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The Recent Downfall of Value Investing

A Study on the Performances of the Magic Formula and the F-Score in the Nordic Market

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Abstract

We have examined if value investing has generated above-market returns and possessed the ability to predict future returns using fundamental analysis in the Nordic market. To address our research question, we have conducted univariate analyses testing the performances of Greenblatt's Magic Formula and Piotroski's F-Score against the MSCI Nordic Countries Net Total Return Index and their respective inverse portfolios. The inverse portfolios were designed using the opposite methodology of the original portfolios and should thus identify stocks predicted to generate below-market returns. Our findings suggests that during the first decade of the 21st century, value investing generated superior returns compared the market. However, in the recent decade the strategies outperformed neither the market nor their inverse portfolios on any significant level.

Tutor: Ting Dong

Keywords: Value investing, Magic Formula, F-Score, Fundamental analysis, Efficient Market Hypothesis

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1. Introduction

The purpose of our study is to investigate if an individual investor can employ an accounting-based value investing strategy in order to achieve superior returns compared to an adequate market index. While value investing historically has seen exceptional returns, recent studies suggest that its glory days are in the past. The results of our study are of interest to private investors and capital market actors looking to beat market indices. By studying the Nordic market between 2001-2021, we aim to answer the following research question:

Does value investing still generate superior returns relative to the market and possess the ability to predict future returns?

Value investing was developed in the 1920s by Benjamin Graham and David Dodd. The investment strategy uses fundamental analysis and accounting-based metrics to identify stocks that are priced below their intrinsic value. The intrinsic value is a firm's true value according to its fundamentals. The strategy provided rationality for many investors when making investment decisions and quickly became popular. Graham and Dodd advocated that an investor should refrain from trying to time an investment correctly. Instead, an investor should aim to estimate the intrinsic value of a stock, which according to theory, will converge with the market value and thus provide an opportunity for investors to predict future returns (Graham, 2003; Columbia Business School, 2015).

Value investing is based upon the theory that markets are efficient, and over longer periods of time, the market value of a firm reflects all available information. However, because of short-term irrational market behaviour, discrepancies occur between firms' market value and intrinsic value. These discrepancies allow for investors to identify undervalued stocks, referred to as value stocks, and overvalued stocks, referred to as growth or glamour stocks, using fundamental analysis. This indicates that there are market inefficiencies to be exploited by investors and generate above-market portfolio returns. Joel Greenblatt, founder of Gotham Capital and famous value investor, described the strategy as "*buying good companies at bargain prices*", an approach that unarguably should generate exceptional returns. The challenge, however, is to identify which companies are of high quality and at what share price the bargain price emerges (Graham, 2003; Greenblatt, 2010).

Ever since its introduction, multiple investors and academics have provided evidence of value investing being an efficient method to identify stocks that will generate above-market returns (Piotroski, 2000; Louis & Lakonishok, 2004; Greenblatt, 2010). Nevertheless, recent studies, mainly conducted on the US market, indicate that value investing has lost its ability to generate the superior returns it once achieved in the past (Blackburn & Cakici, 2017; Lev, & Srivastava, 2019; Maloney & Moskowitz, 2020). However, the same findings have not been reported to the same extent in the Nordic market. This is the literature gap that our study aims to fill by investigating if the Nordic market has witnessed the same drop in performance. In order to investigate this, we have chosen to base our study on the following two value investing strategies: the *F-Score*, developed by Joseph Piotroski in 2000, and the *Magic Formula*, developed by Joel Greenblatt in 2006. These strategies have become popular among retail investors and represent a simple way for an individual investor to implement the fundamental ideas of value investing (Piotroski, 2000; Greenblatt, 2010).

During the last 10-15 years, even the largest fund managers have failed to beat market indices (Pisani, 2019; Jennings, 2020). Thus, the average investor must look elsewhere to increase their returns. Therefore, the primary goal of our study is to test value investing's performance against an adequate market index during the last 20 years. Additionally, we divided the 20-year period into rolling 10-year subperiods allowing us to investigate if there has been any changes in performance. Furthermore, we aim to investigate the value investing strategies' ability to separate stocks that will generate above-market from below-market returns. To test this, we have constructed inverse portfolios of both selected strategies. We constructed the inverse portfolios using the opposite methodology of the original portfolios and thus they should identify stocks predicted to generate below-market returns in the future. By comparing the original strategies' performance against their respective inverse portfolio, we can draw conclusions regarding the strategies inherent ability to predict future returns.

The scope of our study has been limited to the Nordic markets including, Sweden, Norway, Finland and Denmark, between the years 2001 – 2021. By studying a longer time horizon, we believe that we have captured both economic upturns and downturns and created a possibility to detect changes in performance within our chosen time period. Current literature studying the Nordic market is more scarce than literature studying any of the local markets, why we chose to study the Nordic market as a whole. We have chosen to conduct a univariate analysis, testing the portfolios' performances against the Nordic Countries Net Total Return Index and their

respective inverse portfolios. While this allows us to conclude if the same negative trends seen in other markets also exist in the Nordic market, we cannot determine any possible explanations to our findings.

Our quantitative study using univariate analysis, finds that during the last 20 years, the Magic Formula and the F-Score have outperformed the market. The two selected strategies' mean annual returns of 20.7% and 19.8%, respectively, were significantly greater than the market index of 11.1% and their inverse portfolios of 8.6% and 4.8%. These findings indicate that value investing had the ability to generate superior returns during the past 20 years. However, when dividing the full period into 10-year subperiods, value investing's exceptional performance seems to have been concentrated towards the first decade of the 21st century. We identify a negative trend in performance, suggesting that sometime during our studied period value investing has lost its ability to predict future returns and generate returns superior to the market.

Our study contributes to the existing literature by filling the gap that we have found in previous research. While studies overlapping the Nordic market have not found evidence in support of the negative trend witnessed in the US, our study contributes with updated data in the region and our findings can in detail display the recent downfall of value investing. Furthermore, while Greenblatt's Magic Formula has been extensively studied in markets overlapping the Nordics, Piotroski's F-Score has not received the same academic attention in the region. Therefore, our thesis also contributes by adding research to this alternative way of implementing value investing.

Our study consists of six sections. Section 2 includes a review of previous literature and the relevant theories building up to our hypotheses. In section 3, our research method is explained. Section 4 includes descriptive statistics and analysis of our results and method. In section 5, we discuss the results in relation to theories and previous literature. In section 6, we present our conclusions and suggest future research.

2. Literature review and theory

In this section, we present and review related literature and theories. Firstly, we give an introduction to value investing, followed by the selected value investing strategies. Secondly, we review previously conducted research on value investing's performance over different

periods and geographic regions. Here we find extensive evidence in support of the positive performance of value investing. However, recent studies present contradicting evidence, mainly on the US market. Lastly, we present the underlying market theories and how they build up to our hypotheses.

