

Lund University School of Economics and Management

Bachelor Thesis in Economics (NEKH02)

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VT, Juni 2025



LUNDS
UNIVERSITET

Share Buyback's Effect on Performance

A Comparative Study of Nordic Public Companies' Performance Before and After
Share Buybacks

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Abstract

This study examines whether share buybacks lead to real improvements in operational performance for public companies in the Nordic region. Buybacks are frequently associated with mechanical improvements in financial metrics on paper and market signaling, yet how they affect a company's operational performance has not been clearly established. This is analyzed by comparing companies that conducted share buybacks in 2017 with a matched control group using a difference-in-difference regression. The operational performance is measured using three different performance metrics: EBITDA margin, net income margin, revenue growth and is measured from 2015 to 2020. The analysis finds no consistent or statistically significant effect of buybacks on any of the measured performance metrics. One single significant decline in net income margin is found in 2019, but this does not reflect any broader trend or systematic effect. It is concluded that the effects of share buybacks likely are limited to mechanical financial changes and do not drive any improvements in operational performance.

Acknowledgement

I am grateful for Adrian Mehic's guidance and insightful feedback throughout this project. His support and contributions added clarity, making the final work stronger and more coherent.

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1. Introduction

Over the past decades there has been an increasing trend in public companies to execute share repurchases, more commonly referred to as share buybacks. While buybacks are most popular in the US, Europe has in the past years been closing this gap (Goodacre, 2023). Share buybacks are commonly done by companies for three main reasons, creating shareholder value, enhancing financial metrics as well as using excess cash efficiently (Tamplin, 2023). While some believe buybacks are done as a sign of confidence and financial strength, others criticize them for manipulating financial metrics and putting money in the executives' pockets.

In practice companies generally perform share buybacks are done through one of two methods, through the open market or by a tender offer. When buying back shares on the open market, a company buys back shares at the market price gradually over a period of time. This allows the company to be flexible and manage the volume of shares that are repurchased. On the other hand, a tender offer is when the company offers current shareholders a fixed price at which they can sell their shares. This is often done at a premium of the market price resulting in tender offers often allowing quicker buybacks but comes with a larger commitment (CFI, nd).

Despite their increase in popularity, buybacks do not in themselves create any direct increases in efficiency or performance for the company, but rather financial metrics and sentimental signals. The reduction in outstanding shares increases the earnings per share, EPS, without increasing the company's total earnings. Increasing the EPS can indicate enhanced performance on paper and make the company more attractive to investors. Furthermore, as stated previously, buybacks often signal the management's confidence in the company or their belief that the share is undervalued. Whether these effects in turn lead to a boost in performance is unclear.

The aim of this thesis is to investigate if share buybacks lead to any changes in operational performance. This will be done by analyzing companies that have conducted share buybacks and looking at different key financial performance indicators before and following the buybacks. The study will be done on public Nordic companies.

The analysis will be conducted using a difference-in-difference approach to estimate the causal effects of share buybacks on “real” operational performance. By comparing companies that have conducted buybacks with a control group of matched companies that have not, the study aims to investigate if companies that buy back shares experience any change in real performance.

The study begins with reviewing relevant theories and previous research on share buybacks, building a foundation for understanding why companies actually repurchase shares as well as the theoretical effects buybacks might have. It then moves on to describe the data and the methodology used to study these effects. Next, the results of the analysis are presented and interpreted, as well as put in relation to the relevant theoretical framework and previous literature. Finally, the study ends with an overall reflection of the findings as well as bringing possible limitations to light.

The results indicate no consistent or statistically significant effect on real operational performance following share buybacks. While one significant effect was found for a decline in net income two years after the buyback, this does not likely reflect a systematic effect across time.

This leads to the central question explored in this study:

Do share buybacks lead to changes in a company’s operational performance or are the observed effects primarily due to mechanical changes in financial metrics?

2. Theoretical Framework and Previous Research

This chapter will present theoretical insight into share buybacks as a payout policy and a discussion of the theoretical assumptions as to why companies perform share buybacks. Following this, previous research and findings of why real-world company executives choose buybacks will be discussed as well as the share buybacks effect on the company's financial metrics and statements. In closing, previous research and findings will be brought to light and what gaps this study aims to fill.

2.1 Share Buybacks vs Dividends

Share buybacks are often put into comparison with dividends. Buybacks are a financial tool, just like dividends, to return excess capital to shareholders. Dividends are generally payments in the form of cash which are proportional to the shareholder's ownership in the company. These dividends reduce equity by paying out past profits to the owners but also reduce assets as there is a decrease in cash. Share buybacks also result in a reduction in equity by the company buying back the stocks as well as assets decreasing due to an outflow of cash. The main difference between these two methods, which is highly relevant to the research question, is how the buybacks affect other financial metrics on paper.

One theory that touches upon different payout policies is the Dividend Irrelevance Theory, introduced by Modigliani and Miller in 1961. The theory proposes that in perfect capital markets there is no difference whether the company chooses dividends or buybacks. A perfect capital market is characterized by the absence of taxes, no transaction costs and symmetric information. The theory claims that investors and shareholders are indifferent between dividends and buybacks due to the fact that in a perfect capital market, this does not influence the company's value or affect the shares. However in practice this has been criticized and the differences between the payout policies will be discussed in the following pages.

2.2 Companies' Motivations for Choosing Share Buybacks

The following section will discuss different theories on why companies perform buybacks and discuss which are most likely to be the motivation behind the buybacks done for the companies that are observed in this study. This is not directly necessary for the data analysis but will rather give a better overall insight into share buybacks as a whole, enabling a deeper understanding of the topic and results.

2.2.1 Signaling Hypothesis

When a company decides to perform share buybacks, whether it is through the open-market or tender offer, it is announced. This announcement becomes new information on the market that can and most likely will have effects on how the company is perceived and stock price/returns. However, whether this effect is positive or negative is inconclusive. The fact that the management decides to buy back shares can indicate that they believe the stock is undervalued. This is often the case for tender offers when the company offers to buy back at a relatively large premium. However, on the other hand buybacks can signal that the company has stagnated and do not have any profitable ways of investing this excess cash (Vermaelen, 1981). High dividends also give a signal to the market of strength; hence the hypothesis does not primarily explain why companies choose between dividends or buybacks. The signaling hypothesis rather describes the sentimental effect of the company's payout policy. For the case of this study's research question, the signaling hypothesis could be argued to suggest that companies who perform buybacks are expected to experience performance gains post-buyback. This is not a direct effect of the buyback itself but rather that companies conduct share buybacks when the company's managers expect the future performance to be good.

2.2.2 Benefiting Shareholders through Taxation Advantages

One other aspect that can be seen as motivation for the company to choose buybacks over dividends are taxation advantages. In some countries, specifically the US where buybacks are

very popular and studied, realized profits from shares are taxed lower than dividends. The buyback company then creates shareholder value by providing the profits through a lower taxed channel. However, for this study which investigates buybacks in the Nordics, the same cannot be said. For neither Denmark, Finland, Norway or Sweden, realized profits from sold shares are not taxed at a lower rate than dividends.

2.2.3 Free Cash Flow Theory

The Free Cash Flow Theory was brought forward by Jensen in 1986 and discusses the agency costs that come with an excess free cash flow. Free cash flow is defined as the excess cash flow after all investment opportunities with positive present discounted value, in other words profitable investments. Agency costs are conflicts of interest between the company's management and the shareholders, often related to overspending of the management. So what the theory suggests is that companies with higher free cash flow experience higher agency costs as well as discussing solutions (Edubirdie, 2022).

In a study written by Brav et al. in 2005 surrounding companies' payout policies, they surveyed managers and their thoughts around payout policies. The conclusions in short are that managers believe that changes in buyback policies come at less agency costs than changes in dividends. Instead of changing the dividends payments they prefer to instead lower their amount of buybacks. The same for times of excess free cash flow, share buybacks were from the management's perspective preferred, but for different reasons. Changes in the buyback policy are deemed less permanent and therefore do not require as big of a commitment from the company as well as being more flexible. On the other hand, an increase in the dividends payout policy can be seen as more attractive from the shareholder point of view as this commits the management to the payout and gives the shareholders a sense of security to prevent overspending (Brav et al, 2005).

