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MERGER AND ACQUISITION TARGET CHARACTERISTICS OF FINNISH COMPANIES

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ABSTRACT

This paper aims to study the determinants and characteristics of M&A targets of Finnish listed companies and to test if it is possible to predict takeover bids before they are announced. The research problem is understanding the motivations behind target selection in the Finnish market are.

The sample consists of Finnish listed companies, and after pre-processing the data, 120 companies are included in the sample during the period 2009-2021. 6 theories were drawn from previous literature, and proxy variables are used to test these theories. The theories tested are management inefficiency, company size, innovation, undervaluation, leverage, and free cash flow. The study provides evidence that while, on average, target companies are undervalued, undervaluation is not a significant determinant in takeover likelihood i.e., companies can be undervalued but are not necessarily likely acquisition targets. However, companies with significantly more leverage are often targets, and the proxy for leverage is a significant determinant in merger and acquisition target modelling.

The predictive power of the model was tested, and it was found that the model in this study was prone to type 2 errors and failed to correctly classify targets out of the sample, and subsequently had low predictive power. This is in line with previous literature, but the model performed worse than in any previous literature. Issues with data might, in part, contribute to the poor performance along with variable selection and sample size.

Keywords: Merger and acquisitions, target determinants, logistic regression, Finland

INTRODUCTION

Mergers and acquisitions (M&A) are transactions where a company buys another, the term merger is used when the companies form a new combined entity, and the term acquisition is used when a usually bigger company buys another, as the acquisition target is absorbed by the acquirer. M&As can be used to expand quickly, as buying established companies offer significant time savings when for example, entering new markets. They can also be used to acquire innovation without investing in research and development. The even simpler reason is that M&A could occur simply because the target company is undervalued, and the acquirer can generate economic value by buying the company.

When a company is a target of a takeover bid, there are significant abnormal returns for the stockholders of the target company, Jensen and Rubak (1983) found that the weighted average abnormal returns were 29.1% for US targets in the month in which the offer is made. This phenomenon has also been observed in Europe, as Frank and Harris (1989) found similar returns. Due to the potential abnormal returns and strategic implications, a subarea of research has formed. Similarly, to bankruptcy prediction, researchers have attempted to model takeover likelihoods to predict future transactions.

Despite the topic being widely researched, the characteristics and determinants are inconsistent in different studies in different periods and markets. Additionally, only a few studies of the Finnish M&A market have been conducted, but they have included private companies as well as publicly traded. While the studies shed light on the characteristics of Finnish target companies, the information is mostly relevant to the shareholders and the management teams of these companies. This paper will exclude the private companies and explore the characteristics of listed target companies and use financial data to explore the determinants of takeover targets in the Finnish market.

The research problem of this paper is understanding the motives behind M&A target selection and testing the feasibility of predicting target companies using financial data. This

provides insight to management teams and other market participants such as investors. Palepu (1986) concluded that an investment strategy solely based on a takeover likelihood model is unlikely to yield abnormal positive returns, thus making the insights of the study more relevant to management teams than investors, but later research such as Danbolt *et al.* (2014), show that by screening companies suggested as targets by the model can yield abnormal returns. This study tests existing M&A theories as the determinant variables are derived from these theories, and takeover likelihood predictions are made by using the model including the variables. This study, therefore, attempts to offer insights to managerial teams by researching the characteristics of target companies and analyse if selected targets can be determined by the companies' characteristics.

This paper aims to study the M&A target determinants of listed Finnish companies. The applicability of existing M&A theories is tested by selecting the determinant variables based on these theories, and using these variables, a predictive model is employed, to test if it is possible to predict takeover bids before they are announced.

This paper aims to study the determinants and characteristics of M&A targets of Finnish listed companies and to test if it is possible to predict takeover bids before they are announced. The research problem is understanding what the motivations behind target selection in the Finnish market are.

The research questions are as follows:

1. Is there difference in M&A theory related variables in targets and non-targets?
2. Can financial variables be used to predict takeover targets in the Finnish market?

To answer the research questions, first, a univariate framework is employed to study the differences of targets and non-targets, and then a logistic regression model is employed and used to predict target companies using a test sample.

This thesis is divided into 3 sections. First, various existing theories behind mergers and acquisitions are explored, hypotheses are formulated, and a review of the previous empirical literature is provided. The second section focuses on the sample and data collection, provides descriptive statistics, and then presents the methodology used to analyse the data. Finally, the third section will present the results of the logistic regression model, address the model's predictive power, and discuss the model's limitations.

1. MERGER AND ACQUISITION LITERATURE

This section reviews existing literature on M&A and takeover likelihoods hypotheses are drawn from previous theories as Palepu (1986) suggests that determinant variables should be based on existing theories and not chosen by empirically analysing variables. He argues that this approach avoids the statistical overfitting of the model to the sample. M&A motives are first discussed, then the rationale of the use of individual variables, and in the end, a review of previous studies is provided.

1.1. Overview of M&A Theories

Although the process of M&A is understood, there are numerous theories as to the motives behind these transactions. Trautwein (1990) has outlined them into seven theories in his paper, but more explanations possibly exist. The theories in his paper are Efficiency theory, Monopoly theory, Raider theory, Valuation theory, Empire-building theory, Process theory, and Disturbance theory.

The Efficiency theory suggests that managers engage in M&A when the transaction can be used to boost efficiency by lowering costs, the companies have operational synergies, which result in considerable intellectual capital or managerial synergies which enable better monitoring. The theory, therefore, suggests that M&As can boost efficiency by combining their resources with a suitable company Trautwein (1990).

Monopoly theory suggests that M&As are done to limit competition and increase the number of strategies available for the company. (Trautwein 1990).

Raider theory suggests that individuals with substantial wealth engage in greenmail and pay themselves excessive compensation, Trautwein (1990), however, finds the argument illogical.

Valuation theory suggests that management teams better understand the value created by the potential M&As and, therefore, can determine undervalued companies better than the stock market.

Empire-building theory suggests that management teams increase their personal power and utility by growing the company, even though it might not be in the best interest of the shareholders. This theory is in line with Jensen's (1986) paper, which outlines the agency costs associated with free cash flow. Porter (1987) Also found that acquisitions used as an expansion strategy often lead to subpar performance.

Process theory suggests that motives behind M&A are not entirely rational. The motives are due to the strategic thinking process, which is influenced by the personalities and backgrounds of the people executing these transactions.

Disturbance theory suggests that economic disturbances are the reasons behind mergers and acquisitions. A change in the economy or industry in which the company operates can force a merger or acquisition on the basis that individual expectations have changed and the company needs to evolve. Disturbance theory lays down the framework for some of the variables used in the studies discussed in section 1.2, such as Palepu's (1986) paper.