2.1 Literature review

2.1.1 Value investing

In his book, *The Intelligent Investor,* released in 1949, Benjamin Graham presented the core ideas of value investing. Graham defined value investing as a result of thorough fundamental analysis and assessing a company's intrinsic value compared to its market value. By comparing the intrinsic value with the current market price, an investor can identify undervalued stocks, referred to as value stocks, and overvalued stocks, referred to as growth or glamour stocks (Graham, 2003). Graham believed markets to be efficient in the long-term perspective. However, short-term discrepancies between market value and intrinsic value occur as the market reacts to news and information in an irrational manner. Nonetheless, after enough time, the market will identify the intrinsic value. Consequently, the difference between intrinsic and market value diminishes, driving above-average returns for value stocks and below-average returns for glamour stocks. Graham advocated the use of a margin of safety, entailing an investor to only purchase stocks priced well below their intrinsic value. Furthermore, the author advocated that investors should refrain from attempts to time the market. (Graham, 2003)

Following the introduction of value investing in the mid-20th century, several investors have developed portfolio strategies that build upon the basics put forward by Graham. Two prominent strategies are Joel Greenblatt's *Magic Formula* and Joseph Piotroski's *F-Score* (Piotroski, 2000; Greenblatt, 2010).

2.1.2 Greenblatt's Magic Formula

In his book, *The Little Book that Still Beats the Market* from 2010, Greenblatt presented the Magic Formula. Using only two accounting-based metrics, Greenblatt formulated a ranking system that he claimed is sufficient to beat the market. Greenblatt's investment strategy is in line with Graham's philosophy, that an investor should invest in high-quality companies when they are undervalued by the market (Greenblatt, 2010).

In order to construct the ranking system of the Magic Formula, Greenblatt calculated two accounting-based metrics. The first metric was Return on Capital (ROC) and identified high-quality companies. Greenblatt defined Return on Capital as EBIT divided by Net Working Capital and Net Fixed Assets. The second metric was Earnings Yield and identified firms that were relatively undervalued. Greenblatt defined Earnings Yield (EY) as EBIT divided by Enterprise Value (Greenblatt, 2010)

$$Return\ on\ Capital\ (ROC) = \frac{EBIT}{Net\ Working\ Capital + Net\ Fixed\ Assets}$$

$$Earnings\ Yield\ (EY) = \frac{EBIT}{Enterprise\ Value}$$

The operating profit measure, EBIT, is an item in the income statement describing a firm's earnings before interest costs and taxes. Leverage and tax effects often vary across firms and industry. Hence, EBIT serves as a good comparison metric when weighted against firm size (Berk & DeMarzo, 2017). Greenblatt used the capital measure of Net Working Capital + Net Fixed Assets in the Magic Formula to capture the amount of capital that has been invested into the company and is needed to operate its business. The author states that, "*Businesses that earn a high return on capital are better than businesses that earn a low return on capital.*" (Greenblatt, 2010).

Enterprise value is the total firm value and is calculated by adding the market value of equity with debt and deducting cash and marketable securities. Thus, the Earnings Yield metric measures what level of profit the company produces given the value the market gives the company. The metric is very similar to the Price over Earnings metric but displays relative value in an opposite order (Greenblatt, 2010; Berk & DeMarzo, 2017).

Greenblatt suggested that an investor should use a size filter and excluded smaller firms from the sample selection. The size filter was to be decided by the investors themselves, however, Greenblatt recommended a minimum of MUSD 50 in market capitalisation. Furthermore, an investor should exclude firms in the utility and financial sector. Once Greenblatt has calculated both metrics for the firms in the sample, the firms were ranked from 1 to *n* in both categories independently, where *n* was the number of firms in the sample. The two ranks were added together to form a cumulative ranking score ranging from 2 to 2*n*. For example, a company ranked 5th highest in ROC and 4th highest in EY received an accumulated ranking score of 9.

Finally, Greenblatt selected the 30 firms with the lowest cumulative ranking score into the portfolio for the upcoming one-year holding period (Greenblatt, 2010)

2.1.3 Piotroski's F-Score

Another big contributor to the value investing field is the American professor Joseph D. Piotroski, who introduced the F-Score in 2000. Piotroski found that by combining a book-to-market investment strategy with an accounting-based screening method an investor could increase annual returns drastically. Piotroski based much of his study on previous research conducted by Rosenberg, Reid & Lanstein (1985), Fama & French (1992), and Lakonishok, Shleifer & Vishny (1994), whom all provided evidence in support of the usage of accounting-based metrics to predict future stock returns. The book-to-market metric was found particularly helpful, and a high book-to-market ratio became a widely accepted indicator of a value stock. However, Piotroski found that only 44% of high book-to-market stocks generated excess returns in his early research. The low share resulted from high book-to-market firms having a higher financial risk than low book-to-market firms, leading to many high book-to-market firms being underperformers. To tackle this problem, Piotroski refined the strategy, proposing a scoring system, the F-Score, to filter out companies more likely to underperform, leaving only high-quality companies undervalued by the market in the portfolio (Piotroski, 2000).

$$Book\ to\ market\ (BtM) = \frac{Total\ common\ equity}{Market\ capitalization}$$

Piotroski's new strategy selected the highest quintile of firms based on book-to-market and then applied the F-Score to that selection of firms. The F-Score is a binary scoring system on nine criteria resulting in each firm receiving a score between 0-9. By ranking companies based on the nine selected metrics presented in Table 1, an investor could identify high-quality companies poised to have profitable returns in the future. The combination of investing in firms with high book-to-market and high F-Scores resulted in an effective way to identify value stocks and increase portfolio returns. In contrast to Greenblatt's Magic Formula, the F-Score strategy does not take firm size into account, and Piotroski's findings showed that the F-Score had a more significant effect on small firms than large (Piotroski, 2000).

The nine scoring criteria were divided into three categories: profitability, financial leverage/liquidity and operating efficiency. A firm received one point if they fulfilled the criteria and zero points if they did not. The sum of all points then created the firm-specific F-

Score for that year. In Piotroski's study, an F-Score of 8 or 9 classified high-scoring firms, while an F-Score of 0 or 1 classified low-scoring firms (Piotroski, 2000)

Table 1. The F-Score 9 scoring criteria and definition

Criteria	Implication
Profitability	
(1) $\frac{Net\ income_t}{Assets_t} > 0$	Positive net income during the last fiscal year
(2) $\frac{CFO_t}{Assets_t} > 0$	Positive cash flow from operations during the last fiscal year
(3) $\frac{Net\ income_t}{Assets_t} > \frac{Net\ income_{t-1}}{Assets_{t-1}}$	Increase in return on assets compared to previous fiscal year where ROA is defined as Net income / Assets
(4) $\frac{CFO_t}{Assets_t} > \frac{Net\ income_t}{Assets_t}$	Cash flow from operations must be larger than Net Income in the last fiscal year
Financial leverage/liquidity	
(5) $\frac{LTD_t}{Assets_t} < \frac{LTD_{t-1}}{Assets_{t-1}}$	Decrease in Long term debt ratio compared to previous fiscal year
(6) $Current\ ratio_t > Current\ ratio_{t-1}$	Increase in current ratio compared to previous fiscal year
(7) $Equity\ offering_t = 0$	No common equity were issued during the last fiscal year
Operating efficiency	
(8) $Gross\ margin_t > Gross\ margin_{t-1}$	Increase in gross margin compared to previous fiscal year
(9) $\frac{Sales_t}{Assets_t} > \frac{Sales_{t-1}}{Assets_{t-1}}$	Increase in asset turnover compared to previous fiscal year

The author identified several characteristics of high book-to-market firms. Firstly, low analyst coverage lead to predictions of future earnings being harder to perform. Thus, fewer investors were attracted to them. Secondly, he claimed that the voluntary disclosures made by these firms may not have been viewed as credible due to their lacking performance. Lastly, high book-to-market firms tend to be in financial distress more often. By applying the F-Score to these high BtM firms, an investor could select value stocks of higher quality resulting in a lower risk of the selected firms underperforming and defaulting (Piotroski, 2000).