Thus, according to the theory, the hypothesis to why companies choose buybacks over dividends is due to "bad" managers who do not put the shareholders before themselves. It is hard to know if this is the case or not for the observed companies, however, we can assume this is more

directed towards the US. According to Vanessa Houlder from Financial Times, the US corporate governance is generally structured using a single board, combining the supervisory board and management board. This means that the CEO can also be the Chairman of the Board which gives them substantial power and opportunity to put their interests above the shareholders. This structure is much rarer in Europe where a separate, dual-Board system is the standard (Houlder, 2024). We can therefore assume that the hypothesized motivation of managers choosing buybacks for personal gain is not likely regarding the companies in this study.

There is another hypothesis that falls under the free cash flow theory and that is that the company voluntarily wants to return excess cash to the shareholders. This could be the case for the observed companies.

2.2.4 Reallocation of capital

This theory originates from fundamental micro economics and theories of capital markets. It is the idea that in a functioning and efficient market, capital will reallocate itself to the most profitable/efficient investments. According to Eberly and Wang, companies will at some point in time stagnate in terms of growth and these previously most profitable investments will pay back their equity to the shareholders. This money then gets reinvested in the new best allocation for the capital (Eberly & Wang, 2018). Thus, the hypothesis is that the buyback is due to the company maturing and reducing its equity and paying back to the shareholders. It is similar to the free cash flow theory and could be the case for some of the companies in the study. However, the observed companies are at many different stages in this “life-cycle” so it wouldn’t explain all of the buybacks.

2.2.5 Concluding Why Companies Perform Share Buybacks

Concluding the sections above, there are several theoretical frameworks that propose different explanations as to why companies choose to perform buybacks as a payout policy. While each theory offers deeper insight into certain aspects of the motives and behavior of companies as well as shareholders, none can definitively fully explain why the buybacks were performed. This

makes it likely that the answer as to why companies increasingly choose to buyback shares over dividends lies outside of academic theories and unrealistic assumptions.

2.3 Real-World Perspectives and Motivations

While the theories have given us a good theoretical understanding, we are now going to discuss the motivations expressed by real companies, managers and decision makers. This section will mainly be based upon the study Payout policy in the 21st century by Brav et al. from 2005. They surveyed over 380 financial executives in the US, investigating payout policies. As mentioned before, this study was done in the US which will be mostly similar but also differ which is taken into consideration.

2.3.1 Investment

One of the results from Brav et al.s study was that managers prefer buying back shares over changing dividends level due to their greater flexibility. With this flexibility comes the ability to easily be able to choose when to perform the payout. This aspect of flexibility allows managers to try to time the market by buying back when they believe their stock is undervalued. This hypothesis falls in line with the free cash flow hypothesis but is complemented by this timing aspect. The survey found that almost 8 in 9 companies answered that they repurchase shares when they believe it is good value.

2.3.2 Boosting the EPS and Eliminating Dilution

The other most common answer they received was concerning the earnings per share, EPS. By buying back and reducing the outstanding shares, the EPS ratio increases without having to increase the earnings. The EPS is calculated by taking the net income, subtracting preferred dividends that have been paid out and dividing by the average amount of outstanding shares over the year. Preferred dividends are subtracted because they go to preferred shareholders, not the common ones (Schmidt, n.d.).

Equation 2.1: Earning per Share Formula

$$EPS = \frac{\text{Net Income} - \text{Preferred Dividends}}{\text{Average Outstanding Shares}}$$

This is especially interesting and relevant to agency costs when the capital used for the buyback could be used for earnings as well as when the executives compensation is tied to the EPS. Additionally, buybacks were also cited to be used for offsetting the dilution that employee stock options would cause. By reducing the number of outstanding shares by the same amount introduced by employee stock options, dilution could be avoided. Both of these motivations would fall under the category of mechanically adjusting metrics on paper, as will be shown below, and not for increasing actual operational performance. This is not to say that the buybacks won't lead to any performance increases, but rather that to do so is not the main purpose of the buyback.

2.4 Share Buyback's Effect on the Company

In the next section the theoretical impact of share buybacks on companies' performance is discussed, with reference and in comparison, to previous findings. This will aid in understanding how buybacks do or do not lead to genuine improvement in performance or if they simply affect financial metrics on paper.

2.4.1 Real vs Fake Increase in Performance

In order to evaluate whether buying back shares has an effect on a company's performance or efficiency we have to understand and define the difference between mechanical improvements on paper and actual performance gains. In this study, mechanical improvements will refer to changes in financial metrics that are a direct result of the buyback. This is generally when equity or assets is part of a formula because assets are reduced when buying the shares because cash leaves the company and equity is reduced because shareholders are paid out. Thus, an increase in

EPS or ROA (return on assets) are good examples of what could be defined as a mechanical improvement. If these metrics increase it could of course also be due to actual gains in performance or rather a mix of both.

Another very commonly used metric is stock return, which is often used in other papers surrounding share buybacks as a reference of performance. However, this performance is referred to the stock and not the operational performance of the company. Stock returns do not reflect operational performance directly but rather a market perception of performance as well as future expectations and the signaling effect of buybacks. So even though stock returns are not mechanically adjusted by the buyback, it will not be considered a real performance indicator.

In contrast, actual gains in performance are reflected in higher revenues, stronger margins, higher efficiency and improvements in metrics that aren't simply due to the alteration in capital structure. In other words, real performance gains in this study can be defined as improvements in metrics that stem from actual operational improvement or efficiency gains. Distinguishing between these effects is crucial in answering the research question.

2.4.2 Additional Previous Findings

A relatively large amount of studies and research around share buybacks has been done in the past. This is mainly surrounding effects on the stock return/price, share buybacks vs dividends, agency costs and manager's not putting the shareholders' interests first. In the previous sections some earlier findings have been discussed but mainly regarding different theories and hypotheses. These upcoming paragraphs will summarize key findings from studies on share buybacks and focus on their effects on the company conducting them.

One of the studies on share buybacks by Ikenberry et al (1995) was done on abnormal returns on companies who conducted share buybacks. Their findings indicated that the companies who conducted an open-market buyback earned an average abnormal return of 12.1% over a four year period following the buyback announcement. Their study also found that the companies who most likely bought back shares due to undervaluation averaged an abnormal return of 45.3%.

These findings support the signaling hypothesis as well as the surveyed motivations found of Brav et al. in 2005.

Another study that highlights mechanical manipulation of metrics is Hribar et al. (2006). They investigated how companies use share buybacks to manage the EPS. The results showed that a large number of companies increased their EPS through buybacks precisely when the EPS was below analyst forecasts. In other words, the companies used the buybacks to ensure that they would report an EPS in line with or higher than analyst's forecasts and avoid the possibility of being perceived as an underperforming company. However, they also found that the companies who met the expectation due to the buyback received a lower valuation premium compared to the companies who did not use buybacks. This indicates that investors and the market are aware of companies using buybacks for manipulating metrics.

Furthermore, Christine Joll's study in 1998 explored the manager's compensation and their incentives effect on buybacks. She argued and found that because executive compensation often relies on stock prices or EPS metrics, managers are given incentive to conduct buybacks to inflate said metrics and in turn increase their own compensation. While this is not directly regarding the buybacks effect on the company or performance, it supports the view that buybacks can be driven by personal gain rather than benefiting shareholders or the company's operations.

Within the Nordic context, De Ridder (2009), Skjeltorp (2004) and Paulsen (2011) have all investigated share buybacks effect on the stocks' abnormal/excess return. De Ridder found that the initial effect from the first repurchase date was small but that companies that buy back shares outperform their non-buyback competitors on average during a longer three year period. This study was done on a sample of Swedish companies. Skjeltorp who focused on Norwegian companies from 1998-2001 observed a positive excess return around the initial buyback date and during the buyback period. However, long term excess return was only experienced by companies who announced a buyback but did not go through with it. This was suggested to be because the signaling effect would not take place at the announcement due to the fact that the company backed off and instead would lead to greater returns later in the future. Finally, the study done on buybacks on Danish companies by Paulsen in 2011 showed that his findings were

that buybacks yielded negative absolute and relative returns over a one to four year period. He also stated that there was no consistent pattern in the different yearly returns concluding that there was a large aspect of randomness.

