, results for company A, show that this model has been successful in the last two years before bankruptcy. For the remaining three years, it has not been successful, which can be due to the model being designed for predicting only two years before bankruptcy and not five. For the last year before the bankruptcy occurring, it is seen that company A has tried to improve its

financial position from the previous year, with having a slight growth of 0.04 in X_7. Funds to debt ratio, designed to measure a company's ability to cover its debt by only using its operating income, shows that it has still been lower than one, indicating company A may have tried to sell some of its assets, or taken a loan possibly salvage the company. However, failing in doing so.

Table 12. Result for company B (%)

	Con-stant	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	O-Score	Classification
1	-1.32	-2.43	2.55	-0.33	0.03	0.00	-0.34	0.19	0.00	0.20	-1.45	bankrupt
2	1.84	-3.05	1.06	-0.78	-0.06	0.00	-1.10	-2.21	0.00	0.33	-3.96	bankrupt
3	1.13	-2.57	2.32	-0.08	0.03	0.00	-0.42	-0.28	0.00	0.10	0.22	bankrupt
4	1.13	-2.53	2.81	-0.02	0.03	0.00	-0.19	-0.13	0.00	-0.11	0.99	safe zone
5	1.13	-2.54	3.37	-0.17	0.04	0.00	-0.54	-0.27	0.00	0.11	1.12	safe zone

Source: Author's own calculation based on appendix 2

For company B, looking at the results seen in Table 12, the model has been able to predict bankruptcy even during the third year prior of it occurring. Fund to debt ratio, has had a rather large increase of approximately 2 in the last year prior bankruptcy. This might indicate again in this case, that company B has tried to sell assets or take loans to be able to finance its debts, also failing in avoiding the outcome of bankruptcy. Surprisingly, company B has had in 'both dummy' values where total assets have been greater than total liabilities, and net income has been positive for the last two years. Company B has had a steady decrease in the overall index, meaning the company has had financial difficulties for a longer period of time. The second year prior bankruptcy, it is seen the overall index had a much drastic drop of 3.7 following by a small increase of 2.5 impacted by the possible new loan taken and, or the selling of assets.

Table 13. Result for company C

	Con-stant	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	O-Score	Classification
1	-1.32	-14.35	8.79	0.49	0.10	-2.37	0.05	-0.01	-1.72	-0.41	-10.75	bankrupt
2	1.84	-13.17	8.95	0.37	-1.15	-2.74	1.05	0.20	0.00	-0.42	-5.08	bankrupt
3	1.13	-14.07	6.53	0.02	0.04	-4.62	-0.25	-0.04	0.00	0.21	-11.05	bankrupt
4	1.13	-14.24	6.83	0.50	0.21	-4.62	0.77	0.14	-1.91	-0.05	-11.24	bankrupt
5	1.13	-14.51	4.96	0.30	0.14	0.00	0.35	0.08	-1.91	0.05	-9.40	bankrupt

Souorce: Author's own calculations based on appendix 3

Results for company C, shown in Table 13, has proven Ohlson's model to be successful through-out all of the five years. The overall index shows, an increase of almost 6 after the third year before

bankruptcy, which can be seen in the sixth indicator, return on assets, meaning the company has been able to increase its profitability by using efficiently its own assets to generate earnings. Unlike, return on total assets, return on assets includes all interests and tax payments.

Company C has not been able to manage sustained the increase experienced in the second year prior bankruptcy. With a decrease of approximately 6, the company was not able to avoid the outcome of financial difficulties. It is seen that in X_6, the company was not able to be as profitable as in the previous year. Although, company C had managed to increase by 1 its ability to cover its short-term and long-term debts, seen from the current ratio, X_4.

3.5. Applying William H. Beaver's method (1966)

Beaver's predictive method differs from other multivariate models tested in this thesis. His method concentrates on individual ratios. By observing variations in the ratios through-out time, signs of financial difficulties can be detected, which may warn the company of the possible impending bankruptcy, which allows corrective measures to be taken. Signs of this are found with the value dropping to a critical level. In the following subchapters, the next step is to observe how early Beaver's top five ratios are able to give a warning of the impending bankruptcy for company A, B, and C. In the following subchapters all figures can be interpreted in way where, y axel is the ratio and x axel is the number of years before bankruptcy.