2.1.4 Studies in favour of value investing

A study on the Japanese stock market between 1971-1988 found evidence supporting certain fundamentals, such as book-to-market, having significant impact on expected returns (Louis, Hamao, & Lakonishok, 1991) Similarly, Basu (1977) concluded that firms with a low price-to-earnings ratio performed better than firms with a high ratio between 1957-1971. Furthermore, the author stated that the results violated the efficient market hypothesis, implying that the market suffered from inefficiencies. In addition to Basu's findings, Rosenberg, Reid & Lanstein (1985) found in their study that similar results were possible when basing your investment decisions on the book-to-market ratio. The authors found that it was possible to generate excess returns by investing in companies with high book-to-market ratios while shorting companies with low book-to-market ratios. The three aforementioned studies suggest that it is possible to generate abnormal returns based on fundamental analysis. However, since the authors published these findings during the 20th century, there is a risk of the findings being outdated and no longer applicable to today's market.

In his book, *The Little Book that Still Beats the Market*, Greenblatt (2010) presented the Magic Formula's excellent performance in the timespan 1988-2004 against market averages. Even so, the book, targeting retail investors, does not include any statistically tested findings, and one can question the objectiveness of the findings as the author presents them in a commercial book. In an attempt to test the Magic Formula's ability to produce statistically significant alphas, Davydov, Tikkanen & Äijö (2016) studied the performance of the Magic Formula on the Finnish stock market between 1991-2013. The authors concluded that the Magic Formula provided statistically significant risk-adjusted returns when tested against the Fama & French three-factor model, a well-known model to describe expected stock returns. In addition, Blackburn & Cakici (2017) tested the Magic Formula strategy globally over four different regions; North America, Europe, Japan and Asia, between 1991 and 2016. Instead of only purchasing the firms with the lowest cumulative ranking score, the authors also shorted the firms with the highest cumulative ranking score. The authors concluded that this version of the Magic Formula provided statistically significant excess returns in Europe but not in the rest of the studied regions. The authors provided no explanation as to why the results might have been insignificant. The findings of Blackburn & Cakici (2017) are in line with the findings of Davydov, Tikkanen & Äijö (2016), indicating that the Magic Formula was able to perform statistically significant returns well into the 21st century. Both studies were conducted over

roughly the same time period and in overlapping geographic regions as the scope of our study. Hence, these two studies suggest that the Magic Formula should have the possibility to perform significantly better than a Nordic market index during our selected period.

By studying the US market between 1976 and 1996, Piotroski (2000) provided evidence that an investor using a value investing strategy could improve their returns significantly by applying the F-Score filter. The author showed that returns could be increased by selecting high book-to-market (BtM) firms with high F-Scores and shorting high BtM firms with low F-Scores. Noma (2010) studied the Tokyo Stock Exchange between 1986-2001 and used the F-Score to further filter stocks after first filtering them on book-to-market. The author found that if an investor purchased high BtM firms with high F-Scores and shorted low BtM firms with low F-Scores, returns could be increased, supporting Piotroski's findings on the F-Scores ability to generate superior returns. Both these studies examined the performance of the F-Score strategy during roughly the same period, albeit in different geographic regions. However, the two articles implemented different methodologies when constructing their portfolios. Piotroski focused solely on the highest quintile of BtM firms, while Noma used both high and low BtM firms in his portfolios. The different methodologies imply the robustness of the F-Score filter, as it generated excess returns in both cases. While this speaks in favour of the F-Score, neither their selected time period nor geographic regions overlap with the delimitations of our study, introducing an element of uncertainty in our research.

Louis & Lakonishok (2004) conducted a study building on secondary research from the previous decade and provided updated data on value investing's performance. The authors concluded that several studies have established evidence in support of value investing, in line with their quantitative results. However, the authors also concluded that previous literature has not established an explanation as to why. Previously two explanations have been brought forward; (1) higher returns are driven by increased risk related to financial distress, (2) higher returns are driven by increased risk not detected by common asset pricing models. These explanations, however, were by the authors deemed unlikely, although not discarded. Instead, the authors put forward explanations such as agency factors and judgmental biases. The authors derive these explanations from previous psychological research and the notion that the market tends to price stocks more (less) covered by analysts above (below) their intrinsic value. Also that investors may extrapolate past performance too far into the future.

Compiling the articles in this section, one can argue that there is support for the superior performance of value investing both in and outside of the delimitations selected in our study. However, recent studies have presented contradicting evidence regarding the performance of value investing. We present these in the following section.

2.1.5 Studies against value investing

Lev & Srivastava (2019) examined the history of value investing during 1970-2018 in the US market. The authors examined the returns of the Fama and French method where high BtM stocks are purchased and low BtM stocks are sold short over a one-year holding period. The authors found that the strategy generated above-market returns during the '70s and 80's, in line with the above-mentioned research. However, over the next 30 years, the strategy's performance deteriorated. Apart from a brief resurrection between 2000 and 2006, the strategy generated a cumulative negative return. The authors identified two major reasons for the recent failure of value investing: (1) Fundamental economic developments have significantly slowed down the reshuffling of value and glamour stocks, also known as mean reversion, which earlier drove the above (below) average returns for value (glamour) stocks. (2) Accounting deficiencies causing non-comparable accounting metrics and systematic misidentification of value and glamour stocks. Additionally, Lev & Srivastava (2019) tested the performance of a value investing strategy adjusted for accounting deficiencies such as capitalised R&D and SG&A. Their results showed that the adjusted portfolio performed returns greater than the unadjusted portfolio, further implying that accounting deficiencies have impaired unadjusted value investing strategies.

Maloney & Moskowitz (2020) stated that the value premium, defined by Fama and French as the differences in return between high book-to-market firms and low book-to-market firms, has underperformed during the recent decade when studying the US market. The underperformance has resulted in a cumulative flat performance over the past two decades. The authors suggested that a possible explanation to why value investing has underperformed were low interest rates. However, inconsistent results found that changes in yields could not explain the evident recent failure of value investing.