2.5 Summary

This chapter began by comparing buybacks to dividends as a payout policy, showing how they may differ in their impact on financial metrics. Then presenting different views on why companies engage in buybacks. Firstly going over the theoretical hypotheses and later discussing findings of what real world managers state are their explanations. Finally highlighting past empirical studies that showed a mix of results. Some reporting positive stock returns and others, specifically in the Nordic region, fail to find significant value creation. These studies do not clearly separate mechanical effects from real operational improvements. This creates a gap in the literature and leads us back to the research question of this paper.

3. Data

This chapter will outline how the dataset used in the study was collected, cleaned and prepared for analysis. It will begin by disclosing what data source has been used, following with how the treatment and control groups were constructed. It will then introduce the financial variables which are to be analyzed as well as the data processing steps taken.

3.1 Data Source

The primary source of financial data used in this study is Capital IQ Pro. Capital IQ Pro is a financial database that provides data on both public and private companies. The database has a screening tool that allows filtering of companies, transactions, key developments and more. The data set includes financial data of public companies in the Nordics.

3.2 Constructing the Treatment Group

When choosing a treatment group two main decisions were to be made, for what period and geography. For this study a focus on the Nordic region was chosen as well as companies who performed buybacks during the year of 2017. The year 2017 was chosen as it is recent but allows for enough time post buyback to analyze the effects. Three years post buyback was the goal which would have been doable with later years such as 2020 or 2021. However, a lot of drastic changes in the world have happened after and during those years, such as the COVID-19 pandemic, the Ukraine-Russia war and other large political changes that have had a big impact on the world economy. This led to the years 2015-2020 to be collected and 2017 being the treatment year as it allows for a long enough post period that wouldn't tread into these very unstable years. The underlying reasoning is that the analysis would be more realistic as an unstable and uncertain economy alters the way companies act. This in turn could give results that aren't applicable or realistic for most other time periods.

The initial screening was thus public companies with executed buybacks during 2017 and geography filtered after Denmark, Finland, Iceland, Norway and Sweden. The geography filter

goes after the address listed for the company. After this initial screening it was discovered that a small number of the companies included in the results had not engaged in buybacks but other transactions, mainly linked to M&A activity. Each company was manually reviewed and companies without buybacks were excluded to ensure the treatment group only reflected true buybacks.

This final treatment group consisted of 162 public companies with different financial metrics, which will be discussed later on in this chapter, for a time period of six years from 2015 to 2020.

3.3 Constructing the Control Group

To assess the impact of share buybacks on performance a control group of comparable companies that did not buy back shares was constructed. The purpose of the control group is to serve as a benchmark for evaluating if the changes in the variables can be attributed to buybacks or if these changes happened in companies without buybacks as well. The control group was identified using Capital IQ Pro, again applying the same company, geographic and periodic filters as for the treatment group. However, this time filtering for companies that had not performed a share buyback instead of filtering for companies that have bought back shares.

Furthermore, to boost comparability, the control group was filtered to only contain industries matching that of the companies in the treatment group. This was done using NACE codes which group companies under different categories depending on their primary area of business. This ensures that both groups operate in similar industries and share industry specific dynamics, reducing the risk of differences between the groups being driven by industry effects rather than the effect of buybacks.

Similarly to the treatment group, some companies with buybacks had slipped through the filtering including some of the treatment companies. The companies in the control group were manually reviewed to ensure treatment companies or companies with any buyback activity were excluded. The final group consisted of 497 public companies, providing a large sample for

benchmarking. The same performance metrics for the control group were collected for the same six-year period as the treatment group.

3.4 Variables Used

The following section will present and describe the financial variables used to evaluate the impact of share buybacks on company performance. It will discuss the advantages of each variable and how they demonstrate real performance improvement as well as how share buybacks affect them.

3.4.1 EBITDA Margin

EBITDA stands for and is calculated as earnings before interest, taxes, depreciation and amortization. EBITDA margin is calculated by dividing the EBITDA by total revenue multiplied by 100, as shown below. It measures a company's operating profitability as a percentage of its total revenue, while excluding expenses that are not operating expenses, such as interest and tax.

Equation 3.1: EBITDA Margin Formula

$$EBITDA\ Margin = \frac{EBITDA}{Total\ Revenue} \times 100$$

A higher EBITDA margin indicates higher operating efficiency and profitability by showing how much of the revenue remains after covering the operating expenses. EBITDA margin is a good metric to use in comparison between companies' operating performance as it excludes previously mentioned capital expenses and solely focuses on the operations (Lager, 2024). EBITDA margin is also not directly affected by share buybacks, as the buyback does not mechanically alter any of the data in the formula. It is therefore a metric that if it experiences changes post buyback, likely reflects genuine changes in performance and operational efficiency.

3.4.2 Net Income Margin

Net income is calculated as total revenue - total expenses. The net income margin is then calculated by dividing the net income by total revenue and multiplying by 100 to get a percentage.

Equation 3.2: Net Income & Net Income Margin Formulas

$$\text{Net Income} = \text{Total Revenues} - \text{Total Expenses}$$

$$\text{Net Income Margin} = \frac{\text{Net Income}}{\text{Total Revenue}} \times 100$$

This percentage represents the percentage of sales that ends up as a profit. A higher net income margin indicates stronger profitability after accounting for all expenses including interest and taxes. Net income margin is not directly affected by buybacks and will not be mechanically altered. However, it can be indirectly affected due to changes in capital structure which can alter interest payments, which is included in the formula. However, this doesn't have to be the case and the effect is relatively small in comparison to the impact buybacks have on EPS for example. Overall net income margin is a good indicator of real performance improvements although it can be slightly affected by the buyback.

3.4.3 Total Revenue and Revenue Growth

Next, we have total revenue and revenue growth. Total Revenue measures the company's gross income before deducting any expenses. Revenue is not affected by buybacks and can indicate growth, expansion and improved performance in the form of improved competitiveness. However, a limitation of total revenue is that it is not normalized like the previous variables, in the form of a ratio. Without adjusting for the size of a company, comparisons can be misleading. To overcome this, we also look at revenue growth to the prior year. The formula can be seen

below and essentially gives us a percentage of how much the company has grown over the past year.

Equation 3.3: Revenue Growth Formula

$$\text{Revenue Growth} = \frac{\text{Revenue}_t - \text{Revenue}_{t-1}}{\text{Revenue}_{t-1}} \times 100$$

Just like total revenue, revenue growth is not mechanically affected by buybacks. Therefore, any observed changes in revenue growth following buybacks are likely the results of operational improvements or industry/economic shifts, which are to be controlled. Additionally, although total revenue has its limitations, it still allows for pre/post analysis within the same company and analysis of how different sized companies are affected.

3.5 Data Cleaning and Processing

This section will outline the steps taken to prepare the dataset for analysis, including handling missing values, adjusting industry classifications and ensuring group comparability with the use of matching techniques.

3.5.1 Handling Missing Data

After constructing both groups, there were some missing data points. This is not uncommon for large data sets over a longer period of time. To preserve as much of the sample as possible while ensuring data quality and econometric assumptions, an autoregressive imputation was used to fill these gaps.

Specifically an AR(1) model was used which estimated the missing value based on the most recent available observation from that firm. The imputation was done using R's forecast package.

If a value was missing and the prior period's value existed, the model imputed the value according to this equation:

Equation 3.4: AR(1) Model

$$Y = \alpha + \beta Y_{t-1}$$

The process was done for each of the metrics, EBITDA margin, net income margin and revenue growth. If the model was not able to fit a value due to a missing previous value, specifically when the year 2015 was missing, the imputation skipped the value to avoid speculative imputation. This method of handling data is more structured as well as more econometrically and theoretically correct imputation compared to calculating averages and inserting them.

3.5.2 Merging Industry Groups

Another part of the data that needed to be processed and adjusted were the industry categorizations. Initially these were as mentioned exported as NACE codes from Capital IQ Pro which are very specific areas of business. However, some of the industries only contained a very small number of companies. This increases the risk of the results lacking statistical reliability as the estimates are based on very small samples. When including dummy variables in the regression models, small industry groups can cause high standard errors and reduce the power of the model.

To address this, similar industries were merged into broader categories. For example, all different specific manufacturing industries were merged into one industry, manufacturing. This was done to increase the number of observations within each industry while also keeping the comparability preserved.

3.5.3 Welch t-test & Propensity Score Matching

In this study a Difference-in-Difference (DiD) regression will be done to analyze the effect of share buybacks on the different metrics, which will be explained in detail later on. To ensure that any post effects have significance, it is important to analyze the treatment and control group before the buybacks. If there are significant differences between the two groups before the buyback, any difference analyzed post buyback will lose significance. To check this a Welch t-test was conducted, as can be seen in table 3.2.