The theories below are used to provide justification for the variables used in this study instead of empirically analysing many financial variables and choosing them. This is done because of Palepu's (1986) idea that formulating hypotheses based on existing theories provides a better understanding of the underlying motivations and avoids statistical overfitting of the model.

Management inefficiency is theorized to be one of the main reasons behind M&A. The theory builds on agency cost theory and market for corporate control (MCC). The underlying hypothesis behind management inefficiency being a driver behind M&A is that acquisitions are a mechanic which enables new management teams to take control of the company's resources and create more value. Agency costs result from conflicts of interest between shareholders and managers, as their best interests differ. Serious conflicts arise when the company has substantial positive free cash flows left over from all the positive net present value (NPV) projects, and instead of paying out the cash to shareholders, the management invests in negative NPV projects. This is done by management because they are in complete control of the cash flows and do not have any obligations to pay shareholders. Instead, they maximize their personal utility by growing the company, and this, in turn, increases their influence and personal power. (Jensen 1986).

The MCC theory suggests that shareholders are not loyal to management teams and care only about maximizing their economic value. Therefore, they allow the party which can provide them with the most economic value by controlling the company. The market for corporate control can help effective management teams to replace inefficient ones (Jensen & Ruback 1983). The market for corporate control can provide a mechanism in which different management teams compete for the right to run the companies, therefore increasing efficiency in the market by incorporating more competent managers.

H1: Companies with inefficient management are more prone to takeovers

Company size is thought to be a factor in takeover likelihood, the rationale being that larger companies pose higher transaction costs in an acquisition, such as the costs of absorbing the target, takeover premium, and integration of these targets (Palepu 1986; and Ambrose and Megginson 1992; Powell 2001). This in turn decreases the number of companies that have the purchasing power to acquire these targets. (Palepu 1986; Gorton *et al.* 2009). The transaction costs involved with larger companies generally make them undesirable takeover targets. Additionally, antitrust laws can also decrease the viability of mergers between two large companies, and therefore the hypothesis is the following

H2: Company size has an inverse relation to takeover likelihood

Companies can develop new technology or patents by investing in R&D in-house, or the new technologies can be acquired via M&A. A relationship between the number of patents and the likelihood of a takeover by a foreign company was demonstrated by Ali-Yrkkö, *et al*. (2007). Acquisitions can be used to increase the competitiveness of the acquiring companies, although the success of the acquisition, in this case, depends on the industry proximity (Frey and Hussinger, 2006). Further evidence can be found in Hall's (1988) findings, which indicate that targets with similar R&D are preferred in low R&D industries, such as manufacturing. Furthermore, her findings indicate higher valuations for R&D by the acquiring companies than in the overall market. Companies valuing similar technologies higher than the market can be due to overlap in know-how and patents. This overlap could make integration easier and therefore reduce transaction costs. Additionally, Bena and Li (2014) find evidence of an increase in patents and patent quality if merger participants have overlapping technologies. Blonigen and Taylor (2000) find evidence that acquisitions can be used to offset the lack of in-house R&D.

R&D investments are also positively viewed by the market, as demonstrated by a study by the Securities and Exchange Commission (1985), which found that announcing an increase in R&D provided a 1.8% excess return 20 days after the announcement. This indicates that the market reacts positively to innovation.

H3: Innovation has a positive correlation with takeover likelihood

According to valuation theory, management teams in acquiring companies hold private information about the target company and therefore have a better understanding of the fundamental value of the company than the stock market (Holderness and Sheehan, 1985). The acquirer's management might have a better understanding of how the combined operations would benefit the acquiring company, something which the stock market is unable to do due to its limited information. (Trautwein, 1990). If a management team deems their company overvalued or another company undervalued, the rational decision would be to take advantage of this misvaluation therefore, actively seeking a merger would realize profits, and completing such a transaction would benefit the shareholders, as the shareholders would receive a higher price than the management values the company. (Shleifer and Vishny 2003).

If both companies are deemed overvalued, there can still be M&A transactions, on the condition that the acquirer is more overvalued than the target. In this case, the target will be bought with equity, as the acquiring company's equity is more overvalued than the target, which will enable the acquiring company's management to take advantage of their elevated stock price (Dong *et al*. 2006). Dong *et al.* (2006) also argue that if the target is valued below its fundamental value, the target can be acquired with a cash bid. Therefore, the acquiring company capitalizes on inaccurate and cheap pricing of the target company.

H4: Undervaluation has a positive correlation with takeover likelihood

The literature surrounding leverage's effect on M&As is inconsistent, While Jensen (1986) argues that the market for corporate control can operate as a disciplinary mechanism for management teams, he also claims that debt can be used to assure pay-outs from corporations since it introduces a shareholder to whom the company is obligated to pay, limiting management's capacity to spend capital inefficiently. Other arguments include high leverage in targets discourages acquirers from bidding, as acquiring a highly leveraged company would

increase the liabilities on the acquirer's balance sheet and corporate raiders have less net tangible assets to strip after the debt (Eddey 1991). In insolvent companies with high leverage, the leverage can act as a driver for the sale of the company because the company is in a state of financial distress (Danzon *et al*. 2007). Additional support for the latter arguments can be found in Shrieves' and Stevens' (1997) paper which indicated that 15.2% of acquisition targets were close to bankruptcy at the time they were acquired.

H5: Leverage is positively associated with takeover bid likelihood.

Jensen (1986) Defined free cash flow (FCF) as all the excess cash flow the firm had after subtracting required cash flows for positive NPV projects. The agency costs stemming from excess cash flows are "severe" according to Jensen (1988) due to the fact that the management team is not obligated to pay shareholders the exceeding amount left from projects. If the cash stays in the company the agency cost theory suggests that the management team will engage in negative NPV projects in order to increase their power. The empire-building theory outlined in Trautwein's (1990) article suggests that the managers execute mergers to maximize their personal utility, further indicating that substantial amounts of free cash flow increase the likelihood of a takeover bid as the markets seek to replace inefficient management and improving the usage of resources.

H6: Free Cash Flow is positively associated with takeover bid likelihood.

1.2. Review of previous studies

This section of the paper focuses on previous studies on M&A likelihood prediction. Most of the studies have selected the same or similar variables based on the previously mentioned theories. Most studies that differ from the mainstream approach used in M&A likelihood prediction were conducted before Palepu's (1986), paper, and this section will mainly focus on studies and the development of methodology conducted after his paper. The studies before Palepu's paper are briefly summarized at the beginning of this section and the more similar studies are towards the end of this section. The chronological order of the studies demonstrates how the methodology has changed since Palepu (1986) suggested various improvements in methodology to study takeover likelihood.