The final two articles mentioned shed a different light on the value investing field. These findings are also in line with the findings of Blackburn & Cakici (2017), who showed that value investing in recent times had not performed significantly superior returns in non-European

markets. While the studies of Lev & Srivastava (2019) and Maloney & Moskowitz (2020) neither investigated the same portfolio strategies nor geographic region as we do in our study, they presented evidence suggesting that the fundamentals of value investing have shifted in an unfavourable way during our selected time period. In contrast, earlier mentioned articles, whose geographic scopes and selected strategies overlap with ours, have not observed the same findings as Lev & Srivastava (2019) and Maloney & Moskowitz (2020). Therefore, our study contributes by investigating if value investing has suffered from the same downfall in the Nordic market as it has in the US market in recent times.

2.2 Underlying market theories

2.2.1 Efficient market hypothesis

Fama (1965) presented the random walk theory, which involves two separate hypotheses: (1) Two price movements after each other are independent, (2) the price changes conform to some probability distribution. Thus, looking at previous movements to predict future movements is worthless. Based on this theory, Fama developed the Efficient Market Hypothesis (Fama, 1970). Fama divided the theory into three categories depending on the subset of interest. (1) The weak form of efficiency: only information conveyed by historical prices are reflected in the current price, rendering technical analysis useless. (2) Semi-strong form of efficiency: both historical prices and all public information are reflected in the current price, implying that fundamental analysis has no effect in predicting stocks' future returns. (3) Strong form of efficiency: information conveyed by historical prices, public information, and private information held by investors are all reflected in the share price. In the strong form of efficiency, not even investors holding monopolistic inside information will be able to predict future stock returns. Fama concluded that there were no strong evidence against the hypothesis in its weak or semi-strong form and only limited contradicting evidence in its strong form (Fama, 1970).

Since the publishing of the article, Fama has received support from various academics verifying his findings, such as Burton (1973), Samuelson (1973), and Jensen (1978). However, if the efficient market hypothesis in its semi-strong form holds, value investing strategies should not be able to generate abnormal returns. Still, investors using a value investing strategy have been conducting fundamental analysis to continuously generate above-market returns (Mihaljevic, 2013). In order to understand how the investing strategies that Greenblatt and Piotroski

designed have been able to systematically beat the market, the following sections will present the main market inefficiencies and anomalies found by academia.

2.2.2 Fundamental analysis of accounting information

Ou & Penman (1989) demonstrated in their studies that fundamental analysis based on information in financial statements could be used in favour of the investor to predict stock returns. Several accounting-based measures that correlated positively with the movement of stock prices were put together into an aggregate measure called Pr. The authors constructed a portfolio, investing in companies with high Pr-scores and shorting firms with low Pr-scores. The authors found evidence suggesting that fundamental analysis, in contrast with the efficient market hypothesis, could generate excess returns. Later, Lev & Thiagarajan (1993) and Abarbanell & Bushee (1998) published articles with similar results, further approving fundamental analysis and its usefulness in separating high-value from low-value firms resulting in above-average returns.

However, Lev & Srivastava (2019) showed that the usage of accounting information for fundamental analysis has started to lose its competitive advantage during the last decade. The authors showed that intangible assets, which are very difficult to accurately valuate, have taken a larger share of companies' total invested capital. This leads to the accuracy of accounting metrics becoming less dependable when predicting future stock performance. The arisen problem is especially noticeable for glamour stocks which often are intangibles-intensive. Hence, such companies might be more accurately valuated by the market than by accounting fundamentals (Lev & Srivastava, 2019). The effects of accounting deficiencies might differ between the US and Nordic markets due to differences in accounting standards. Firms using IFRS could face impairment of long-lived assets earlier than firms using US GAAP. Furthermore, IFRS allows for some capitalisation that US GAAP does not, such as capitalisation of development costs (PwC, 2020). This makes it hard to predict how accounting deficiencies might affect the Nordic market.

2.2.3 The book-to-market effect

Book-to-market is a measure of what value the market gives the common equity on the balance sheet (Berk & DeMarzo, 2017). As earlier mentioned, Rosenberg, Reid, and Lanstein (1985) showed in their study that it is possible to beat the market by investing in high book-to-market firms while shorting low book-to-market firms.

Fama and French (1992) also studied the book-to-market ratio and used it in their three-factor model. According to the authors, the ratio is considered a risk factor as they found that firms with a high book-to-market ratio more often had worse profitability than low book-to-market firms and thus were more prone to financial distress. Piotroski (2000) later supported these findings. However, Lakonishok, Schleifer & Vishny (1994) argued against Fama and French and showed that value stocks, defined as high book-to-market stocks, are not riskier than their counterparts of the low book-to-market growth stocks. Instead, abnormal returns are rather explained by investors and analysts putting too much confidence in past performance, although research has found historical spread in performance to be highly mean-reverting.

2.2.4 Mean reversion

The phenomenon of firm performance reverting to the long-run mean of the entire dataset is called mean reversion (Berk & DeMarzo, 2017). Haugen (1995) determined that above-average earnings could be achieved in the short run. However, positive abnormal profits tend to revert towards the mean of the population as the time perspective becomes longer, often driven by increased competition. The same goes for negative abnormal performances, which also seem to revert towards the population average and their performance increases towards sample mean. In conclusion, overperformers will not be able to sustain above-average performance for eternity but rather decline in performance, and more importantly, underperformers will likely perform better in the future.

Haugen (1995) also found empirical evidence for the market's expectations for different historical performances. Market expectations were very high for companies who had performed abnormal earnings in the past and very low for companies with low historical earnings. As mean reversion occurs and overperformers decline in performance, market expectations are not met and stock prices change accordingly. As a result, Haugen argued that the market on average overvalues previous overperformers, and on average, undervalues previous underperformers. To conclude his empirical findings, Haugen stated that the market as a whole overreacts to past and present information (Haugen, 1995). Goedhart, Wessels and Koller (2010) later supported Haugen's findings and confirmed that abnormal levels of revenue growth and return on invested capital are not sustainable in the long run.

In contradiction to these findings, Lev and Srivastava (2019) showed in their research that there has been a slow-down of the mean reversion phenomenon, crippling the future performance of

previously underperforming value stocks. The authors argue that the financial crisis in 2008 fundamentally changed the economic environment. The primary argument was that financial institutions have become more risk averse, leading to previous underperformers experiencing troubles receiving financing. This results in value stocks being stuck in the so-called value trap, where underperformers remain underperformers due to the lack of financing.

2.2.5 Size effect

Research on the size effect regards the market value of a company's equity and its effect on its future performance. Early research by Roll (1981) proclaimed that small firms had the advantage over large firms when it came to future performance. Possible explanations were that there was limited information available to investors on small firms; thus, only a selected set of investors were willing to invest in such companies, resulting in less competition and higher returns. However, research undertaken during the 21st century suggests that it is not possible to achieve risk-adjusted abnormal returns because of the underlying riskiness of small-firm portfolios compared to large-firm portfolios (Patel, 2012). Fama & French (1992) incorporated firm size as a risk factor in their three-factor asset pricing model, since small firms during the 1980s typically had lower earnings than large firms, and higher returns merely compensated for the increased risk.