Table 3.5: Welch T-test pre buyback before PSM matching

Table 3.5: Welch T-Test Results Before Propensity Score Matching					
Variable	Treatment Mean	Treatment SD	Control Mean	Control SD	P-value
EBITDA Margin	17.167	30.420	-2.097	50.104	0.0000
Net Income Margin	13.625	63.351	-1.092	113.350	0.0038
Revenue Growth	9.861	95.794	42.703	236.845	0.0119

Note: Welch t-tests were conducted to assess pre-treatment differences between the treatment and control groups. All variables show statistically significant differences prior to matching.

As can be seen in the table above, the results revealed significant differences across all 3 metrics. This strongly suggests the groups are not comparable before the buyback and the parallel trend assumption that is necessary for DiD is unlikely to hold. The parallel trend assumption is, assuming the treatment group did not perform a buyback, the two groups would follow a similar trend. This ensures that any differences that are observed after the treatment, in this case the buyback, can be argued to be due to the treatment.

To improve the balance between the groups and ensure that a DiD regression can be done with the parallel trend assumption holding, a propensity score matching (PSM) was done using the MatchIt package in R. R is a statistical software and the MatchIt package uses averages for the metrics during the pre-buyback period to estimate a logistic regression model. Companies in the treatment group were then matched with the two nearest control companies based on their propensity score using the nearest-neighbor method. This method ensures that each treatment company is paired with control companies that are sufficiently similar in the metrics for the

pre-treatment period. A small number of companies in both groups were excluded during this process due to the lack of close matches.

After matching, a Welch t-test was done again on the new sample. As can be seen in table 3.3 below, the results greatly improved with all three metrics now not being significantly different. This shows that the PSM gives value and also ensures that the assumptions for DiD regression hold.

Table 3.6: Welch T-test after PSM

Variable	Treatment Mean	Treatment SD	Control Mean	Control SD	P-value
EBITDA Margin	17.543	35.355	15.630	26.716	0.4113
Net Income Margin	12.104	57.489	10.231	42.219	0.6193
Revenue Growth	9.575	99.207	21.747	210.410	0.4105

Note: Welch t-tests were repeated after matching. The results indicate no statistically significant differences between the treatment and control groups, supporting the balance achieved through propensity score matching.

3.6 Final Data Summary

To summarize, the final dataset consists of 150 public Nordic companies that have conducted buybacks during 2017 and 290 matched control companies that did not. The data spans from 2015 to 2020 and includes the companies' EBITDA margin, net income margin and revenue growth. Lastly the data cleaning and processing was explained, demonstrating how the data has been processed so it is ready for analysis and will ensure credible results.

4. Method

This chapter will explain the empirical approach used to estimate the causal effect of share buybacks on real performance. It starts with outlining the DiD regression model and the hypotheses being tested. Finally, the key assumptions required for the analysis are presented as well as steps taken to ensure they are upheld.

4.1 Overview of Empirical Approach

The purpose of this study is to investigate the causal impact of share buybacks on companies' real performance as defined earlier. To achieve this, a Difference-in-Difference regression is used to compare the treatment group vs the control group pre and post buyback. The underlying logic of the approach has been to first identify a group of firms that have conducted buybacks and match them with a comparable control group of companies that did not. This matching as explained in the data section was done based on the pre-treatment data.

Once the matched sample is established, a DiD regression is used to estimate the causal effect of buybacks. The regression can be described as comparing the change in metrics over time between the treatment and control group, before and after the buybacks. By using PSM and accounting for common time shocks with period fixed effects, the model attempts to isolate the effects of the buyback.

4.2 Difference-in-Difference (DiD) Model

The analysis will be done specifically using a dynamic DiD regression model. This is where the treatment effect is allowed to vary by year following the buyback, so we look at each year after the buyback separately. This is done by including different interaction terms between the treatment group dummy and year dummies for each post-treatment year. These interaction terms measure the difference in performance for companies who have conducted a buyback in each year relative to the control group, while controlling for time trends through the period fixed

effects. Finally, industry dummies are included to absorb and account for industry specific effects that could affect the metrics measured.

The specification of the model can be written as:

$$Y_{it} = \alpha + \sum_k \delta_k \times dummyIndustry_{ik} + \sum_{t=2017}^{2020} \beta_t \times (Treatment_i \times Year_t) + \gamma_t + \varepsilon_{it}$$

Where:

- Y_{it} is the outcome variable (e.g., revenue growth, EBITDA margin) for firm i in year t .
- $IndustryDummy_{ik}$ are dummies for each broad industry group.
- $(Treatment_i \times Year_t)$ are year-specific interaction terms capturing the treatment effect.
- γ_t are period fixed effects, automatically included in the model. These are accounted for but not part of the outcome in shape of coefficients.
- ε_{it} is the error term.

The most interesting coefficients are the ones in front of each interaction term, β_t , which estimate the average effect that the buyback has on the treatment companies. Having year specific interaction terms allows us to analyze both short term and long term effects.

4.3 Hypotheses

The hypotheses tested in this study aim to assess whether share buybacks have a statistically significant and measurable effect on a company's real performance. In order to assess this, both hypotheses for individual year specific treatment effects and a joint hypothesis test are conducted. All hypothesis testing will be done using Eviews, a statistics and data analysis program and tested at a confidence level of 95%.

Primary hypothesis:

H_0 : Share buybacks have no effect on companies' real performance.

H_1 : Share buybacks have a significant effect on companies' real performance.

Secondary Hypotheses:

The secondary hypotheses that will be conducted to answer the main hypothesis are done on the year specific interaction terms. For each metric, the regression includes a set of post-treatment interaction terms. These capture the year specific treatment effect and will be tested using two different tests for each regression.

First an individual hypothesis test will be done, also known as a T-test:

$H_{0,t}$: $\beta_t = 0$ (no effect in year t)

$H_{1,t}$: $\beta_t \neq 0$ (effect exists in year t)

If the p-value < 0.05 , the null hypothesis (H_0) for that year is rejected, indicating a statistically significant effect of the buyback. This will be done for each individual year post-treatment. The results will indicate if there are any specific years that do show a significant effect on performance.

Secondly, a joint hypothesis test will be done, also known as an F-test or a Wald test:

H_0 : $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$

If the null hypothesis for the F-test is rejected, it implies that the buyback had a significant effect in at least one post-treatment year. If we fail to reject the F-test (p-value > 0.05) it suggests that there is no significant effect from the buyback at all during the post-treatment period. However, it is still possible for an individual null hypothesis to be rejected by a T-test. This is not likely, but it is possible and would indicate a marginal effect. These 2 different hypothesis testings will give us sufficient statistical arguments to answer our main hypothesis and in turn, the research question.

4.4 Assumptions & Diagnostics

The DiD regression requires several core assumptions to be met in order for the estimated treatment effects to have credibility and be able to be interpreted as causal. The most critical assumption is the parallel trends assumption. This assumes that if the treatment would not have taken place, the difference between treatment and control group would stay constant over time (Columbia University, n.d.). In other words, any observed post-treatment difference can be derived to be an effect of the treatment and not to any underlying differences between the groups.

Even though there is no statistical test to ensure that this assumption holds, there are visual and other checks that can be done. In this study we have done 3 different checks and changes to support this assumption, PSM, Welch T-tests and a visual check.

- **PSM:** Propensity Score Matching was applied using matched pre-treatment values of the measured metrics. This helped to create a control group that is similar to the treated group during the period before the buyback.
- **Welch T-test:** Two Welch T-tests were conducted, before and after the PSM. The tests confirmed that the variables between the groups were no longer statistically different after matching. This supports the method used for PSM as well as increases the credibility of the regression.
- **Visual Trend:** As can be seen below in figures 4.1, 4.2 and 4.3, a visual representation of the three different metrics' averages for both groups over time was presented. The trend before treatment for the two groups can be deemed parallel in EBITDA Margin and Net Income margin, which further supports the claim that the assumption holds for. On the other hand, when comparing the two groups' pre-treatment trends for the growth in revenue they appear to violate the assumption. As stated, there is no statistical test to prove that the assumption holds but rather different tests and checks that can give indications. In this case the revenue growth trend lines indicate a violation of the parallel

trends assumption and should therefore be interpreted with caution, even though the PSM and welch T-test support the claim that they are similar before the buyback.