Before Palepu's (1986) paper, the research on takeover likelihood had achieved respectable accuracies in their takeover models, he highlights studies such as Stevens (1973), Belkaoui (1978) and Dietrich and Sorensen (1984) which indicated that takeovers could, in fact, be modelled with impressive accuracy. Dietrich and Sorensen's (1984) logistic model had a reported accuracy of 90%, which is outstanding given that these events generally generate abnormal returns, moreover Stevens' (1973) MDA had an accuracy of 70% in the original sample. He concludes that the model performed well in different time periods, indicating the stability of his model. Belkaoui (1978) achieves a 15% misclassification rate using a discriminant analysis model, further indicating that takeover likelihood can be modelled with high accuracy.

Palepu in his 1986 paper argues that these previously mentioned papers suffer from numerous methodological flaws in sampling, model selection, and cut-off points. He implies that if these studies were able to predict M&A targets so accurately, the stock market must have missed it, or the models lack predictive power out of the sample. Furthermore, he argues that the variables selected for the study should be based on existing theories, and not chosen by empirical analysis of the variables, this should avoid overfitting the model. His hypotheses were inefficient management, company size, undervaluation, growth-resource mismatch, industry disturbance, and price to earnings ratio. He does not state that these are the only possible hypotheses and related variables to be used in similar models in the future. But the models should use variables based on existing theories. He also employs a conditional maximum likelihood estimator, to estimate the optimal cut-off point to increase the predictive power of his model.
Despite the methodological improvements, the predictive power of his logistic model is substantially lower than those of previous research. His model identified 80% of the actual targets and 45% of the non-targets, out of the sample. He also notes that the model is prone to classification errors and therefore the economic usefulness of his model is low. The high number of type 2 errors lowers the economic feasibility, and he demonstrates this, by employing an investment strategy based on his model's predictions and it did not generate abnormal returns. Implying that the model does not pick takeover targets more accurately than the stock market.

Hall (1988) is the first, at least to the knowledge of the author of this paper, to employ the multinomial logistic model. By doing this she differentiated private and public acquirers and captured significant differences in acquisition characteristics between the two groups. She found that private acquisitions focus less on R&D intensive companies, and public acquisitions tend to

acquire companies with R&D in line with the industry average. She suggests that R&D quality might be the factor behind it as the R&D efforts of targets are valued higher by the acquiring companies. Moreover, she finds that if both companies have high R&D intensity, the returns from the transaction were higher.

Ambrose and Megginson (1992) set out to improve Palepu's (1986) model by proposing new variables related to ownership structure, asset structure, and takeover defences in addition to those proposed by Palepu (1986). Ambrose and Megginson (1992) also employ univariate analysis between targets and non-targets. Their results indicate that Palepu's (1986) model's explanatory power is reduced during their study period and that the only logistic model which is significant includes all the new variables in addition to the ones Palepu (1986) originally used. They find that tangible assets have a positive relationship to takeover bid probability, and that company's size and net change in institutional holdings are negatively related to the bid probability. Interestingly they find that blank-check preferred stock authorizations are the only takeover defence that is significantly negatively related to bid likelihood while other defences such as poison pills do not affect the bid likelihood.

Walter (1994) used a similar methodology as Palepu (1986) while also adding new variables, the new variables were related to current costs, as he theorized, they would give a more accurate picture of the company. These new variables were asset turnover, dividend pay-out, inflationary tax loss, tax savings, and industry. With the current cost variables model, he managed to statistically significant excess return when compared to the sample but not when compared to zero. This is because the sample returned an abnormal return of -2.98%. Although his models predicted a higher number of targets than models in previous studies, they still suffered from a considerable number of type 2 errors. He also found that the market-to-book ratio was the most significant variable, contrary to Palepu's (1986) paper. This deviation suggests that the significance of the variables varies over time and current cost data could provide better accuracy in the models, as it had more current information about the company.

Barnes (2000) continued his previous work attempting to improve the models' accuracy from his (1998) paper. Barnes's (1998) research indicated that improving the model to reduce type 2 errors, increases returns for a strategy using the model to identify targets. Barnes (1998) used logistic regression and linear discriminant analysis (LDA) in an attempt to model takeover likelihood. He noted that logistic should theoretically be superior to LDA the models had similar

performance. Barnes (2000) continues from his previous research, attempting to reduce the number of type 2 errors while using similar variables as Palepu (1986). Barnes (2000) attempted to improve the model by adjusting the cut-off point, and despite this, the models presented in the study did not classify any targets. His strategy based on the models generated negative abnormal returns.

Powell (2001) aims to improve the methodology further in his study to generate an excess return, he does this by implementing a multinomial logistic model to improve the explanatory power the reason for this is that "In a typical binomial setting, in which takeover targets are treated as belonging to one homogenous group, differences between hostile and friendly targets are ignored. This may result in biased takeover probabilities and poor predictive performance." (Powell's 2001) His paper uses return on capital employed, market-to-book ratio, free cash flow, log of total assets, the ratio of tangible fixed assets to total assets, and for growth-resource imbalance he uses two variables: the ratio of cash and marketable securities to total assets, and the ratio of debt to total share capital and reserves. Despite the modifications in methodology, the multinomial models fail to generate abnormal returns as a part of an investment strategy, though his results indicate that multinomial models have better explanatory power.

Ali-Yrkkö *et al*. (2005) form a new hypothesis that patenting discloses the discovery of new inventions and therefore is a value driver in M&A, they measure if a company holds patents or has pending applications. Additionally, they use return on investment, free cash flow, industry control dummy variables, size, tangible assets to total assets, and growth-resource imbalance. With these variables they employ first univariate analysis, then multinomial logistic regression and then robust check their models. They chose multinomial logistic regression to capture potential differences between domestic and foreign bidders. Their results indicate that foreign bidders are likelier to acquire small Finnish companies with patents, but the diversity of reasons why companies holding the patents are more likely targets remain unanswered. As the sample consisted of private companies no returns could be measured.

Desyllas *et al.* (2009) investigated innovation as well as other motives of high-tech acquirers, they used similar financial variables as Palepu (1986) but added innovative variables such as R&D intensity and Patent stock into their logistic model. Desyllas *et al*. (2009) employ simple logistic models for acquirers and targets instead of a multinomial model. They find that targets have high R&D intensity and high patent stock, but low R&D productivity, they measure the

latter by dividing patents per money spent. Their findings indicate that companies that struggle to stay productive are likelier takeover targets.