2.3 Hypotheses

Our hypotheses are derived from the aforementioned literature and the following three underlying arguments:

(1) Evidence suggests that the efficient market hypothesis holds in its semi-strong form (Fama, 1970). However, there is also evidence that discrepancies between market value and intrinsic value exist over shorter periods of time (Basu, 1977; Rosenberg, Reid & Lanstein, 1985). These discrepancies result in opportunities for investors to exploit as mean reversion drives below-average companies to generate above-average returns, making it possible in theory for value investing to hold (Haugen, 1995).

(2) There is extensive research providing evidence for value investing's ability to generate above-market returns, both before and during our studied time-period (Louis & Lakonishok, 2004; Davydov, Tikkanen & Äijö, 2016; Blackburn & Cakici, 2017) The scopes of the more recent studies largely overlap with the scope of ours and provide support for value investing having the ability to beat the Nordic market between 2001-2021.

The first two arguments make up the basis of our first hypothesis: that over the full 20-year period value investing strategies have outperformed the market index and their respective inverse portfolios.

(3) Studies on the US market provide evidence suggesting that value investing has lost its ability to generate above-market returns in recent times (Blackburn & Cakici, 2017; Lev & Srivastava, 2019; Maloney & Moskowitz, 2020) The increased effect of accounting deficiencies combined with the slow-down in mean reversion should negatively affect both value investing strategies towards the end of our studied period.

The third argument makes up the basis for our second hypothesis: that when dividing the full time period into 10-year subperiods, the value investing strategies' performance against the market index and their respective inverse portfolios should differ over time. In detail, we expect the performance to be greater towards the beginning of our studied period and decline towards the end.

To test our hypotheses, we have stated four null hypotheses. We believe that we will find support to reject the first and third null hypotheses but not the second and fourth.

Our four null hypotheses to be tested are:

$H_0$1: *The value investing strategies have not outperformed the market index over the last 20 years*

$H_0$2: *The value investing strategies have not outperformed the market index over a 10-year period regardless of the starting year*

$H_0$3: *The value investing strategies have not outperformed their respective inverse portfolios over the last 20 years*

$H_0$4: *The value investing strategies have not outperformed their respective inverse portfolios over a 10-year period regardless of the starting year*

3. Method

To study our research question, we conducted a quantitative study. The two strategies selected to represent value investing in our study were Greenblatt's Magic formula and Piotroski's F-Score. When constructing the portfolios, we followed the methodology of Greenblatt and Piotroski as closely as possible. In order to examine the strategies' ability to separate stocks that will generate above-market from below-market returns, we also constructed inverse portfolios capturing stocks with the opposite characteristics as the ones captured in the original portfolios. The inverse portfolios should therefore have selected firms that will generate below-market returns in the future. The statistical tests chosen to study the returns of the portfolios were the same univariate statistical tests used in Piotroski's study, a parametric paired sample t-test and a non-parametric Wilcoxon signed rank test.

3.1 Sample selection

We studied the Nordic markets, including Sweden, Norway, Finland, and Denmark, between the years 2001 until 2021. Even though Iceland is part of the Nordics we chose to exclude it from consideration due to its small economy and it not being a part of the MSCI Nordic Countries Net Total Return Index. In order to construct the Magic Formula and F-Score portfolios as well as their respective inverse portfolio, we downloaded the necessary financial

data from the Capital IQ database. We selected firms with a market capitalization above zero on at least one point between April 1st 2001 and April 1st 2021 for our sample. This screening criterion ensured that our study did not suffer from survivorship bias, where delisted firms were not included in the back-testing and thus wrongfully excluded from the study. Following the methodology that Greenblatt presented in his book, we excluded firms in the financial and utility sectors. For consistency purposes, we excluded the same industries for the sample selection for all portfolios. Firms that lacked sufficient data in the database were excluded from consideration that year (Greenblatt, 2010). Furthermore, we only included firms traded on the larger Nordic exchanges: OMX Nordic Exchange Stockholm, OMX Nordic Exchange Copenhagen, OMX Nordic Exchange Helsinki, Oslo Bors and Nordic Growth Market. Thus, we excluded more illiquid markets such as over-the-counter exchanges, to ensure that all the necessary trades could be performed at the desired time. Table 2 presents the number of firms in our sample after following the sample selection process.

Table 2. Sample construction procedure

Category	**Number of firms**
Listed firms in the Nordics	2628
Excluded financial firms	-286
Excluded utility firms	-35
Excluded firms not listed on main exchanges	-53
Final sample	**2254**

The selected holding period was one year, after which we rebalanced the portfolios, following the methodology of Greenblatt (2010). We collected stock price data as of April 1st each year between 2001 and 2021, together with financial information from each respective previous fiscal year. By choosing the 4th month as the start date of our holding period, we ensured that our study did not suffer from look-ahead bias, where financial information not available to the investor at the time of the construction of the portfolios, were not included in our back-testing study.

3.2 Construction of portfolios

3.2.1 Magic Formula

When constructing the Magic Formula portfolios, we implemented a size requirement as suggested by Greenblatt. We selected a size requirement above or equal to MUSD 50 in market capitalisation. After filtering on size, we then ranked all firms based on Earnings Yield. The firm with the highest Earnings Yield received the highest ranking score, and the firm with the lowest Earnings Yield received the lowest ranking score. The firm with the highest Earnings Yield thus received a ranking score of 1. We repeated the same procedure for the metric Return on Capital, where the firm with the highest Return on Capital received the highest ranking score and vice versa. We then added the ranking scores together to form a cumulative ranking score for every firm. We chose the 30 firms with the lowest cumulative ranking score for each year to finally construct our portfolios, all firms with equal weights. Greenblatt suggested in his book that 20-30 firms is an adequate portfolio size and leads to the portfolio being neither too diversified nor too little. To form our inverse portfolios, we followed the same procedure as for the original portfolio, the only difference being that we selected the 30 firms with the highest cumulative ranking score for each one-year holding period. We repeated the same process for each year (Greenblatt, 2010).