Figure 4.1: EBITDA Margin over time

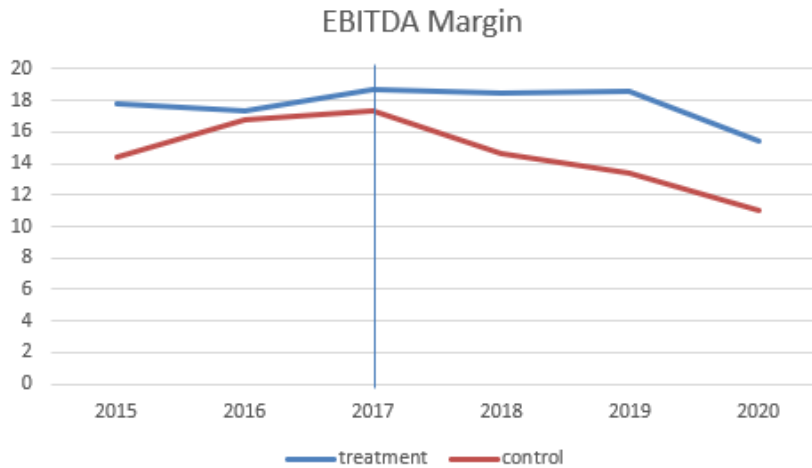


Figure 4.2: Net Income Margin over time

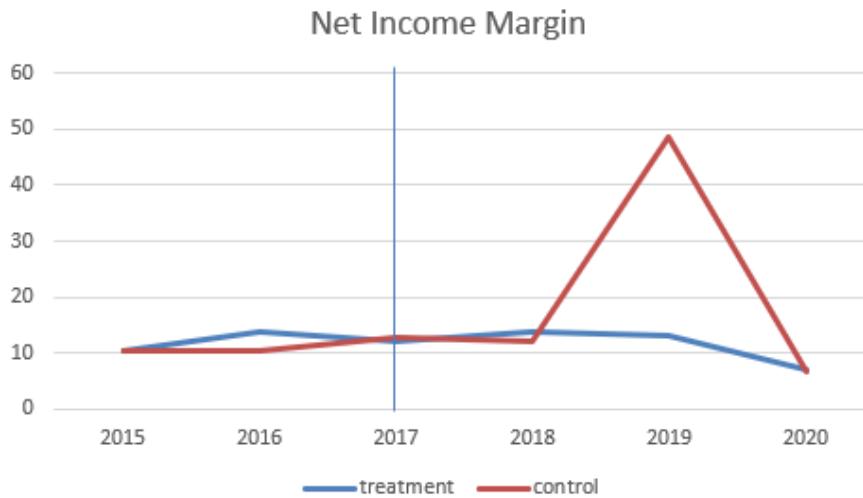
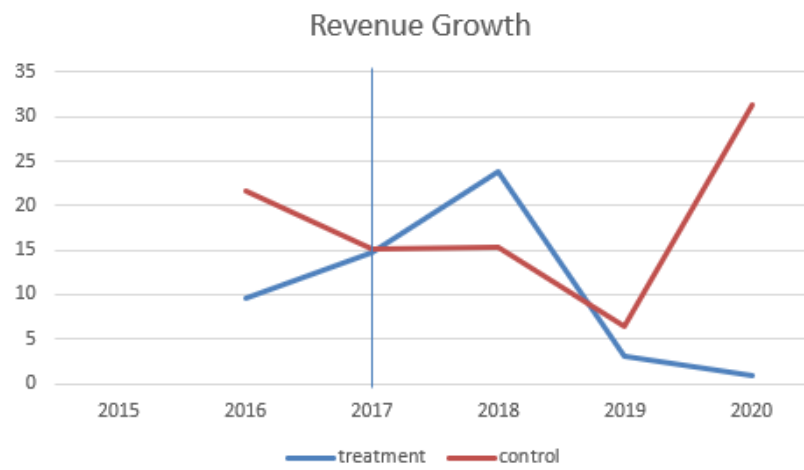


Figure 4.3: Revenue Growth over time



5. Analysis and Discussion

This chapter will present and interpret the results of the empirical analysis. First, the individual DiD regression results for each metric will be reviewed, followed by a summary of the findings. Next, the findings are compared and related to relevant theories as well as previous findings. Finally, the chapter is concluded with a critical reflection on the findings, method as well as limitations of the study.

5.1 Individual Regression Results

This section presents and interprets the regression results for each performance metric. The original regression outputs and Wald tests can be found in the appendix.

5.1.1 Net Income Margin

Table 5.1: DiD Regression - Net Income Margin

Table 5.1: Panel Regression Results for Net Income Margin				
Variable	Coefficient	Std. Error	t-Statistic	P-value
Constant	5.1511	4.9644	1.0376	0.2996
DUMMY_ADMIN	1.4206	20.0890	0.0708	0.9436
DUMMY_EL_GAS	61.4401	22.2943	2.7568	0.0059
DUMMY_ENTERTAIN	-4.7941	20.9491	-0.2246	0.8223
DUMMY_FIN_INSUR	79.5161	14.3589	5.5378	0.0000
DUMMY_HEALTH_SOCIAL	2.5383	30.6766	0.0842	0.9329
DUMMY_INFO_COMMI	0.4899	9.6427	0.0508	0.9595
DUMMY_PRO_SCIENTECH	-0.2016	11.2588	-0.0171	0.9857
DUMMY_REAL_ESTATE	87.2284	12.2219	7.1371	0.0000
DUMMY_TRANSPORT	-9.3977	16.6352	-0.5649	0.5722
INTERACT_2017	-4.0649	16.7840	-0.2422	0.8087
INTERACT_2018	-1.3574	16.7098	-0.0812	0.9353
INTERACT_2019	-38.6078	16.7857	-2.3000	0.0215
INTERACT_2020	-2.0489	16.9239	-0.1211	0.9036

Notes: The regression was estimated using panel least squares with period fixed effects. The dependent variable is Net Income Margin. Robust standard errors are reported.

R-squared: 0.0372 **Adjusted R-squared:** 0.0202 **Observations:** 2626 **Cross-sections:** 440
F-statistic: 5.899 **Prob(F-statistic):** 0.0000

Table 5.2: Joint Wald Test - Net Income Margin

Table 5.2: Wald Test of Joint Significance for Interaction Terms (Net Income Margin Model)

Test Statistic	Value	df	P-value
F-statistic	1.3478	(4, 2618)	0.2498
Chi-square	5.3911	4	0.2495

Null Hypothesis: Interaction_2017 = Interaction_2018 = Interaction_2019 = Interaction_2020 = 0

Interaction Term	Coefficient	Std. Error
Interaction_2017	-3.6976	16.6838
Interaction_2018	-1.3007	16.6838
Interaction_2019	-38.8124	16.6838
Interaction_2020	-2.5544	16.6873

Note: This Wald test evaluates whether the post-buyback interaction terms jointly differ from zero in the Net Income Margin regression model.

The first regression that will be analyzed is the one with net income margin as the dependent variable. The results show a statistical significant effect for the year 2019 with a p-value of 0.0279. The coefficient of -38.48 suggests a substantial decrease in the net income margin during 2019 for the companies that conducted share buybacks. However, this effect is not observed in other years. The coefficients are all also negative for the other post-buyback years but are not statistically significant.

The joint Wald test returns a p-value of 0.2498, suggesting that the overall post-buyback is not statistically significant across all years. In other words, while a significant drop in net income margin can be detected in 2019, there is no consistent effect of the buyback over time after conducting the buyback.

5.1.2 Revenue Growth

Table 5.3: DiD Regression - Revenue Growth

Variable	Coefficient	Std. Error	t-Statistic	P-value
Constant	10.4404	5.8172	1.7947	0.0728
DUMMY_ADMIN	2.1393	23.2619	0.0919	0.9267
DUMMY_EL_GAS	28.0177	25.4917	1.1029	0.2702
DUMMY_ENTERTAIN	-8.3577	24.2614	-0.3445	0.7305
DUMMY_FIN_INSUR	39.8625	16.3623	2.4361	0.0152
DUMMY_HEALTH_SOCIAL	5.9225	35.1251	0.1686	0.8667
DUMMY_INFO_COMMI	6.7283	11.9066	0.5658	0.5719
DUMMY_PRO_SCIEN_TECH	30.5232	12.9296	2.3600	0.0184
DUMMY_REAL_ESTATE	5.4910	14.1226	0.3890	0.6974
DUMMY_TRANSPORT	-9.4854	19.6423	-0.4829	0.6293
INTERACT_2017	-1.0959	17.6720	-0.0619	0.9506
INTERACT_2018	7.1656	17.6039	0.4069	0.6842
INTERACT_2019	-1.3571	17.6703	-0.2437	0.8075
INTERACT_2020	-3.4611	17.6784	-0.1761	0.0784

Notes: The regression was estimated using panel least squares with period fixed effects. The dependent variable is Revenue Growth. Robust standard errors are reported.