Bena and Li (2014) employ a conditional logistic regression model to determine how R&D intensity and patent stock, affect takeover likelihood. They show that companies with high R&D and slow growth are likelier targets while companies with large patent stocks are likelier acquirers. The synergies between companies increases the likelihood of takeovers, and they conclude that innovation is important driver in M&A.

Danbolt *et al*. (2016) built on the previous takeover likelihood research and focused on improving the returns generated by employing a predictive logistic model and using it to create an investment strategy. While their model's predictive power was low, they sought to reduce the amount of type 2 errors as it was previously noted by Palepu (1986) and Powell (2001) that M&A target companies underperform before the bid and the misclassification led to the model predicting distressed companies as targets. Danbolt *et al*. (2016) improved the investing strategy's performance by screening companies that were close to bankruptcy and eliminating them as investment options, in doing this they managed to generate abnormal returns.

The studies mentioned above had differences in that the significance of the variables fluctuated between studies i.e., they were not uniform. But a common characteristic was that the models were prone to type 2 errors, meaning that the models misclassified many of the target companies as non-targets.

2. METHODS AND DATA

This section provides an overview of the data and methods used in this study. First the sample and collection are discussed, and then descriptive statistics of the sample are provided along with univariate comparison of the groups non-target and target. Next, issues with multicollinearity are checked and then the method for takeover likelihood estimation is presented.

2.1 Sample and data collection

The data used in this paper is compiled of secondary data retrieved from the Thomson Reuters EIKON database. The retrieved sample is compiled of listed companies in the Helsinki stock exchange (OMXH) and consists of 143 listed entities.

The period for M&A events was set to 2009-2022 and the financial data was retrieved for periods 2009-2021. The data set including the M&A events had private companies which were not in the scope of this research and thus were eliminated. The data set containing the financial information, and the data set containing the M&A information were combined, using matching year and company name as criteria in R. As the M&A data was retrieved for a longer period the beginning and ending periods, meaning years 2008 and 2022, were consequently dropped from the data.

During the pre-processing duplicates of data entries were found and removed, along with listed fixed-income assets, an exchange-traded fund (ETF), and a special purpose acquisition company (SPAC). The reason for removing fixed-income assets and the ETF is that they are not traditional companies which have defined operations and their financial ratios are not comparable to the other companies on the exchange. Additionally, the fixed-income assets are issued by companies, and if the company is bought, the fixed-income assets are part of the deal. The SPAC was removed because although it has probably the highest change to be involved with an M&A transaction, the company does not have any meaningful operations before the M&A deal, and it is highly improbable that it will be a target of an M&A bid before the first acquisition is done.

After combining the data sets, there were 1638, observations in the period from 2009 to 2021. The sample used for the descriptive calculations consists of 1027 observations after removing observations with missing values and duplicates caused by multiple bids in the same period. The sample consists of 952 non targets and 87 target companies, meaning that the of all the observations in the sample approximately 8.37% are targets.

Moreover, the data was further divided into training and testing data sets with a 70%/30% split so that the predictive power of the model could be assessed out of sample. The decision to include potential outliers was made since the M&A targets might have different properties and should thus be included in the sample in addition to the already small number of targets in the sample. Furthermore, the variables are partially normalized due to them being ratios excluding the proxy for company size which is normalized by taking a logarithm of revenue.

Below is Table 1. which summarises the expected behaviour of the independent variables and the formulas of the determinants, it should be noted that due to the missingness of data ROE, Price to book value and R&D intensity were readily available in the Thomson Reuters Eikon database and the readily available data had more values than would be possible to calculate from the accounting data available in the same database. For this reason, ROE, R&D intensity, and Price to book value are not calculated by the author, but the formulas to calculate these values are still shown. The reason for showing the formulas is that if the study was to be repeated and the data was collected from a different source which might not include readily calculated values, the accounting data should still be available.

Table 1. Expected determinants of takeover bid

Determinant	Formula	Expected relationship
ROE	$\frac{Net\ Income}{Shareholders'equity}$	-
PB	$\frac{Marketcap}{Book\ value}$	-
R&D intensity	$\frac{Research\ and\ development\ expense}{Revenue}$	+
SIZE	$ln\ (Revenue)$	-
D/A	$\frac{Total\ liabilities}{Total\ assets}$	+
FCFTA	$\frac{Free\ Cash\ Flow}{Total\ assets}$	+

Source: Author's compilation

As Palepu (1986) suggested the variables should be based on theories, but the how the variables such as size and profitability are calculated differs between different papers. The way these variables were chosen is based on data availability, and usage in previous studies.

2.2 Descriptive statistics

Table 2. presents descriptive statistics of the processed data sample, the mean for return on equity is 9.9% across the sample companies during the selected period the negative value of -2 can be explained with negative shareholders' equity which turns the return on equity to negative. Price to book value had a mean value of 2.914 with a high deviation, this can be explained by the different expectations regarding different companies and industries. The R&D intensity had a mean of 0.015, but more interestingly the median value is 0 which means that most companies did not engage in research and development while the maximum value is 1.523 which means that a company spent 152.3% of their revenue on research and development. The proxy for company size is the logarithm of revenue and it was expected that companies have deviations in their revenue. The debt to assets ratio's mean is 0.555, meaning that just over half of the assets are funded by debt, the maximum value of 2.540 indicates a high level of financial distress, as the company has less assets than liabilities. Free cash flow to total assets has a mean of 0.032 and a high deviation, this indicates that the companies in the sample have a high variance in their cash

flows leftover from operations. The distribution of targets by year is presented in appendix 1. The most bids received by Finnish companies in the sample was in the year 2011, when there were 21 bids, which was followed by a sharp decline to 10 bids in 2012 and 2 bids in 2013, after which the M&A activity stays stable until the number of bids increases again to 11, followed by a similar decline to 6 bids in 2021 and 3 bids in 2022. This observation tells that in the sample the M&As are not equally distributed between the years.

Table 2. Descriptive Statistics of the preprocessed sample

Variable	Mean	SD	Median	Min	Max
ROE	0.099	0.181	0.111	-2.000	1.235
PB	2.914	4.404	1.913	-6.261	74.464
R&D intensity	0.015	0.064	0.000	0.000	1.523
SIZE	19.756	1.909	19.586	12.714	25.445
D/A	0.555	0.166	0.569	0.068	2.540
FCFTA	0.032	0.671	0.015	-0.593	21.363

Source: Author's calculations

To study the differences between targets and non-targets a Welch's *t*-test was conducted to capture the univariate relationships with a single variable. Welch's test was chosen because of the unequal sample size between targets and non-targets. Therefore, Welch's *t*-test is more suitable for analysing differences between means in the two groups. The results are presented in Table 3. The only variables with significant differences in means at $p<0.05$ level in the *t*-test were the price-to-book ratio the proxy for undervaluation and D/A the proxy for leverage ratio.