3.5.1. Cash flow to total debt ratio

According to Beaver's (1966) study results, cash flow to total debt acts as the most accurate predicting indicator. However, cash flow, has not been yet used in other models, which can be misleading. This ratio is designed to measure how a company can cover its debts through cash flow only, the higher the ratio is, the better the company is capable of covering its debts. Although, it is unlikely for a company to devote all its cash flow just to cover debts. Results for all three companies for five the years before bankruptcy can be found in Figure 1. Exact values can be seen from appendix 3.
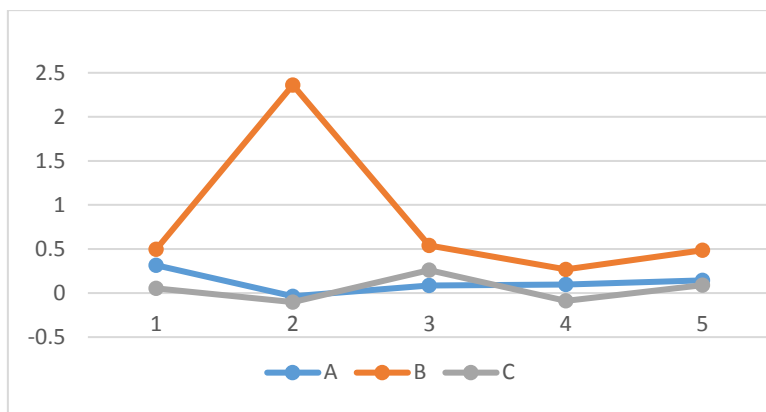
Figure 1. Results for cash flow to total debt ratio
Soure: author's own calculation based on appendix 1,2 and 3

Looking at company A, it is seen that from five to two years prior the bankruptcy, there has been a steady decrease in this ratio. Although more precisely seen from Appendix 4, it is apparent that in the second year it is seen to have a negative value. After this, the company has managed to take action and increase its capability of covering debts through cash flow. This, however has not had an impact in the salvation of the company.

Company B has been able to stay afloat, with its cash flow to debt ratio maintaining a positive value. From the fifth year to the fourth year, company B had a decrease, which might have been alarming for the company. After this, the company managed to have an increase of 2, following by a decrease but maintaining a positive value.

Company C has had a slightly different journey throughout the five years before bankruptcy. Company C's cash flow to debt ratio has every year altered between a decrease and an increase. The company has not managed to maintain an increase nor maintain a positive value. With the company going back and forth, and have the ratio drop to a negative value at times, it shows the company has financially struggled

3.5.2. Net income to total assets ratio

Net income to total assets, also known as return on assets (ROA), is a ratio which is designed to measure how well a company uses its own assets to generate earnings. In this chapter, the author will use the following guideline values found in Table 14, which is said to be applicable in comparisons in different industries (kokonaispääomatuotto …2018).

Table 14. Guidelines for ROA interpretation

Good	over 10%
Satisfying	5-10%
Weak	under 5%

Source: Kokonaispääomatuotto…(2018)

Following the guidelines for ROA interpretation, it is seen from Figure 2 that all three companies' ratio dos no exceed 5%, which is a poor performance.
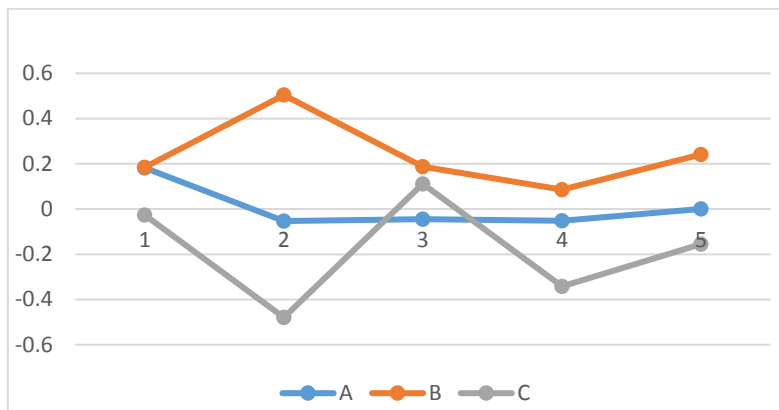
Figure 2. Results for net income to total assets ratio
Soure: author's own calculation based on appendix 1,2 and 3

Company A has had a steady decline starting from the fifth year prior bankruptcy. After the second year prior bankruptcy, company A has managed to have an increase of approximately 2, meaning it has managed to more efficiently convert its investments into income. This however has not helped the company evade bankruptcy.

Company B succeeded to maintain positive values in ROA, including the fact it has had a few declines along the way. In this case, this company has been the most successful company, comparing all three, in generating earnings using fewer funds. Company B has been able to have an increase of approximately almost 0.5 in between the fourth and second year prior bankruptcy.

Company C, again, has had a rather different path. Starting low at the ROA ratio being almost -0.2 during the fifth year before bankruptcy and continued to have a decrease of 0.2 the following year. Although company C has managed to increase its ROA ratio to a positive value of only 0.1, it is still an extremely poor performance. Arriving at the last year before bankruptcy the company did not manage to maintain the increase of the previous year and has then gone bankrupt.