R-squared: 0.0079 **Adjusted R-squared:** -0.0017 **Observations:** 2200 **Cross-sections:** 440
F-statistic: 0.1289 **Prob(F-statistic):** 0.4301

Table 5.4: Joint Wald Test - Revenue Growth

Table 5.4: Wald Test of Joint Significance for Interaction Terms (Revenue Growth Model)

Test Statistic	Value	df	P-value
F-statistic	0.8392	(4, 2182)	0.5002
Chi-square	3.3567	4	0.5000

Null Hypothesis: Interaction_2017 = Interaction_2018 = Interaction_2019 = Interaction_2020 = 0

Interaction Term	Coefficient	Std. Error
Interaction_2017	-1.0959	17.6704
Interaction_2018	7.1656	17.6704
Interaction_2019	-4.3061	17.6704
Interaction_2020	-31.1182	17.6748

Note: This Wald test evaluates whether the post-buyback interaction terms jointly differ from zero in the Revenue Growth regression model.

Next is the regression done with revenue growth as the dependent variable. The results fail to find a significant effect from the buyback during any of the years during the post-buyback period. The most statistically significant year was 2020, with a coefficient of -31,1 and a p-value of 0.078. While most of the coefficients are negative, especially the final year which also has the most significance, the decline in revenue growth is not statistically significant at the 95% confidence level.

The joint Wald test which once again tests if the buyback had a significant effect over the entire post-treatment period. The test results show a p-value of 0.5002 indicating that the buyback had no effect on revenue growth for the post-treatment period. Therefore, the regression provides no evidence that share buybacks lead to any improvement or decline in revenue growth.

5.1.3 EBITDA Margin

Table 5.5: DiD Regression - EBITDA Margin

Table 5.5: Panel Regression Results for EBITDA Margin				
Variable	Coefficient	Std. Error	t-Statistic	P-value
Constant	10.1639	0.8337	12.1909	0.0000
DUMMY_ADMIN	-2.0506	3.3769	-0.6073	0.5437
DUMMY_EL_GAS	15.4128	3.6867	4.1806	0.0000
DUMMY_ENTERTAIN	3.0435	3.5215	0.8643	0.3875
DUMMY_FIN_INSUR	22.3657	2.4208	9.2386	0.0000
DUMMY_HEALTH_SOCIAL	-1.7348	5.1659	-0.3364	0.7366
DUMMY_INFO_COMMI	-2.1446	1.6139	-1.3283	0.1840
DUMMY_PRO_SCIEN_TECH	-3.5539	1.8868	-1.8422	0.0659
DUMMY_REAL_ESTATE	46.5914	2.0502	22.7523	0.0000
DUMMY_TRANSPORT	7.2435	2.7906	2.5875	0.0100
INTERACT_2017	-0.3805	2.8904	-0.1315	0.8922
INTERACT_2018	2.1879	2.9005	0.7789	0.4361
INTERACT_2019	3.4973	2.8091	1.2450	0.2132
INTERACT_2020	2.6255	2.8096	0.9345	0.3502

Notes: The regression was estimated using panel least squares with period fixed effects. The dependent variable is EBITDA margin. Robust standard errors are reported.

R-squared: 0.2022 **Adjusted R-squared:** 0.1967 **Observations:** 2638 **Cross-sections:** 440
F-statistic: 40.00 **Prob(F-statistic):** 0.0000

Table 5.6: Joint Wald Test - EBITDA Margin

Table 5.6: Wald Test of Joint Significance for Interaction Terms (EBITDA Margin Model)

Test Statistic	Value	df	P-value
F-statistic	0.7578	(4, 2619)	0.5527
Chi-square	3.0311	4	0.5526

Null Hypothesis: Interaction_2017 = Interaction_2018 = Interaction_2019 = Interaction_2020 = 0

Interaction Term	Coefficient	Std. Error
Interaction_2017	-0.3805	2.8090
Interaction_2018	2.1879	2.8090
Interaction_2019	3.4973	2.8090
Interaction_2020	2.6255	2.8096

Note: This Wald test evaluates whether the post-buyback interaction terms jointly differ from zero in the EBITDA Margin regression model.

The final regression is done on the EBITDA margin. The results show that none of the post-treatment interaction terms are statistically significant. The p-values range from 0.2132 to 0.8922, well above the threshold of significance. While the coefficients indicate a positive effect of the buyback on EBITDA margin, they all lack statistical significance.

The joint Wald test further supports the results from the individual t-tests. With a p-value of 0.5527, the effect that share buybacks had on EBITDA margin on the entire post-treatment period is considered zero at a confidence level of 95%.

5.2 Summary of Findings

The results of the DiD regression and hypothesis analysis reveal that share buybacks did not produce any significant changes in performance across the measured financial metrics. The only statistically significant effect was found in the net income margin regression for the specific year 2019, where the estimated coefficient was negative and relatively large. Even though the estimation is statistically significant, the joint Wald test fails to reject the null hypothesis of buybacks not having an effect with respect to the entire post-buyback period. This limits the strength of the individual year 2019 and indicates that a systematic effect can't be inferred.

For the other two metrics, EBITDA margin and revenue growth, no significant effects could be found. Their regressions and hypothesis tests fail to reject all null hypotheses, supporting the finding that share buybacks had no significant impact on the companies performance. While the revenue growth showed mainly negative coefficients and EBITDA margin mainly showed positive ones, it might suggest a potential effect in each direction but as stated, the lack of significance prevents any conclusions to be taken.

With that said, the findings together support the main null hypothesis that share buybacks do not lead to real performance improvements in terms of the measured metrics.

5.3 Comparison to Theory & Previous Literature

This section will interpret the results from the perspective of the theories presented earlier in the study and discuss if any of these can support the findings.

5.3.1 Signaling Hypothesis

The signaling hypothesis suggests that companies perform share buybacks in order to signal confidence and future strength to the market. If this were the primary reason for companies to conduct share buybacks, it would not be unreasonable to expect an increase in real performance. The hypothesis, as stated, claims companies perform buybacks when the future looks bright in terms of business. This would in theory mean that performance is likely to increase in the years to come. This does not support the findings that buybacks have no effect on the real performance at all and contradicts the one significant negative effect on net income margin seen in 2019.

5.3.2 Free Cash Flow Hypothesis

According to the free cash flow hypothesis, companies with excess free cash flow and limited investment opportunities can turn to buybacks as a way to spend this cash and also return past profits to the shareholders. The theory also touches on the agency cost problem, that excess cash in a company leads to a conflict of interest between managers and shareholders. Share buybacks can be seen as returning profits to shareholders but also as a more flexible payout policy in comparison to increasing dividends. The latter is related to “bad” managers who put their own interest above the shareholders’ and want to avoid committing to a payout policy which would lower their spending freedom. As stated in the theoretical framework section, this was deemed unlikely for this study due to the geographical norms regarding management structure. Hence the hypothesis would claim that buybacks are performed in absence of investment opportunities and as a way to return capital to the shareholders.

This can be argued to somewhat support the findings, specifically the aspect of buybacks being performed when companies lack profitable investments. The companies that performed buybacks could have run out of investment opportunities and reached a point of stagnation in growth, leading to excess cash being used for buybacks. This would mean no increase in performance as well as perhaps a negative development in growth post-buyback. The negative growth is not statistically significant so no conclusion can be drawn there, but the findings of no performance gains is partially consistent with the free cash flow hypothesis.

5.3.3 Share buybacks as an Investment

Moving on to the real-world findings from surveyed managers, one of the main reasons to perform buybacks was found to be due to their flexibility. This flexibility allows the companies to time the buybacks to when the share is believed to be undervalued. This includes aspects from both the signaling hypothesis and the free cash flow hypothesis. In Brav et al.'s (2005) study they found that 8 in 9 managers said they performed buybacks when they believed the share to be undervalued. The findings would, for the same reasons as mentioned for the signaling hypothesis of future prospects, therefore not be in line with this empirical finding from Brav et al.