The significant difference in price-to-book ratio between non-targets and targets supports the undervaluation theory outlined in section 1.1.4, as the target companies have a significantly smaller price to book ratios. This result indicates that the target companies are trading at cheaper valuations in terms of book value relative to the non-target companies and the motivation is partially affected by the valuation of the company. The varying significance between studies is noted i.e., section 1.2 where the empirical background is laid, Walter (1994), found that the market-to-book ratio was the most significant variable in his paper contradicting Palepu's (1986), and similar results can be observed in this univariate comparison.

D/A ratio having a significantly higher mean in the target companies than in the non-targets supports the hypothesis formulated in section 1.1.5. The higher leverage could also mean that the target companies are closer to financial distress than the non-targets as the increased liabilities could become overburdensome as the companies with higher levels of debt have fewer options for financing and selling equity becomes a way to escape bankruptcy. This finding is in line with Danzon *et al.* (2007).

The statistical insignificance of the other variables has been observed in previous studies, and the shift in which variables are significant varies between studies, but it is surprising that the proxy for managerial efficiency is not a significant factor as Jensen's (1986) paper is one of the most cited.

Table 3. Univariate comparison

	Non-Targets		Targets		T-test for means	
	Mean	SD	Mean	SD	*T* stat	*p*-value
ROE	0.100	0.185	0.107	0.125	-0.443	0.659
PB	2.969	4.565	2.369	1.879	2.284	0.024**
R&D intensity	0.014	0.064	0.019	0.053	-0.754	0.453
SIZE	19.734	1.874	19.972	2.188	-0.919	0.361
D/A	0.551	0.170	0.589	0.111	-2.649	0.009**
FCFTA	0.034	0.700	0.022	0.0531	0.490	0.624

Notes: ***p<0.1; **p<0.05; *p<0.1

Source: Author's calculations

Lastly, the issue of multicollinearity was addressed by constructing a correlation matrix which shows the correlation between the independent variables. The matrix which is presented in table 4 shows that the highest correlation between independent variables is 0.287, which indicates that the independent variables are not significantly correlated with each other.

Table 4. Correlation coefficient matrix

Variable	ROE	PB	R&D intensity	SIZE	D/A	FCFTA
ROE	1	0.287	-0.013	0.163	-0.230	0.045
PB	0.287	1	0.081	-0.083	-0.042	0.008
R&D intensity	-0.013	0.081	1	-0.040	-0.105	-0.025
SIZE	0.163	-0.083	-0.040	1	0.206	0.007
D/A	-0.230	-0.042	-0.105	0.206	1	0.001
FCFTA	0.045	0.008	-0.025	0.007	0.001	1

Source: Author's calculations

To further ensure that multicollinearity is not found in the data, a VIF test was conducted, and the highest value was 1.326, which indicates that there is not a significant multicollinearity, and no further actions were needed to address issues related to multicollinearity within the data.

2.2 Methodology

The empirical part of this paper will employ quantitative methods to predict M&A target selection in the Finnish market, the probabilistic part of the research is conducted by fitting a binomial logistic regression model to the acquired data. The research aim is to explore whether a model can be used to predict M&A targets, and which variables impact the target selection. Measuring returns by using this model to identify investment opportunities is out of the scope of this research, although it could provide a framework for such investment strategies in the future.

The variables used in this study are proxies for the hypotheses in section 1.1 and Management inefficiency has been a hypothesis in previous studies such as (Palepu 1986), and similarly, it will be a hypothesis in this paper as well. And the proxy used for it is accounting profitability; return on equity ROE. The hypothesis and formula are given below.

$$ROE = \frac{Net\ income}{Shareholder's\ Equity} \quad (1)$$

For the company size hypothesis the proxy is natural logarithm of revenue, the natural logarithm transforms the revenue into more normalized value, and reduces skewness. Absolute values could

$$SIZE = LN(Revenue) \tag{2}$$

This model will use R&D intensity as a proxy for innovation. The reason for this is that an absolute number would skew the inputs as companies with higher revenue are naturally able to invest more in terms of absolute amount into R&D. Therefore, R&D intensity measures how much a companies invests into R&D as a percentage of their revenue.

$$R\&D\ intensity = \frac{R\&D\ expenditure}{Revenue} \tag{3}$$

A consistently used proxy for undervaluation is the PB ratio which stands for the price to book ratio, a similar proxy has been used in previous studies such as Palepu (1986). The undervaluation proxy measures the market valuation to book value, essentially indicating how the market values the company compared to the accounting value of the company. A lower PB ratio then indicates lower market valuation relative to the book value of the company, making the company cheaper than those with higher PB ratio.The formula is given below. The hypothesis is that cheaper companies are targets more frequently.

$$PB\ Ratio = \frac{Market\ Price\ per\ Share}{Book\ Value\ per\ Share} \tag{4}$$

The proxy for leverage is the debt to assets ratio, the formula is given below. Similarly to R&D innovation, and absolute amount of liabilities would not be sufficient, as bigger companies naturally would have more liabilities.

$$DA = \frac{Total\ liabilities}{Total\ assets} \tag{5}$$

The proxy for free cash flow is free cash flow to total assets, the reason for this is the same as R&D intensity, and DA, an absolute amount would not give very comparable figure.

$$FCF = \frac{Free\ Cash\ Flow}{Total\ assets} \quad (6)$$

The choice of model was driven by the fact that the wanted output is categorical, and the commonly used models for this purpose are logistic and probit models. Categorical output means that a simple linear regression model does not suffice, as the output needs to be non-target = 0 or target = 1. Due to the small size of the Finnish stock market, only a small sample could be obtained. Therefore, the model does not differentiate between hostile and friendly takeovers or domestic and foreign bidders. Since the model does not need to differentiate between multiple categorical outcomes, a binomial logistic regression model was chosen similarly to Palepu (1968), Powell (2001), and Danbolt *et al.* (2016). The formula for the model is as follows:

$$P_{it} = \frac{1}{1+e^{-z_{it-1}}} \quad (7)$$

where

P_{it} - probability of an event
Z_{it} - vector of characteristics
t - time index
i - individual index

The vector of characteristics is estimated by the formula (8)

$$z_{it-1} = \beta_{0+}\beta_1 X_{1it-1} + \beta_2 X_{2it-1} + \cdots + \beta_n X_{nit-1} \quad (8)$$

where

β_0 - intercept
β_n - estimated coefficient
X_{nit-1} - independent variable
t - time index
i - individual index

Additionally, despite the data being in a panel format, the previous literature except for Bena and Li (2014), concluded that the panel components were not significant and thus used pooled models. For this reason, a pooled model is also used in this paper, although the variables are lagged by one year as it is not possible to predict targets using data of the current year as it will not be published before the year ends. [1]

[1] Analysing panel component variance for logit models is extremely hard in R as the panel data libraries are missing functions to do so, for example, the survival package and pglm packages and the models are not compatible for

Simple robustness checks were conducted to assess how the coefficients change if a variable is omitted, the results for these tests can be found in appendices 2-7. The practice of conducting robustness checks is commonly used in empirical studies and provides insight to what variables are robust if the conditions change i.e., are they still statistically significant (Lu and White, 2014).