3.5.3. Total debt to total assets ratio

Total debt to total assets ratio is known as a leverage ratio, emphasizing the company's growth by assessing the capital structure. It is to be noted that debt to total assets ratio is preferable to stay under 1%. As the share of debt should not be too high.
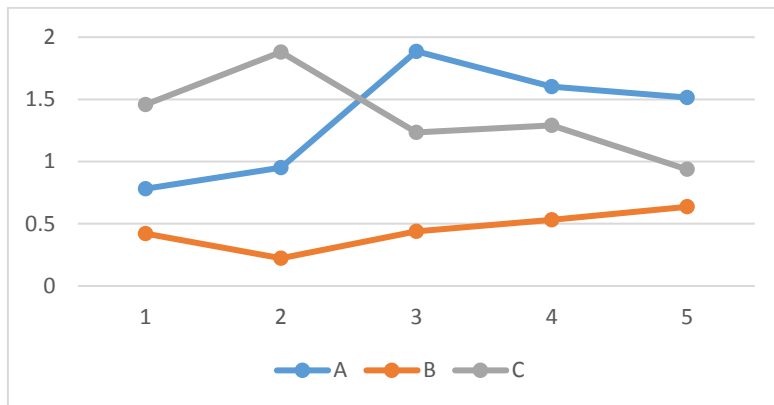
Figure 3. Results for total debts to total assets ratio
Soure: author's own calculation based on appendix 1,2 and 3

We can see from Figure 3, that company A has three to five years before bankruptcy had an exceptionally high ratio, meaning the share of debt has been high. After the second year prior bankruptcy, company A' ratio has dropped under 1%, which is somewhat positive. Although, this could be due to its payments of debts, which at the end lead to bankruptcy.

Company B has had a different approach. Its share of debts has decreased starting from the fifth year prior bankruptcy until the second year. After this, the company had not been able to maintain the decrease of the ratio but had a small increase. As it is known for a fact that all companies have gone bankrupt, we can assume that although the increase debt could not be affordable in company B, which lead to bankruptcy.

The total debt to total assets ratio had a continuous increase for company C, also starting from the fifth year prior bankruptcy with the ratio being just under 1. The second year prior bankruptcy the ratio had reached almost 2, which can be considered high; as it is preferable it is under 1. Although the last year before bankruptcy company C was able to lower its share of debts, it did not help avoiding bankruptcy.

3.5.4. Working capital to total assets ratio

Working capital to total assets ratio, designed to assesses the company's liquidity. This ratio measures a company's overall working capital, as a company should have enough liquidity to cover its short-term debts and other possible unexpected expenses. The smaller the ratio is, the higher the probability of a company going into bankruptcy This ratio, is also used in Altman's study, proven to be one of the most well-performing ratios.
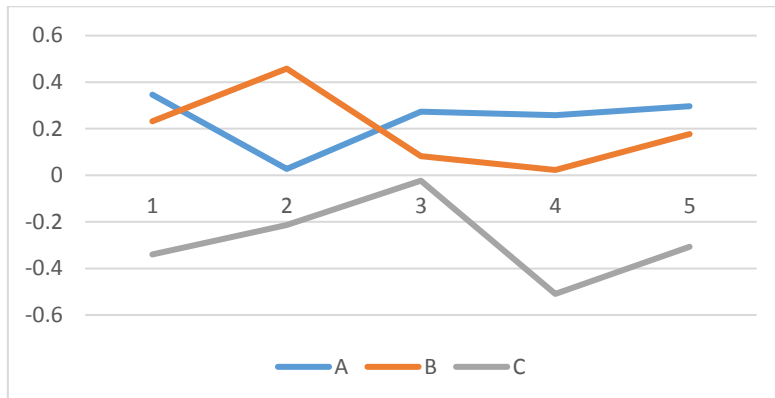
Figure 4. Results for working capital to total assets ratio
Soure: author's own calculation based on appendix 1,2 and 3

For company A, it is seen from Figure 4 that it was in a better financial position than company B. The company was able to maintain a ratio of approximately 0.5 for the three first year prior bankruptcy. The second year prior bankruptcy, company A seemed to have some difficulties with its ratio dropping a little over 0.2.

It is seen from Figure 4, that company A, has first struggled starting from the fifth year before bankruptcy until the third year with the ratio being under 0.2 at all times. However, the ratio has not had a negative value at any point which is positive for the company. It is still considered to be quite low, as the smaller the ratio is the less it has any reserves to cover short-term debts and upcoming expenses. Company A has managed after to this to increase its ratio up to approximately 0.4. Although, the company has not been able to maintain the increase, leading to it falling back to 0.2.

Company C has done much worse than other companies seen in Figure 4. At its lowest, the ratio has been approximately -0.5 during the fourth year prior bankruptcy, which indicates of financial

difficulties. After this, company C was able to increase its ratio but however was not able to be maintained, following by a continuous decrease starting from the third year prior bankruptcy.