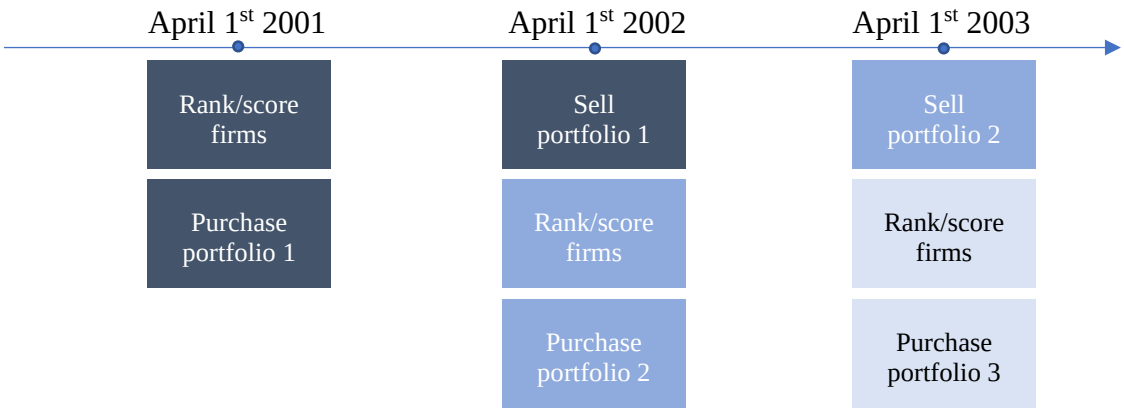
3.2.2 F-Score

When constructing the F-Score portfolios, we sorted the sample of firms on book-to-market. We classified firms that had a book-to-market ratio above the sample median as high book-to-market firms, and firms below the sample median as low book-to-market firms for each year. This contradicted with Piotroski's methodology, where the author classified only the highest 20% as high book-to-market firms. However, when only including the top quintile, the sample became too small for the F-Score to be effectively implemented and construct large enough portfolios. Hence, we shifted the classification from the highest 20% to the highest 50%. We then scored the high book-to-market firms on each of the 9 scoring criteria, with each firm receiving an F-Score ranging from 0-9. In line with Piotroski's method, we classified firms with an F-Score of 8 or 9 as high scoring firms. Piotroski did not apply any portfolio sizes in his study, but for consistency purposes, we applied the same portfolio size limit of 30 firms to the F-Score as for the Magic Formula. If the total number of high scoring firms were lower than 30, we included all firms in the portfolio. If the total number of high scoring firms were greater than 30, we first included all firms with an F-Score of 9. We then sorted the firms with

an F-Score of 8 on book-to-market, and the firms with the highest ratios were selected to fill the remaining of the 30 slots. We repeated this process for each year (Piotroski, 2000).

To create our inverse F-Score portfolios, we first selected low book-to-market firms. Further, we classified firms with an F-Score of 0, 1, or 2 as low scoring firms. Piotroski did not classify firms with an F-Score of 2 as low scoring firms in his original paper. However, the sample regarded in Piotroski's paper was considerably larger than in our study, creating a need to include firms scoring 2 in our classification of low scoring firms. The inverse F-Score portfolios included low scoring and low book-to-market firms. If the total number of low scoring firms were lower than 30, we included all firms in the inverse portfolio. If the total number of low-scoring firms were greater than 30, we first included all firms with an F-Score of 0 and 1. We then sorted the firms with an F-Score of 2 on book-to-market and selected the firms with the lowest ratios to be included in the remaining of the 30 slots in the inverse portfolios. We repeated this process for each year (Piotroski, 2000).

Figure 1. **Visualisation of the portfolio construction timeline**



3.3 Calculations of returns

We calculated firm-specific monthly returns using stock price data from Capital IQ on the first trading day of each month. If a firm delisted, the reason was investigated. If the delisting reason was a tender offer or similar offer to take a firm private, we used the last known share price to calculate returns as we assumed that the last known share price reflects the tender offer. If the delisting reason was bankruptcy, we assumed the final share price to be zero. In cases of delisting, we included no new stock until we rebalanced the portfolio on April 1st, the upcoming year.

To calculate the total return, we used the dividend-adjusted share price since this adjustment includes the total return that an investor would receive from holding a share, both from increases in share price and paid out dividends. Thus, the total return for a one-month holding period is:

$$Total\ Return_t = \frac{Dividend\ Adj.\ Share\ Price_t - Dividend\ Adj.\ Share\ Price_{t-1}}{Dividend\ Adj.\ Share\ Price_{t-1}}$$

3.4 Selected benchmark

The selected benchmark for our study was the MSCI Nordic Countries Net Total Return Index (MSCI Nordic Index). This index consists of 79 firms across the Nordic region and captures 85% of the free-floating market capitalisation of the Nordic markets. The MSCI Nordic Index was a fitting index to use as a benchmark since it provided us with the average return over the four selected markets. Furthermore, this index provided the total return, including dividend effects, similar to the return used to calculate portfolio returns (MSCI, 2021).

3.5 Univariate tests

The previous literature within the area of value investing mainly used one of the two following methodologies to test significance: (1) a univariate analysis such as a paired sample t-test or Wilcoxon signed rank test or (2) a regression against an asset pricing model such as CAPM, Fama and French 3 Factor Model or Carhart Four-Factor Model. Since our study aims to test whether or not an investor can beat the market index by using value investing strategies, we chose to conduct our analysis using the univariate analysis in line with Piotroski's methodology (Piotroski, 2000).

In our univariate analysis, we used the one-tailed version of a paired sample t-test complemented with a Wilcoxon signed rank test to investigate if portfolio means and median monthly returns are superior to the tested benchmark. Based on the results of the univariate analysis, we can draw conclusions about whether value investing strategies are effective in beating the market and if the selected strategies are effective methods to separate stocks that will generate above-market from below-market returns. If we instead had run a regression against an asset pricing model rather than a univariate analysis, we could have drawn conclusions on the risk-adjusted performance of the strategies and value investing. However,

this does not allow for conclusions regarding value investing's performance against the market index, only relative to the theoretical definition of portfolio specific risk (Piotroski, 2000).

Kothari & Warner (1997) discussed the problem of using a parametric test when looking at long time horizons and the tendency of the test to show abnormal returns too often. To minimize this problem and increase the reliability of our findings, we also used the non-parametric Wilcoxon signed rank test. The authors suggested that using a non-parametric test can serve as a good complement with fewer potential problems of misspecification.

Firstly, we tested the two value investing strategies against the MSCI Nordic Index. Both the Magic Formula and the F-Score were tested against the MSCI Nordic Index over the full period, April 2001 to April 2021. Secondly, we divided the period into six 10-year rolling subperiods with starting dates in April 2001, 2003, 2005, 2007, 2009, and 2011. We studied the 10-year subperiods in order to investigate if the value investing strategies performed evenly over the entire selected time period or if the performance of the strategies has changed over time. Lastly, we also tested the original portfolios' mean and median monthly returns against their respective inverse portfolio, to test if the strategies are effective tools for separating stocks that will generate above-market from below-market returns. We tested the original portfolios against their respective inverse portfolio both over the full 20-year period and the rolling 10-year subperiods.

For us to reject our null hypothesis, both strategies must have performed statistically significant superior returns according to both the parametric and the non-parametric univariate tests over the tested time period. In which case, we could reject the null hypothesis on the higher of the two significance levels displayed by the paired sample t-test and Wilcoxon signed rank test. If one of the two tests did not provide significant results, we could not reject the hypothesis on any significance level.

3.6 Test of robustness

To test the robustness of our results, we have chosen to perform two robustness tests. First, we modified the portfolio size. Greenblatt proposed in his book that an investor should include 20-30 stocks in a portfolio in order for the Magic Formula to properly work. In the robustness test, we changed this assumption so that all the portfolios only included 15 stocks. The second robustness test performed was an alternation of the holding period. In his book, Greenblatt

suggested that an investor should rebalance the portfolio each year, which is also the holding period Piotroski used for his primary test. In the robustness test we changed the holding period to two years, in line with the methodology of Piotroski, who also included a two-year holding period for robustness (Piotroski, 2000; Greenblatt, 2010).