The predictive power was assessed by calculating the optimal cut-off point and using the model to make predictions in the test data set. Based on these predictions, the predictive power metrics such as accuracy, specifity, and sensitivity were calculated. The idea of calculating a cut-off point rather than choosing an arbitrary number was first utilized in Palepu's (1986) paper where he argued that this should yield more accurate results. Moreover, receiver operating curve (ROC) and the area under the curve (AUC), are calculated, to assess how the model differs from random selection (Fawcett 2006).

comparison. The reason for using 2 different packages is that pglm does not have a working fixed effects model and the fixed model must be made by using a different library, thus a pooled model is used. STATA could be used to do this easily, but the previous literature has analysed the panel components and chosen pooled models because the panel components i.e. time and the individual index had no significant effects on the models. Additionally, because the libraries for panel logistic regression are incomplete, predicting out of sample using the models does not work in R.

3. FINDINGS AND DISCUSSION

This section presents the results of the logistic regression model and then discusses the explanatory power and limitations. The estimated model was used out of sample by using the testing data set, and the calculations regarding predictive power are based on the predictions in the test data set.

3.1 Regression Estimation

Table 5. presents the results for the regression, as the t-test for means indicated, the debt to assets ratio is also significant in the regression results, indicating that an increase in leverage increases the likelihood of a takeover bid. Interestingly, the price to book value is not significant in the regression, despite having a significant difference in means between non-targets and targets. The coefficients are expressed as log-odds ratios, they can be exponentiated to obtain odds ratios, which then in turn can be used to see an increase in odds of being a target. This is done to the significant varible to illustrate the implied change.

Table 5. Regression output

Coefficients	Estimate	Std. Error	z-value	Pr(>z)
Intercept	-1.624	1.587	-1.024	0.306
ROE	1.615	1.089	1.484	0.138
PB	-0.086	0.070	-1.223	0.221
R&D intensity	1.371	3.361	0.408	0.683
SIZE	-0.086	0.080	-1.065	0.287
D/A	1.502	0.733	2.047	0.041**
FCFTA	-0.047	0.256	-0.182	0.855
McFadden R^2	0.017			

Notes: ***p<0.1; **p<0.05; *p<0.1

Source: Author’s calculations

Overall, the model fits the data poorly as indicated by low McFadden R^2, but the model presented in Table 5. Has the highest McFadden R^2 of all the models. The other models were made as robustness checks and can be found in appendices 2-8. The only variable that maintains significance in these tests is the proxy for leverage, and debt to assets ratio, indicating that in the Finnish market the financial state of the company influences the takeover likelihood.

H1: Companies with inefficient management are more prone to takeovers

The null hypothesis cannot be rejected, as the p-value is higher than 0.05, the proxy for managerial inefficiency, ROE does not provide evidence that companies with lower accounting profitability, are more likely to be acquired. The statistical insignificance of the result is somewhat surprising as Jensen's (1986), theory has been the basis for many similar hypotheses in previous literature.

H2: company size has an inverse relation to takeover likelihood

The regression results show that company size is not a determinant in takeover likelihood, this could be due to the varying reasons, why the mergers and acquisitions happen in the first place. The size could be a deterring factor, but because of the strategic implications and the fact that companies are able to pay for the merger with equity, should decrease the deterrence. That is why the result is not as surprising as the insignificance of managerial efficiency.

H3: Innovation has a positive correlation with takeover likelihood

Innovation's effect on takeovers has been previously studied in the Finnish market by Ali-Yrkkö *et al.* (2005) and Lehto and Lehtoranta (2004), they found evidence that innovative factors affect takeover likelihood, but this paper cannot conclude that innovation is a significant factor in the target selection, when considering listed companies.

H4: Undervaluation has a positive correlation with takeover likelihood

Undervaluation theory is one of the most common theories in the M&A prediction literature and can be found in Palepu's (1986) paper, the significance of the theory has varied previously, and in this paper the proxy for undervaluation is also insignificant as was the case with Palepu's (1986) paper. It is interesting that although the price to book value had a significant difference in the univariate framework, the same does not hold true in a multivariate comparison.

H5: Leverage is positively associated with takeover bid likelihood

The theory that financial distress is a driver for companies to seek merging, seems to hold true in this study. The fact that the proxy for leverage is the only significant variable, in both univariate and multivariate frameworks, indicates that the target companies are more levered, and the leverage increases the probability of being acquired. This is in line with Shrieves' and Stevens' (1997) and (Danzon *et al*. 2007), although the underlying motivation is unclear as it cannot be determined from this analysis if the target companies were seeking to escape financial distress, or if the situation was exploited by other companies, and parts of the target company were sold at a discount. The odds for D/A are 4,490 which corresponds to an approximate 349% increase in the odds of being target in the following year, if all the other variables stay fixed. Although it should be noted that if the D/A ratio would increase by one, it would mean that the company would take on additional amount of debt which would equal to the value of the total assets and would therefore be highly levered as the company would bear more debt than it holds assets.

H6: Free Cash Flow is positively associated with takeover bid likelihood.

The Free Cash Flow and the agency costs related are based on Jensen's (1986) theory as well, the theory is loosely related to managerial inefficiency, and is proven insignificant in this study. Free Cash Flow is also used in previous studies, such as Danbolt *et al.* (2016), The results contradict Danbolt *et al.* (2016), as Free Cash Flow is not significant in the univariate or multivariate framework. But are similar to Ali-Yrkkö *et al.* (2005), who found that Free cash flow was not significant in either univariate or multivariate framework, this result is interesting and could possibly be a characteristic of the Finnish market, but further studies would be required to validate this.