3.5.5. Current ratio

Current ratio, known as a liquidity ratio is designed to measure the capability of a company to meet its short-term and long-term payment obligations. With the current ratio, it is possible to estimate how 'healthy' the company is by assessing how efficient its operating cycle is and its ability to convert its products into cash. The author will use guidelines seen in Table 15, which may help in evaluating a company's current ratio (Current…2018)

Table 15. Guidelines for current ratio interpretation

Excellent	over 2.5
Good	2-2.5
Satisfying	1.5-2
Passable	1-1.5
Weak	under 1

Source: Current…2018
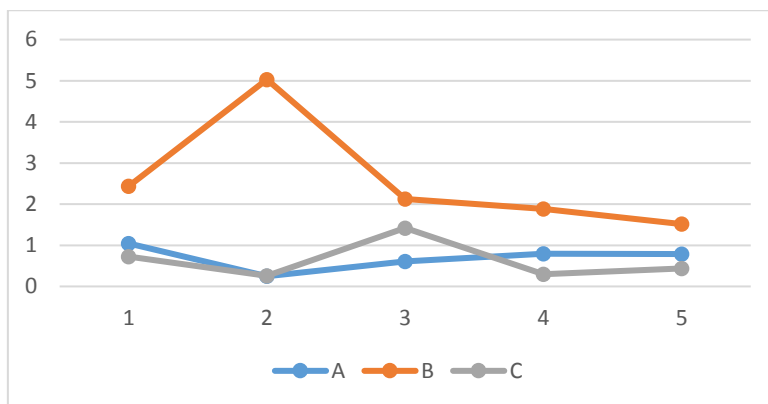
Figure 5. Results for the current ratio
Soure: author's own calculation based on appendix 1,2 and 3

Company A's results seen in Figure 5, shows us that according to the guidelines has had a really poor current ratio with a ratio being under 1, meaning products have not been converted to cash as efficiently as it should have been, which has resulted in the company being in financial difficulties. The company however had maintained this poor ratio for the whole five years. This gave a clear sign that the company had been struggling and ended up being bankrupt.

Looking at the result for company B, from Figure 5, it is seen that its results have been at a satisfying level, being just under 2 for the first three to five years prior bankruptcy. After this, company B has had a large increase going up to 5, which is said according to the guidelines an excellent result. The company has, however after this increase not managed to maintain it but drop it to 2.5, which is still considered to be a good result. Beaver's model has not in this case given any warning of the impending bankruptcy.

Company C, has taken rather the same path as company A. Its result for the current ratio has been weak, except for the third year prior bankruptcy, with having a small increase reaching approximately 1.5 which is considered passable or satisfying. In this case it this ratio has been able to give a warning about the upcoming bankruptcy.

4. ACCURACY AND EFFECTIVENESS

Altman's Z-score model has not performed well with the three Finnish construction companies used in this research. Although, taking into consideration the fact that Altman's model is originally designed to predict bankruptcy within two years of it occurring, the model has proven to be according to this study 50% accurate. However, Altman's model performed out of the three multivariable models the worst when predicting bankruptcy five years prior of it occurring with the accuracy rate being 40%. Altman's model was successful in predicting bankruptcy five years before for only one company, which was company C. Altman's model can be considered to be so accurate, as for company B, his model did not give any warning and was classified as safe throughout the five years before bankruptcy.

Laitinen's model has proven to be more successful than Altman's model with approximately 67% of successful predicting. His model has been able to predict bankruptcy for all three companies. As Laitinen's model is designed to predict bankruptcy five years before, the model should be able to successfully accomplish this. In this case, the model gave a warning every year during the time period of five years before bankruptcy, only for company A. However, for company C, the third year was classified as safe when all remaining years were classified as bankrupt.

Ohlson's model has performed in a percentage point of view as well as Laitinen's model with 67%. However, this model can be considered more reliable as the model has not had a "gap" year. Meaning the company has not for example gone from bankrupt to safe, and back to a bankrupt position, unlike Laitinen's model. Ohlson's model had for company A predicted bankruptcy from the second to the first year prior the bankruptcy had occurred. For company B, the model had predicted bankruptcy three years before bankruptcy. At last for company C it had been able to predict bankruptcy five years before and has maintained the correct prediction throughout the years. Considering the fact that Ohlson's model is designed to predict bankruptcy only two years prior of it occurring the model has performed relatively well.