5.3.4 Boosting EPS and Metric Manipulation

The second primary motivation stated by managers is to boost the earnings per share. The buyback mechanically boosts the EPS along with other financial metrics that are often used when analyzing a company's value. This motivation aligns with the findings that the buyback does not have an effect on real performance. If mechanically altering metrics is the primary purpose of buybacks, it would explain why no significant changes in real performance could be observed.

5.3.5 The Results in Comparison to Past Findings

Previous research on share buybacks have mainly focused on stock market reactions, stock returns, EPS manipulation and managers motives. The past research has not separated mechanical on paper performance vs real operational performance as has been done in this study.

The past findings on performance have been on share returns which can not be directly compared to the findings in this study.

By taking this new approach to performance evaluation this study largely adds to the existing literature rather than building on it. The prior studies are still important as they can together with the findings and method used in this study help in gaining a more complete picture of all aspects surrounding share buybacks.

5.4 Critical Reflection and Limitations

While the methodological approach of this study was designed and structured to estimate the causal effects of share buybacks on the company's real performance with as much credibility as possible, there are limitations.

The use of a DiD regression combined with the propensity score matching helped ensure that the treated and control companies were comparable in terms of pre-treatment data. This is one essential check for the parallel trends assumption to hold. However, the results showed no consistent or significant effect of the buyback across all three metrics and all periods, with exception to the single significant year 2019 regarding the net income margin. This singular finding, while statistically significant and valid, has to be interpreted with criticism as well as the method in whole.

Firstly, the parallel trends assumption can only be investigated for the pre-treatment period. If factors that are unobserved affect the treatment and control group differently, the estimates can be biased. The fact that the results show inconsistent effects of the buyback may be a sign of such unobserved factors during the post-buyback period. There is no way to test this and there is no clear evidence that would point to this, however it is a possibility.

Secondly, the study captures metrics at a period separated by calendar year. The treatment group consists of companies that have performed buybacks during the year 2017, but these buybacks take place at different times during the year. It is possible that the buybacks do have an effect on

performance but that is very short term or very long term and is not captured in the time period that this study investigates. A longer post period could have been investigated but was deemed less credible as this would introduce very economically speaking unstable years due to the COVID-19 pandemic and political conflicts.

Despite these limitations, the choice of method in this study was designed to answer the research question in the most disciplined and statistically sound way possible. The lack of significant performance effects is therefore not likely a result of flaws in the method, but rather a result of an absence of real performance effects or the fact that financial data often is relatively random.

6. Conclusion

This study set out to investigate whether share buybacks lead to changes in real company performance, gains beyond the mechanical effects buybacks have on financial metrics. Using a difference-in-difference regression combined with propensity score matching, the analysis focused on public Nordic companies. The performance was measured using three key operational metrics, net income margin, EBITDA margin and revenue growth.

The findings suggest that buybacks do not lead to any statistically significant changes in what has been defined as real performance. While one significant decline in net income margin could be found two years after the buyback, the effect was not supported enough to be classified as a systematic effect over time. No significant effects were found on the EBITDA margin or revenue growth, supporting the claim that share buybacks likely have no effect on the company's real performance.

These results support the theoretical and empirical findings that one primary motivation for companies to conduct share buybacks is to mechanically improve financial metrics. This further aligns with the view that buybacks may be used strategically in terms of on paper performance, rather than driving real performance or returning value to the shareholders.

By focusing specifically on share buybacks' effect on real operational performance instead of stock returns, on paper metrics or market reactions, this study takes a relatively unique angle of research. Future research that could complement and extend the findings in this study is for example analyzing longer or shorter term effects as well as other metrics or company characteristics that might indicate real performance gains. However, this thesis finds little to no evidence that share buybacks have any effect on real performance.

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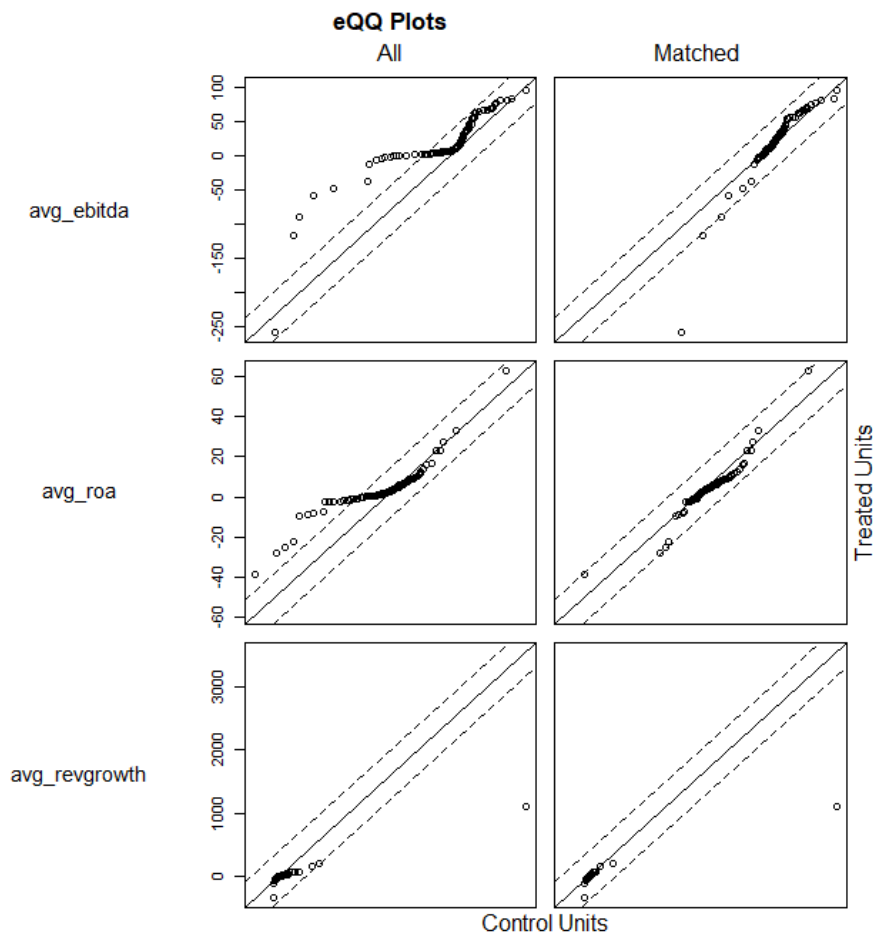
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Appendix

A.1: Visual of before and after PSM matching 1 to 2:



A.2: Regression output, EBITDA margin:

Dependent Variable: EBITDA_MARGIN_AR1
Method: Panel Least Squares
Date: 05/26/25 Time: 10:54
Sample: 2015 2020
Periods included: 6
Cross-sections included: 440
Total panel (unbalanced) observations: 2638

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.16385	0.833722	12.19094	0.0000
DUMMY_ADMIN	-2.050644	3.376887	-0.607259	0.5437
DUMMY_EL_GAS	15.41280	3.686748	4.180595	0.0000
DUMMY_ENTERTAIN	3.043546	3.521524	0.864270	0.3875
DUMMY_FIN_INSUR	22.36573	2.420834	9.238852	0.0000
DUMMY_HEALTH_SOCIAL	-1.734837	5.156595	-0.336431	0.7366
DUMMY_INFO_COMM	-2.144576	1.613880	-1.328833	0.1840
DUMMY_PRO_SCIEN_TECH	-3.553989	1.886184	-1.884222	0.0596
DUMMY_REAL_ESTATE	46.59144	2.050208	22.72523	0.0000
DUMMY_TRANSPORT	7.234364	2.796095	2.587310	0.0097
INTERACT_2017	-0.380545	2.809045	-0.135471	0.8922
INTERACT_2018	2.187994	2.809045	0.778910	0.4361
INTERACT_2019	3.497339	2.809045	1.245028	0.2132
INTERACT_2020	2.625492	2.809636	0.934460	0.3502

Effects Specification

Period fixed (dummy variables)			
R-squared	0.202171	Mean dependent var	15.67742
Adjusted R-squared	0.196688	S.D. dependent var	31.10922
S.E. of regression	27.88247	Akaike info criterion	9.501050
Sum squared resid	2036095.	Schwarz criterion	9.543384
Log likelihood	-12512.89	Hannan-Quinn criter.	9.516378
F-statistic	36.86999	Durbin-Watson stat	0.470085
Prob(F-statistic)	0.000000		

A.3: Joint Wald test output, EBITDA margin:

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	0.757769	(4, 2619)	0.5527
Chi-square	3.031077	4	0.5526

Null Hypothesis: C(11) = 0, C(12) = 0, C(13) = 0, C(14) = 0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(11)	-0.380545	2.809045
C(12)	2.187994	2.809045
C(13)	3.497339	2.809045
C(14)	2.625492	2.809636

Restrictions are linear in coefficients.