The results indicate that the takeover likelihood is poorly described by the variables chosen in this study with the exception of leverage, as the significance is low. Previous literature has used current cost variables to compose a more up to date picture of the company before the M&A transaction. Other variables could perhaps be used to better describe the innovative element, such as patent-related variables used by Ali-Yrkkö *et al.* (2005) and Lehto and Lehtoranta (2004) when studying the Finnish M&A transactions. The patent variables were statistically significant in their models.

3.1 Predictive Power

The model presented in Table 5. was used to predict target companies out of the sample, the earlier mentioned test data set was used for this purpose. The model fitted poorly to the data set in which it was trained, so it was to be expected that the model would have poor predictive power in the test data set.

Before the model was used an optimal cut-off point was calculated, to improve the predictive power. The optimal cut-off point was set to maximize sensitivity and specificity, and the cut-off point was then calculated to be 0.162 i.e., the companies which the model predicts to have a probability of being acquired is above 0.162, are classified as targets. The low value of the cut-off point tells that the probability of a company being a target is generally low.

Using the optimal cut-off point the model had an accuracy of 0.930, this shows that of all predictions, the model was able to accurately classify 93% of the companies based on the dependent variable. The sensitivity also known as the true positive rate, was 0, meaning that the model was unable to classify a single target correctly. The specificity also known as the true negative rate was 0.997, meaning that the model is very accurate in predicting non-targets. The usefulness of the model is low, due to the tendency to predict that a company will not be a target. In fact, the model predicted, that only 1 company would be a target in a test set which included 313 observations, and 21 actual targets. The predictive power was further assessed by measuring the area under the receiver operating curve (ROC). The plot can be found in appendix 8. The area under the ROC curve is 0.517, indicating that the model does not have any meaningful predictive power, as the area under the curve (AUC) of 0.5 indicates that the model does as well as guessing. The model's behaviour in that it is prone to type 2 errors is in line with previous studies, but due to the already sample size when using only listed, screening the companies close to bankruptcy and other similar screening methods might not even be possible in the Finnish market. Therefore, an investment strategy based on a takeover likelihood model is unlikely to work if it only includes Finnish companies.

The predictive power and subsequently the economic value of the model is low, it is likely that an investment strategy based on this model would probably not generate significant abnormal returns. The limitations of the model include small sample size, as the Finnish market has fewer companies and therefore less observations. The data quality is also questionable as the data

gathered from the Thomson Reuters EIKON database had missing values and some values were presumably incorrect. Further evidence can be found in a blog post in the blog Databases at Aalto Department of Finance by Blomster (2020) in which he states the following: "Unfortunately SCREENER application in Eikon has several issues including the issue of yielding results that are simply put incorrect."

To improve the model in the Finnish market the data could be gathered from a different source, but similar issues arise if the data is not validated. The obvious choice would be to gather the data by hand or validate the data by hand, but this requires considerable time investments, for a model that has in previous studies been prone to type 2 errors and the sample size would still be small, although less observations would have to be omitted. Another option could be to include other Nordic countries in the sample and that would lead to increased sample size, presumably increasing the predictive performance when analysing listed companies. Ali-Yrkkö *et al.* (2005) and Lehto and Lehtoranta (2004), mitigated the problem with sample size by using data from private companies as well, but then the sample consists mostly of private companies, and the relevance of the models is limited to the shareholders of the private companies and the management teams. The relevance of these studies to retail investors is therefore limited.

Logistic regression suffers if the number of outcomes for either event is small Williams (2012), therefore increasing the sample size, by extending the study to private companies or to other countries could improve the model's performance. Allison (2012) also discusses the possibility of introducing penalized regression models to reduce small sample size bias and therefore improving performance without increasing sample size. This could improve the predictive powers if similar studies were conducted in countries with small number of listed companies, such as in Finland or Estonia.

CONCLUSION

This paper examines, the characteristics of merger and acquisition targets of Finnish listed companies during the period 2009-2022. The univariate framework provided evidence that targets in these transactions had a significantly lower price to book value ratios and higher debt to asset ratios. This finding indicates that publicly traded Finnish companies that receive takeover bids on average bear more debt than non-targets, and they are priced lower relative to their book value than non-target companies.

The likelihood of companies being targets in a M&A was studied as well by employing a logistic regression model, and the results indicate that the only significant variable in the multivariate framework was the debt to asset ratio, the proxy for leverage. This result indicates that the target selection in M&As is poorly described by the variables chosen in this study except for D/A which was the proxy for leverage. Although the target companies had the characteristic of trading with lower valuation multiples, the price to book value does not explain M&A target selection very well.

The impact of leverage in M&A transactions has not previously been studied in the Finnish market, and it was proven significant in both univariate and multivariate frameworks. The fact that leverage had significant impact on takeover likelihood, indicates that companies with significant amount of leverage are more likely to be targets and this begs the question, why is it so. Further studies would be needed to conclude that financial distress pressures management teams to seek buyers for their companies, or that buyers exploit the financial distress of the target, but it is certainly a characteristic of Finnish target companies.

Moreover, the predictive power of the model was tested by employing the model out of the training sample, and predicting the target companies, using a cut-off point which maximizes sensitivity and specificity the model achieved high accuracy and specificity, but did not manage to classify a single target correctly when tested the out of the training sample and thus low sensitivity. The model has similar characteristics as the logistic models in the previous literature, which were also prone to type 2 errors, and had low predictive power out of sample. Although in previous literature, the models employed had more significant variables, which had led to better performance than the model in this study.

The issues with the model can be in part attributed to the small sample size, due to the small number of listed companies in Finland, and missing values in the data obtained from the Thomson Reuters EIKON database. These issues can be mitigated, by expanding the scope of the studies. Including other Nordic countries or the whole Europe into the study would certainly yield more observations and thus enable presumably more accurate models. Addition to this could be to include one specific industry to hopefully determine industry-specific characteristics and achieve better predictive power. More measures could be taken against inaccurate data, such as cross-validation, or collecting the data by hand. Using penalized regression model, could also help with the low number of events as Allison (2012) suggested.

To conclude, M&A is an unexpected event, and modelling it has proven challenging in the previous literature. Acquired companies and nearly bankrupt companies share similar characteristics, and this study also shows that an increase in debt increases the likelihood of a takeover bid, but the overall predictive power of the model was lower than those in previous studies. The observed unequal distribution of M&As could indicate that variables related to industry disturbance could be effective in M&A modelling but modelling if an industry disturbance would occur in the first place would most likely prove to be as difficult as M&A modelling.