Beaver's model can be challenging to understand, with no precise cut-off points derived by Beaver. Cut-off points must be derived from counterpart companies. In this case, as all models have been tested in way where only companies that have surely gone bankrupt, no cut-off points could have been developed. It is possible to examine the graphs, and monitor there decrease over the years, or interpret the ratios using general guidelines. As only individual ratio are used to attempt in predicting bankruptcy, five accuracy percentages will be obtained. Cash flow to total debt ratio has in this case been 93% accurate. This ratio was able to predicted bankruptcy starting from the fifth year for each company excluding one exception the second year before bankruptcy for company B. Net income to total assets ratios has as in this case been 53% accurate following the guidelines explained in chapter 3.5.2. The reason of such poor results lie in company B, as for this company no alarming values have been obtained. Total debt to total assets ratio has had the same accuracy of 53% as the ROA ratio. However, in this case the ratio has given a warning at least during one year over the time period of five years for each company, unlike ROA. By observing Figure 4 the ratio has for company C given a clear warning with the ratio maintaining a negative value. For other companies it is not as clear, as the obtained values maintain a positive values. In this case it is possible to inspect the decreases in the ratio for company A and C. However, if the results showed higher ratio values, it could not have been appropriate to interpret the decreases as a warning of bankruptcy, unless the decrease had been of great differences . With this method the ratio has obtained a accuracy rate of 60%. Current ratio has shown an accuracy rate of 53% when following the guidelines explained in chapter 3.5.5. For company B this ratio has not given any warning with the ratio being classified "satisfying" and "good" for each year except the second year before bankruptcy where it has had a value way above "excellent" according to the guidelines.

CONCLUSION

The aim of this thesis was to evaluate the performance and reliability of four different bankruptcy prediction methods compiled by well know researchers in the accounting field. As not all methods are designed to predict bankruptcy five years before bankruptcy, the capability of succeeding in this task was also tested. Most of the researches conducted by the well-known researchers derived there models based on U.S. manufacturing companies, the author has wanted to base this study on Finnish construction companies.

As a result, the author has come to a conclusion that the four models used can truly predict bankruptcy, excluding some small exceptions. The best performing method was according to this study Beaver's first ratio cash flow to total debt, with an accuracy of 93% with only one inaccurate result. Cash flow to total debt ratio had the ability of predicting bankruptcy five years prior to bankruptcy. The least reliable model has proven to be Altman's model with only 40% correctly predicted bankruptcies. Even though Altman's model was designed to only predict bankruptcy two years before bankruptcy, it cannot be drawn to the cause of a poor successful rate, as Ohlson's model had accomplished to predict bankruptcy five years before with an accuracy of 67% correctly predicted predictions. Ohlson's model also being designed to predict bankruptcy only two years before it occurring can be considered the most reliable taking in consideration the fact that it has not had a "gap" year regarding each company.

As there are many uncertainties associated with forecasting, the reliability of models should be tested with more material. However, as these are studies that have already been conducted, the results should give accurate results. When using Altman, Laitinen and Ohlson's models, the interpretation of the results obtained is more simple compared to Beaver's method. To properly be able to use Beaver's model, counterpart companies should be used for computing a cut-off point, however, this is not possible when applying the model to a single company. Thus, in this case the overall analysis of ratios can be conducted to establish a company's financial health.

In conclusion, bankruptcy can be predicted using the four predictive methods. In addition, the methods have in the majority cases been able to predict bankruptcy up to five years before bankruptcy occurring. Excluding Altman's model, every method has had the accuracy rate over 50%, which can be considered positive as the methods have succeeded to predict bankruptcy more than they have failed. More research could be developed in a way where the number of companies would be greater, as only three companies have been used in this thesis.

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APPENDICES

Appendix 1. Financial statement of Rakennus MI & RE Oy (company A)

Balance sheet						
Unconsolidated	31/01/2017	31/01/2016	31/01/2015	31/01/2014	31/01/2013	31/01/2012
	EUR	EUR	EUR	EUR	EUR	EUR
	12 months	12 months	12 months	12 months	12 months	12 months
	Local GAAP	Local GAAP	Local GAAP	Local GAAP	Local GAAP	Local GAAP
Assets						
Fixed assets	385,417	472,000	27,000	36,000	44,000	33,000
- Intangible fixed assets	275,527	346,000	2,000	3,000	4,000	1,000
- Tangible fixed assets	109,218	125,000	24,000	32,000	39,000	31,000
- Other fixed assets	672	1,000	1,000	1,000	1,000	1,000
Current assets	1,257,672	111,000	17,000	23,000	22,000	26,000
- Stock	119,503	20,000	12,000	15,000	12,000	12,000
- Debtors	987,557	66,000	5,000	7,000	10,000	14,000
- Other current assets	150,612	25,000	0	1,000	0	0
* Cash & cash equivalent	34,971	5,000	n.a.	n.a.	n.a.	n.a.
TOTAL ASSETS	1,643,095	583,000	44,000	58,000	64,000	58,000
Liabilities & Equity						
Shareholders funds	358,188	29,000	-37,000	-35,000	-32,000	-32,000
- Capital	30,000	30,000	3,000	3,000	3,000	3,000
- Other shareholders funds	328,188	-1,000	-40,000	-38,000	-35,000	-35,000
Non-current liabilities	79,999	107,000	55,000	64,000	69,000	63,000
- Long term debt	79,999	107,000	18,000	27,000	32,000	26,000
Current liabilities	1,204,905	447,000	28,000	29,000	28,000	27,000
- Loans	26,666	21,000	18,000	18,000	20,000	20,000