A.4: Regression output, net income margin:

Dependent Variable: NET_INCOME_MARGIN_AR1
Method: Panel Least Squares
Date: 05/27/25 Time: 09:28
Sample: 2015 2020
Periods included: 6
Cross-sections included: 440
Total panel (unbalanced) observations: 2637

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.157639	4.951980	1.041531	0.2977
DUMMY_ADMIN	1.407045	20.05625	0.070155	0.9441
DUMMY_EL_GAS	61.42937	22.25557	2.760179	0.0058
DUMMY_ENTERTAIN	-4.717304	20.91529	-0.225543	0.8216
DUMMY_FIN_INSUR	79.49590	14.33459	5.545741	0.0000
DUMMY_HEALTH_SOCIAL	2.568313	30.62643	0.083859	0.9332
DUMMY_INFO_COMM	0.551636	9.585271	0.057550	0.9541
DUMMY_PRO_SCIEN_TECH	-0.803431	11.20256	-0.071718	0.9428
DUMMY_REAL_ESTATE	86.26489	12.17675	7.084395	0.0000
DUMMY_TRANSPORT	-9.412029	16.60677	-0.566758	0.5709
INTERACT_2017	-3.697589	16.68380	-0.221627	0.8246
INTERACT_2018	-1.300740	16.68380	-0.077964	0.9379
INTERACT_2019	-38.48124	16.68380	-2.306503	0.0212
INTERACT_2020	-2.554449	16.68730	-0.153077	0.8783

Effects Specification

Period fixed (dummy variables)

R-squared	0.036941	Mean dependent var	15.04583
Adjusted R-squared	0.030319	S.D. dependent var	168.1706
S.E. of regression	165.6016	Akaike info criterion	13.06423
Sum squared resid	71795766	Schwarz criterion	13.10657
Log likelihood	-17206.18	Hannan-Quinn criter.	13.07956
F-statistic	5.578911	Durbin-Watson stat	2.320634
Prob(F-statistic)	0.000000		

A.5: Joint Wald test output, net income margin:

Wald Test:

Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	1.347767	(4, 2618)	0.2498
Chi-square	5.391069	4	0.2495

Null Hypothesis: C(11) = 0, C(12) = 0, C(13) = 0, C(14) = 0

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(11)	-3.697589	16.68380
C(12)	-1.300740	16.68380
C(13)	-38.48124	16.68380
C(14)	-2.554449	16.68730

Restrictions are linear in coefficients.

A.6: Regression output, revenue growth

Dependent Variable: REV_GROWTH_AR1
Method: Panel Least Squares
Date: 05/26/25 Time: 10:56
Sample (adjusted): 2016 2020
Periods included: 5
Cross-sections included: 440
Total panel (balanced) observations: 2200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.44036	5.817222	1.794733	0.0728
DUMMY_ADMIN	2.139327	23.26187	0.091967	0.9267
DUMMY_EL_GAS	28.01772	25.40191	1.102977	0.2702
DUMMY_ENTERTAIN	-8.357684	24.26142	-0.344485	0.7305
DUMMY_FIN_INSUR	39.86253	16.63625	2.396125	0.0167
DUMMY_HEALTH_SOCIAL	5.922542	35.53101	0.166687	0.8676
DUMMY_INFO_COMM	6.728870	11.10655	0.605847	0.5447
DUMMY_PRO_SCIEN_TECH	30.52328	12.99580	2.348704	0.0189
DUMMY_REAL_ESTATE	5.941084	14.12256	0.420680	0.6740
DUMMY_TRANSPORT	-9.485434	19.26458	-0.492377	0.6225
INTERACT_2017	-1.098578	17.67039	-0.062171	0.9504
INTERACT_2018	7.715611	17.67039	0.436641	0.6624
INTERACT_2019	-4.306119	17.67039	-0.243691	0.8075
INTERACT_2020	-31.11822	17.67484	-1.760594	0.0784

Effects Specification

Period fixed (dummy variables)

R-squared	0.007899	Mean dependent var	15.42361
Adjusted R-squared	0.000169	S.D. dependent var	175.3496
S.E. of regression	175.3347	Akaike info criterion	13.17942
Sum squared resid	67079624	Schwarz criterion	13.22602
Log likelihood	-14479.36	Hannan-Quinn criter.	13.19645
F-statistic	1.021886	Durbin-Watson stat	1.413848
Prob(F-statistic)	0.430070		

A.7: Joint Wald test revenue growth

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	0.839184	(4, 2182)	0.5002
Chi-square	3.356734	4	0.5000

Null Hypothesis: C(11) = 0, C(12) = 0, C(13) = 0, C(14) = 0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(11)	-1.098578	17.67039
C(12)	7.715611	17.67039
C(13)	-4.306119	17.67039
C(14)	-31.11822	17.67484

Restrictions are linear in coefficients.

A.8: Welch T-test, EBITDA margin:

Test for Equality of Means of EBITDA_MARGIN_AR1
Categorized by values of TREATMENT_DUMMY
Date: 05/27/25 Time: 13:55
Sample: 2015 2020 IF YEAR<=2016
Included observations: 878

Method	df	Value	Probability
t-test	876	-0.897479	0.3697
Satterthwaite-Welch t-test*	478.2099	-0.822353	0.4113
Anova F-test	(1, 876)	0.805469	0.3697
Welch F-test*	(1, 478.21)	0.676265	0.4113

*Test allows for unequal cell variances

Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	1	721.8176	721.8176
Within	876	785024.0	896.1461
Total	877	785745.8	895.9473

Category Statistics

TREATMENT...	Count	Mean	Std. Dev.	Std. Err. of Mean
0	579	15.63013	26.71552	1.110259
1	299	17.54345	35.35507	2.044637
All	878	16.28171	29.93238	1.010169

A.9: Welch T-test, net income margin:

Test for Equality of Means of NET_INCOME_MARGIN_AR1
Categorized by values of TREATMENT_DUMMY
Date: 05/27/25 Time: 13:57
Sample: 2015 2020 IF YEAR<=2016
Included observations: 877

Method	df	Value	Probability
t-test	875	-0.547748	0.5840
Satterthwaite-Welch t-test*	463.9734	-0.497112	0.6193
Anova F-test	(1, 875)	0.300028	0.5840
Welch F-test*	(1, 463.973)	0.247120	0.6193

*Test allows for unequal cell variances

Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	1	689.3038	689.3038
Within	875	2010283.	2297.467
Total	876	2010973.	2295.631

Category Statistics

TREATMENT...	Count	Mean	Std. Dev.	Std. Err. of Mean
0	580	10.23056	42.21850	1.753028
1	297	12.10388	57.48891	3.335845
All	877	10.86497	47.91274	1.617898

A.10: Welch T-test, revenue growth:

Test for Equality of Means of REV_GROWTH_AR1
 Categorized by values of TREATMENT_DUMMY
 Date: 05/27/25 Time: 13:56
 Sample: 2015 2020 IF YEAR<=2016
 Included observations: 440

Method	df	Value	Probability
t-test	438	0.670673	0.5028
Satterthwaite-Welch t-test*	434.9634	0.823814	0.4105
Anova F-test	(1, 438)	0.449802	0.5028
Welch F-test*	(1, 434.963)	0.678670	0.4105

*Test allows for unequal cell variances

Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	1	14645.48	14645.48
Within	438	14261207	32559.83
Total	439	14275852	32519.03

Category Statistics

TREATMENT...	Count	Mean	Std. Dev.	Std. Err. of Mean
0	290	21.74710	210.4102	12.35572
1	150	9.575892	99.20701	8.100219
All	440	17.59782	180.3303	8.596911