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APPENDICES

Appendix 1. Target count by year

Year	Non-target Count	Target Count
2010	53	6
2011	44	21
2012	63	10
2013	61	2
2014	61	4
2015	67	2
2016	79	2
2017	80	3
2018	80	3
2019	95	2
2020	85	11
2021	93	6
2022	91	3
Total	952	75

Source: Author’s calculations

Appendix 2. Robustness check without ROE

Coefficients	Estimate	Std. Error	z-value	Pr(>z)
Intercept	-1.984	1.575	-1.260	0.208
PB	-0.040	0.054	-0.748	0.455
R&D intensity	0.944	3.315	0.285	0.776
SIZE	-0.057	0.079	-0.723	0.470
D/A	1.215	0.693	1.753	0.080*
FCFTA	-0.030	0.223	-0.133	0.894
McFadden R^2	0.010			

Notes: ***p<0.1; **p<0.05; *p<0.1

Source: Author's calculations

Appendix 3. Robustness check without price to book value

Coefficients	Estimate	Std. Error	z-value	Pr(>z)
Intercept	-2.079	1.570	-1.324	0.186
ROE	0.873	0.801	1.090	0.276
R&D intensity	0.506	3.365	0.150	0.880
SIZE	-0.068	0.080	-0.846	0.398
D/A	1.437	0.718	2.000	0.045**
FCFTA	-0.046	0.265	-0.175	0.861
McFadden R^2	0.012			

Notes: ***p<0.1; **p<0.05; *p<0.1

Source: Author's calculations

Appendix 4. Robustness check without R&D intensity

Coefficients	Estimate	Std. Error	z-value	Pr(>z)
Intercept	-1.622	1.592	-1.019	0.308
ROE	1.579	1.080	1.462	0.144
PB	-0.081	0.068	-1.191	0.234
SIZE	-0.085	0.081	-1.046	0.295
D/A	1.466	0.725	2.024	0.043*
FCFTA	-0.049	0.026	-0.188	0.851
McFadden R^2	0.017			

Notes: ***p<0.1; **p<0.05; *p<0.1

Source: author's calculations

Appendix 5. Robustness check without size

Coefficients	Estimate	Std. Error	z-value	Pr(>z)
Intercept	-3.247	0.484	-6.705	0.000***
ROE	1.403	1.080	1.300	0.194
PB	-0.078	0.070	-1.103	0.270
R&D intensity	1.213	3.463	0.350	0.726
D/A	1.375	0.719	1.912	0.056
FCFTA	-0.047	0.262	-0.181	0.856
McFadden R^2	0.014			

Notes: ***p<0.1; **p<0.05; *p<0.1

Source: Author's calculations

Appendix 6. Robustness check without DA

Coefficients	Estimate	Std. Error	z-value	Pr(>z)
Intercept	-1.351	1.560	-0.866	0.386
ROE	1.190	1.084	1.098	0.272
PB	-0.078	0.069	-1.130	0.258
R&D intensity	0.520	3.50	0.155	0.877
SIZE	-0.055	0.079	-0.695	0.487
FCFTA	-0.044	0.254	-0.172	0.863
McFadden R^2	0.006			

Notes: ***p<0.1; **p<0.05; *p<0.1

Source: Author's calculations

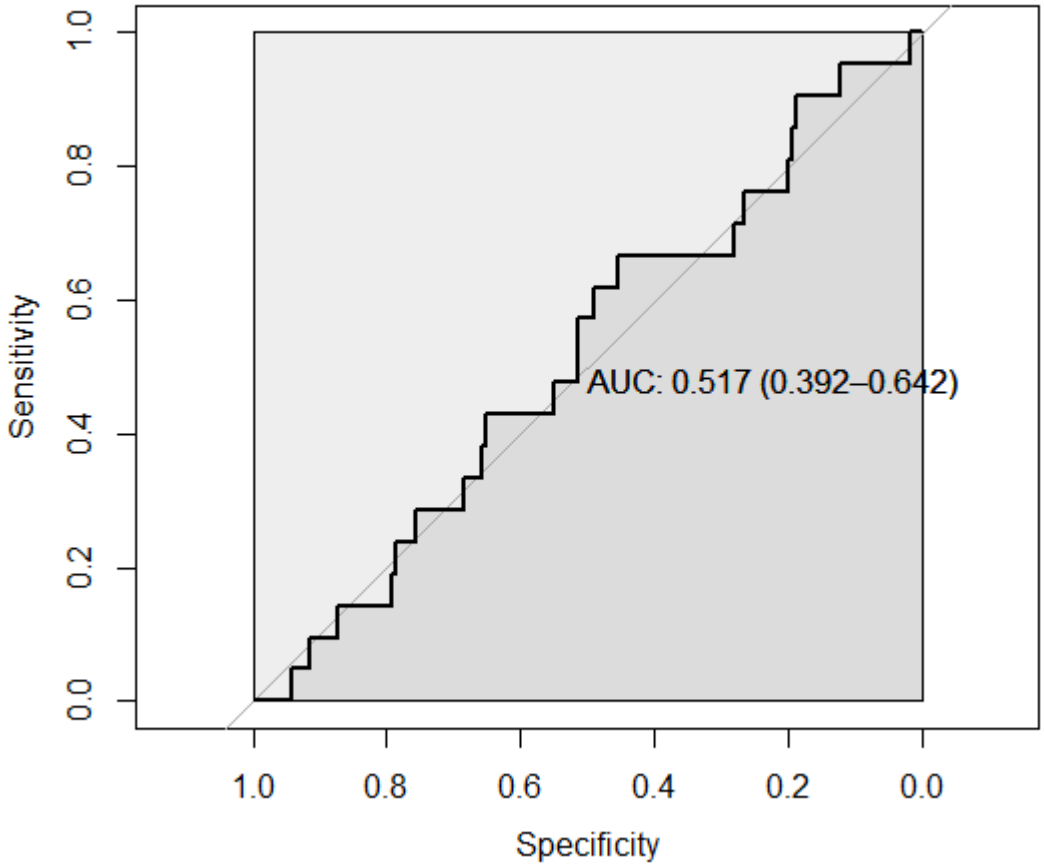
Appendix 7. Robustness check without Free Cash Flow

Coefficients	Estimate	Std. Error	z-value	Pr(>z)
Intercept	-1.624	1.588	-1.023	0.306
ROE	1.607	1.088	1.477	0.140
PB	-0.086	0.070	-1.222	0.222
R&D intensity	1.387	3.362	0.413	0.680
SIZE	-0.086	0.081	-1.065	0.287
D/A	1.501	0.734	2.045	0.041**
McFadden R^2	0.017			

Notes: ***p<0.1; **p<0.05; *p<0.1

Source: Author's calculations

Appendix 8. ROC and AUC



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