	31/01/2017	31/01/2016	31/01/2015	31/01/2014	31/01/2013	31/01/2012
- Creditors	537,959	70,000	5,000	7,000	3,000	3,000
- Other current liabilities	640,280	356,000	5,000	4,000	5,000	4,000
TOTAL SHAREH. FUNDS & LIAB.	1,643,095	583,000	44,000	58,000	64,000	58,000
Memo lines						
Working capital	569,101	16,000	12,000	15,000	19,000	23,000
Net current assets	52,767	-336,000	-11,000	-6,000	-6,000	-1,000
Enterprise value	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Number of employees	25	n.a.	n.a.	n.a.	n.a.	n.a.
Profit & loss account						
Unconsolidated	31/01/2017	31/01/2016	31/01/2015	31/01/2014	31/01/2013	31/01/2012
	EUR	EUR	EUR	EUR	EUR	EUR
	12 months	12 months	12 months	12 months	12 months	12 months
	Local GAAP	Local GAAP	Local GAAP	Local GAAP	Local GAAP	Local GAAP
Operating revenue (Turnover)	6,534,460	412,000	98,000	90,000	106,000	86,000
- Sales	6,433,336	403,000	98,000	90,000	106,000	86,000
Costs of goods sold	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Gross profit	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other operating expenses	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Operating P/L [=EBIT]	402,318	-28,000	0	0	2,000	-11,000
- Financial revenue	246	0	0	0	0	0
- Financial expenses	46,269	2,000	2,000	3,000	3,000	2,000
Financial P/L	-46,023	-2,000	-2,000	-3,000	-3,000	-2,000
P/L before tax	356,295	-31,000	-2,000	-3,000	0	-13,000
Taxation	57,319	n.a.	n.a.	n.a.	n.a.	n.a.
P/L after tax	298,976	-31,000	-2,000	-3,000	0	-13,000
- Extr. and other revenue	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
- Extr. and other expenses	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Extr. and other P/L	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

P/L for period [=Net income]	298,976	-31,000	-2,000	-3,000	0	-13,000
Memo lines						
Export revenue	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Material costs	1,727,496	165,000	37,000	30,000	39,000	34,000
Costs of employees	1,378,082	151,000	33,000	30,000	32,000	28,000
Depreciation & Amortization	106,827	11,000	9,000	12,000	14,000	10,000
Research & Development expenses	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other operating items	2,919,734	113,000	19,000	18,000	19,000	n.a.
Interest paid	46,269	2,000	2,000	3,000	3,000	2,000
Cash flow	405,803	-20,000	7,000	9,000	14,000	-3,000
Added value	1,887,473	n.a.	n.a.	n.a.	n.a.	n.a.
EBITDA	509,145	-17,000	9,000	12,000	16,000	-1,000

Source: Amadeus database

Appendix 2. Financial statement of Eteläkaaren Rakennus Oy (company B)

Balance sheet						
Unconsolidated	31/12/2016	31/12/2015	31/12/2014	31/12/2013	31/12/2012	31/12/2011
	EUR	EUR	EUR	EUR	EUR	EUR
	12 months	12 months	12 months	12 months	12 months	12 months
	Local GAAP	Local GAAP	Local GAAP	Local GAAP	Local GAAP	Local GAAP
Assets						
Fixed assets	65,000	47,000	34,000	30,000	40,000	32,000
- Intangible fixed assets	0	0	0	0	0	0
- Tangible fixed assets	62,000	47,000	34,000	30,000	40,000	32,000
- Other fixed assets	3,000	0	0	0	0	0
Current assets	771,000	634,000	185,000	145,000	147,000	76,000
- Stock	0	0	0	0	0	0
- Debtors	410,000	312,000	55,000	38,000	52,000	14,000
- Other current assets	361,000	322,000	130,000	107,000	95,000	62,000
* Cash & cash equivalent	118,000	106,000	55,000	57,000	31,000	19,000
TOTAL ASSETS	836,000	681,000	219,000	175,000	187,000	108,000
Liabilities & Equity						
Shareholders funds	484,000	530,000	123,000	82,000	69,000	26,000
- Capital	3,000	3,000	3,000	3,000	3,000	3,000
- Other shareholders funds	481,000	527,000	120,000	79,000	66,000	23,000
Non-current liabilities	37,000	26,000	9,000	16,000	22,000	8,000
- Long term debt	37,000	26,000	9,000	16,000	22,000	8,000
- Other non-current liabilities	0	0	0	0	0	0
* Provisions	0	0	0	0	0	0
Current liabilities	316,000	126,000	87,000	77,000	97,000	74,000
- Loans	0	0	0	0	0	0
- Creditors	216,000	0	37,000	34,000	19,000	64,000
- Other current liabilities	100,000	126,000	50,000	43,000	78,000	10,000