4. Empirical results and analysis

In this section, we present the descriptive statistics and the results of our analyses. Our findings suggest that value investing has outperformed both market index and their inverse portfolios during the studied period. However, we identify a negative performance trend when dividing the 20-year period into subperiods. Our results are supported by the conducted robustness test.

4.1 Descriptive statistics

Table 3 provides data on different value investing measures and return data for the entire selected time period, April 1st 2001 – April 1st 2021. Over this time period, the Magic Formula and the F-Score yielded a mean monthly return of 1.58% and 1.52%, respectively. In comparison, the inverse portfolios of the Magic Formula and F-Score yielded 0.69% and 0.39%, respectively, over the same time period.

There is a large difference between the book-to-market ratio of the firms selected by the original F-Score strategy and its inverse portfolio. However, there seems to be no apparent difference between the book-to-market ratio of the firms selected by the Magic Formula and its inverse portfolio. There is a large difference in Earnings Yield between both original strategies and their respective inverse portfolio. When comparing the different quality metrics, we identify the same differences between both strategies and their inverse portfolios. Despite their selection processes focusing on different metrics, the descriptive statistics suggest that the two strategies identify quality in a similar way. When looking at the two size metrics, market capitalisation and total assets, the data shows that firms selected in the original portfolios are considerably larger than in the inverse portfolios, despite the F-Score not implementing any size filter in the selection process.

Table 3. Descriptive statistics for firms included in the portfolios

2001-2021	Magic Formula (obs=600)			F-Score (obs=543)			Magic Formula Inverse (obs=600)			F-Score inverse (obs=514)		
Variables	**mean**	**median**	**std. dev.**	**mean**	**median**	**std. dev.**	**mean**	**median**	**std. dev.**	**mean**	**median**	**std. dev.**
Monthly returns	0.0158	0.0160	0.0652	0.0152	0.0151	0.0622	0.0069	0.0046	0.0927	0.0039	-0.0046	0.0898
Size metrics												
Market cap.	3642.4	262.1	13189.4	1482.2	101.4	6091.3	208.9	99.6	534.3	186.7	35.3	700.9
Total assets	3995.0	237.9	15863.6	2337.9	226.1	8723.9	237.1	57.1	1093.2	145.6	13.4	877.2
Value metrics												
Book-to-market	0.455	0.366	0.342	1.115	0.910	0.769	0.544	0.303	0.921	-0.114	0.175	3.542
Earnings yield	0.182	0.130	0.197	0.136	0.087	0.654	-0.263	-0.126	1.174	-0.235	-0.114	0.410
Quality metrics												
Return on capital	23.890	18.900	17.598	6.376	5.410	5.498	-57.973	-21.900	637.833	-46.635	-26.700	89.198
Return on assets	13.783	11.800	8.912	4.628	4.070	3.855	-23.072	-17.400	22.682	-26.997	-20.100	29.766
CFO / assets	0.180	0.159	0.123	0.103	0.091	0.073	-0.275	-0.194	0.346	-0.437	-0.263	0.603
ΔROA	3.050	1.270	9.527	2.702	1.510	4.108	0.126	-2.600	23.940	-10.544	-7.681	17.851
ΔCurrent ratio	0.101	0.040	1.737	0.241	0.110	2.367	-0.248	-0.126	8.814	-0.970	-0.376	3.407
ΔLTD/assets	-0.012	0.000	0.071	-0.028	-0.019	0.050	-0.004	0.000	0.177	0.055	0.000	0.395
ΔAsset turnover	0.121	0.020	1.943	0.091	0.059	0.124	-0.044	-0.005	0.246	-0.146	-0.083	0.447
ΔGross margin	1.837	0.700	7.636	3.494	1.700	7.019	-3.694	0.000	45.237	-16.914	-4.650	41.800

Table 4 and Figure 2 show the annual performance of the selected strategies, the MSCI Nordic Index and the inverse portfolios. Over the full 20-year period, the Magic Formula and the F-Score yielded a total Multiple on Invested Capital (MoIC) of 26.0x and 23.8x, equal to a CAGR of 17.7% and 17.2%, respectively. In comparison the MSCI Nordic Index, yielded a MoIC of 4.78x and 8.1% CAGR. The inverse portfolios yielded returns of 1.86x and 0.99x in MoIC, respectively, equal to CAGRs of 3.2% and -0.1%. Hence, over the full 20-year period the original portfolios seem to have generated superior returns compared to the tested benchmarks.

When comparing the CAGRs in the first and second decade, the differences between the original portfolios and the MSCI Nordic Index and their respective inverse portfolios have decreased in the second decade than in the first. In the second decade, the CAGR for the F-Score, 5.6%, is less than for the F-Score Inverse portfolio, 6.0%, and the MSCI Nordic Index, 6.7%.

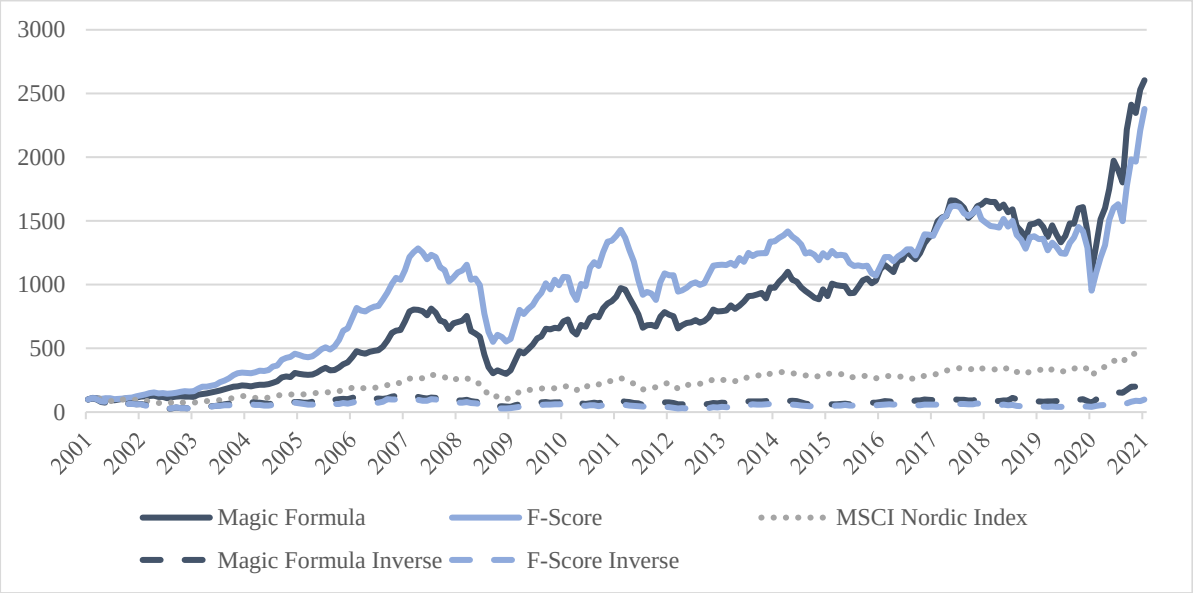
Table 4. Accumulated annual returns indexed to April 1st 2001