	31/12/2016	31/12/2015	31/12/2014	31/12/2013	31/12/2012	31/12/2011
TOTAL SHAREH. FUNDS & LIAB.	836,000	681,000	219,000	175,000	187,000	108,000
Memo lines						
Working capital	194,000	312,000	18,000	4,000	33,000	-50,000
Net current assets	455,000	508,000	98,000	68,000	50,000	2,000
Enterprise value	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Number of employees	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Profit & loss account						
Unconsolidated	31/12/2016	31/12/2015	31/12/2014	31/12/2013	31/12/2012	31/12/2011
	EUR	EUR	EUR	EUR	EUR	EUR
	12 months	12 months	12 months	12 months	12 months	12 months
	Local GAAP	Local GAAP	Local GAAP	Local GAAP	Local GAAP	Local GAAP
Operating revenue (Turnover)	5,914,000	2,713,000	1,399,000	1,086,000	1,299,000	1,190,000
- Sales	5,912,000	2,709,000	1,398,000	1,086,000	1,297,000	1,189,000
Costs of goods sold	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Gross profit	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other operating expenses	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Operating P/L [=EBIT]	243,000	433,000	63,000	42,000	74,000	38,000
- Financial revenue	n.a.	0	0	0	1,000	0
- Financial expenses	9,000	3,000	11,000	18,000	14,000	16,000
Financial P/L	-9,000	-3,000	-11,000	-18,000	-13,000	-16,000
P/L before tax	235,000	430,000	52,000	24,000	61,000	22,000
Taxation	40,000	87,000	11,000	6,000	16,000	7,000
P/L after tax	195,000	343,000	41,000	18,000	45,000	15,000
- Extr. and other revenue	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
- Extr. and other expenses	41,000	n.a.	0	3,000	n.a.	n.a.

Extr. and other P/L	-41,000	n.a.	0	-3,000	n.a.	n.a.
P/L for period [=Net income]	154,000	343,000	41,000	15,000	45,000	15,000
Memo lines						
Export revenue	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Material costs	1,461,000	498,000	391,000	331,000	283,000	224,000
Costs of employees	3,744,000	1,457,000	750,000	563,000	682,000	467,000
Depreciation & Amortization	21,000	16,000	11,000	10,000	13,000	11,000
Research & Development expenses	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other operating items	445,000	308,000	183,000	140,000	247,000	n.a.
Interest paid	9,000	3,000	11,000	18,000	14,000	16,000
Cash flow	175,000	359,000	52,000	25,000	58,000	26,000
Added value	3,968,000	1,906,000	824,000	612,000	770,000	516,000
EBITDA	264,000	449,000	74,000	52,000	87,000	49,000

Source: Amadeus database

Appendix 3. Financial statement of Suoko Oy (company C)

Balance sheet						
Unconsolidated	30/09/2016	30/09/2015	30/09/2014	30/09/2013	30/09/2012	30/09/2011
	EUR	EUR	EUR	EUR	EUR	EUR
	12 months	12 months	12 months	12 months	12 months	12 months
	Local GAAP	Local GAAP	Local GAAP	Local GAAP	Local GAAP	Local GAAP
Assets						
Fixed assets	463,000	613,000	790,000	1,017,000	1,406,000	1,750,000
- Intangible fixed assets	0	0	0	0	0	0
- Tangible fixed assets	463,000	613,000	790,000	1,017,000	1,406,000	1,750,000
- Other fixed assets	0	0	0	0	0	0
Current assets	989,000	99,000	466,000	470,000	535,631	659,000
- Stock	0	0	0	0	0	0
- Debtors	499,000	22,000	233,000	436,000	224,341	558,000
- Other current assets	490,000	77,000	233,000	34,000	311,290	101,000
* Cash & cash equivalent	1,000	31,000	10,000	2,000	97,749	n.a.
TOTAL ASSETS	1,451,000	711,000	1,256,000	1,486,000	1,941,632	2,408,000
Liabilities & Equity						
Shareholders funds	-665,000	-626,000	-293,000	-434,000	121,399	514,000
- Capital	17,000	17,000	17,000	17,000	16,818	17,000
- Other shareholders funds	-682,000	-643,000	-310,000	-451,000	104,581	497,000
Non-current liabilities	745,000	953,000	1,222,000	357,000	605,551	824,000
- Long term debt	101,000	181,000	0	0	0	33,000
- Other non-current liabilities	644,000	772,000	1,222,000	357,000	605,551	791,000
* Provisions	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Current liabilities	1,371,000	384,000	328,000	1,562,000	1,214,680	1,070,000
- Loans	87,000	87,000	0	0	0	39,000
- Creditors	993,000	174,000	262,000	1,193,000	820,588	726,000
- Other current liabilities	291,000	123,000	66,000	369,000	394,092	305,000

	30/09/2016	30/09/2015	30/09/2014	30/09/2013	30/09/2012	30/09/2011
TOTAL SHAREH. FUNDS & LIAB.	1,451,000	711,000	1,256,000	1,486,000	1,941,632	2,408,000
Memo lines						
Working capital	-494,000	-152,000	-29,000	-757,000	-596,247	-168,000
Net current assets	-382,000	-285,000	138,000	-1,092,000	-679,049	-411,000
Enterprise value	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Number of employees	n.a.	15	18	n.a.	18	18
Profit & loss account						
Unconsolidated	30/09/2016	30/09/2015	30/09/2014	30/09/2013	30/09/2012	30/09/2011
	EUR	EUR	EUR	EUR	EUR	EUR
	12 months	12 months	12 months	12 months	12 months	12 months
	Local GAAP	Local GAAP	Local GAAP	Local GAAP	Local GAAP	Local GAAP
Operating revenue (Turnover)	5,897,000	1,576,000	2,469,000	1,920,000	4,104,236	4,131,000
- Sales	5,897,000	1,576,000	2,440,000	1,830,000	4,062,968	4,109,000
Costs of goods sold	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Gross profit	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other operating expenses	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Operating P/L [=EBIT]	-27,000	-300,000	164,000	-465,000	-217,803	-446,000
- Financial revenue	n.a.	1,000	0	n.a.	n.a.	n.a.
- Financial expenses	12,000	41,000	40,000	43,000	73,884	46,000
Financial P/L	-12,000	-40,000	-40,000	-43,000	-73,884	-46,000
P/L before tax	-39,000	-341,000	124,000	-509,000	-291,688	-492,000
Taxation	n.a.	n.a.	-16,000	n.a.	11,127	1,000
P/L after tax	-39,000	-341,000	140,000	-509,000	-302,815	-493,000
- Extr. and other revenue	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
- Extr. and other expenses	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Extr. and other P/L	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
P/L for period [=Net income]	-39,000	-341,000	140,000	-509,000	-302,816	-493,000
Memo lines						
Export revenue	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Material costs	1,107,000	527,000	n.a.	n.a.	n.a.	n.a.
Costs of employees	947,000	545,000	672,000	602,000	767,978	743,000
Depreciation & Amortization	154,000	204,000	263,000	341,000	468,383	579,000
Research & Development expenses	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other operating items	3,716,000	599,000	1,370,000	1,441,000	3,085,675	n.a.
Interest paid	12,000	41,000	40,000	43,000	73,884	46,000
Cash flow	115,000	-137,000	403,000	-168,000	165,567	86,000
Added value	n.a.	n.a.	1,099,000	n.a.	1,018,556	876,000
EBITDA	127,000	-96,000	427,000	-124,000	250,580	133,000

Source: Amadeus database

Appendix 4. Results for cash flow to total debt ratio

	A	B	C
1	0.32	0.50	0.05
2	-0.04	2.36	-0.10
3	0.08	0.54	0.26
4	0.10	0.27	-0.09
5	0.14	0.49	0.09

Source: Author's own calculations

Appendix 5. Results for net income to total assets ratio

	A	B	C
1	0.18	0.18	-0.03
2	-0.05	0.50	-0.48
3	-0.05	0.19	0.11
4	-0.05	0.09	-0.34
5	0.00	0.24	-0.16

Source: Author's own calculations

Appendix 6. Results for total debt to total assets ratio

	A	B	C
1	0.78	0.42	1.46
2	0.95	0.22	1.88
3	1.89	0.44	1.23
4	1.60	0.53	1.29
5	1.52	0.64	0.94

Source: Author's own calculations

Appendix 7. Results for working capital to total assets ratio

	A	B	C
1	0.35	0.23	-0.34
2	0.03	0.46	-0.21
3	0.27	0.08	-0.02
4	0.26	0.02	-0.51
5	0.30	0.18	-0.31

Source: Author's own calculations

Appendix 8. Result for current ratio

	A	B	C
1	1.04	2.44	0.72
2	0.25	5.03	0.26
3	0.61	2.13	1.42
4	0.79	1.88	0.30
5	0.79	1.52	0.44

Source: Author's own calculations