Portfolio/ index	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	CAGR ('01-'11)
MF	100.0	121.5	119.9	208.0	299.1	429.5	712.8	706.6	328.2	712.4	904.1	24.6%
FS	100.0	131.3	163.9	307.0	447.5	736.0	1113.0	1096.2	574.7	1060.0	1382.7	30.0%
MFI	100.0	63.5	27.8	84.3	79.7	112.4	122.0	90.9	42.2	83.7	82.7	-1.9%
FSI	100.0	60.3	29.0	65.1	69.3	72.7	98.3	74.5	30.7	63.8	55.2	-5.8%
MSCI	100.0	98.7	72.0	123.5	141.8	191.5	242.3	261.2	117.2	202.3	249.1	9.6%

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	CAGR ('11-'21)	CAGR ('01-'21)
MF	904.1	765.5	791.2	975.6	910.7	1120.5	1396.2	1658.3	1496.7	1103.5	2604.1	11.2%	17.7%
FS	1382.7	1072.3	1156.0	1340.8	1214.2	1144.9	1381.9	1486.1	1356.9	953.1	2379.0	5.6%	17.2%
MFI	82.7	75.7	74.0	91.2	60.8	79.3	93.3	91.7	83.5	71.3	186.3	8.5%	3.2%
FSI	55.2	38.4	40.5	63.5	47.8	55.9	59.2	57.6	44.5	40.9	98.7	6.0%	-0.1%
MSCI	249.1	225.8	249.1	310.2	297.8	276.3	287.5	340.3	331.1	286.2	478.2	6.7%	8.1%

Notes: This table present the accumulated annual returns over the full time period April 1st 2001 - April 1st 2021. Variables presented are: *Magic Formula (MF), F-Score (FS), Magic Formula Inverse (MFI), F-Score Inverse (FSI), MSCI Nordic Countries Net Total Return Index (MSCI).*

Figure 2. Accumulated returns indexed to April 1st 2001



4.2 Hypotheses testing

4.2.1 Null hypothesis 1

Table 5 shows the results of the paired sample t-test and the Wilcoxon signed rank test for the Magic Formula and the F-Score against the MSCI Nordic Index over the full time period April 1st 2001 to April 1st 2021. The mean monthly return for the Magic Formula and F-Score were 1.58% and 1.52%, respectively. The mean monthly return for the MSCI Nordic Index was 0.88%, indicating that the mean monthly return was almost twice as high for the selected

strategies than for the market index. When comparing the median monthly returns, similar results are found.

For the Magic Formula, both univariate tests show a significant difference between the mean and median monthly returns of the strategy and the market index on a 1% significance level. We find similar results for the F-Score. However, the differences in mean and median return are statistically significant on a 5% level according to both univariate tests.

Table 5. Univariate analysis of full-period performance against MSCI Nordic Index

Monthly returns	**Mean**	**Std. Err.**	**Median**	**Obs**	**Monthly returns**	**Mean**	**Std. Err.**	**Median**	**Obs**
MF	0.015812	0.004211	0.016003	240	*FS*	0.015245	0.004017	0.015110	240
MSCI	0.008827	0.004354	0.009075	240	*MSCI*	0.008827	0.004354	0.009075	240
MF-MSCI	0.006985	0.002407	0.006928	240	*FS-MSCI*	0.006418	0.002771	0.006034	240
T-statistic (Z-value)	**2.9020**	-	**(2.756)**	**240**	T-statistic (Z-value)	**2.3165**	-	**(2.483)**	**240**
P-value	**0.0020****	-	**0.0059****	**240**	P-value	**0.0107***	-	**0.0130***	**240**

Notes: This table presents the results for the univariate tests, paired sample t-test and Wilcoxon signed rank test, on monthly returns over the full time period April 1st 2001 - April 1st 2021. The variable *MF-MSCI* represents the difference between the variables *Magic Formula (MF)* and *MSCI Nordic Countries Net Total Return Index (MSCI).* The variable *FS-MSCI* represents the difference between the variables *F-Score (FS)* and *MSCI Nordic Countries Net Total Return Index (MSCI).* Significance levels are indicated by: * p<0.05; ** p<0.01; *** p<0.001.

Over the full time period of 20 years, both of our selected value investing strategies outperformed the market index. Since the differences in mean and median monthly returns are significant on at least a 5% significance level for both strategies, we can reject our first null hypothesis, $H_0 1$, on a 5% significance level. This indicates that during the last 20 years the value investing strategies generated superior returns compared to the market.

4.2.2 Null hypothesis 2

Table 6 shows the results of both univariate tests for the selected strategies tested against the MSCI Nordic Index when dividing the full period into 10-year subperiods. The Magic Formula had a mean and median monthly return greater than the market index in all 10-year subperiods. However, the difference in mean and median monthly returns are statistically significant on a 1% level between 2001-2011. Between 2003-2013, the difference in mean monthly returns is significant on a 5% level according to the parametric test alone. During all subsequent subperiods, there is no statistical significance regarding the differences in the Magic Formula's monthly performance compared to the MSCI Nordic index.

The F-Score had a mean and median monthly return above the market index in the first three 10-year subperiods (2001-2011, 2003-2013, 2005-2015). After which, the F-Score performed monthly returns below the market index. During the first subperiod, the differences are significant according to the parametric test on a 1% level and the non-parametric test on a 0.1% level. In the second subperiod, the difference in median monthly return is significant on a 5% level according to the non-parametric test alone. For all the subsequent subperiods there is no statistical significance between the F-Score's monthly performance compared to the MSCI Nordic.

Table 6. Univariate analysis of subperiod performance against MSCI Nordic Index

The Magic Formula tested against the MSCI Nordic Index

	2001-2011			2003-2013			2005-2015		
	Mean	Std. Err.	Median	Mean	Std. Err.	Median	Mean	Std. Err.	Median
MF	0.020895	0.006257	0.021808	0.018410	0.006489	0.021808	0.011842	0.006437	0.014307
MSCI	0.010908	0.007385	0.012588	0.013268	0.006877	0.020161	0.008830	0.006571	0.010036
MF-MSCI	0.009987	0.003783	0.009220	0.005142	0.003035	0.001646	0.003012	0.002941	0.004271
T-statistic (Z-value)	**2.6403**	**-**	**(2.718)**	**1.6941**	**-**	**(1.689)**	**1.0244**	**-**	**(1.006)**
P-value	**0.0047****	**-**	**0.0063****	**0.0464***	**-**	**0.0915**	**0.1539**	**-**	**0.3164**

	2007-2017			2009-2019			2011-2021		
	Mean	Std. Err.	Median	Mean	Std. Err.	Median	Mean	Std. Err.	Median
MF	0.008027	0.006291	0.009432	0.142569	0.005135	0.011573	0.010729	0.005625	0.006840
MSCI	0.003985	0.006488	0.004491	0.010214	0.005095	0.005164	0.006747	0.004641	0.006574
MF-MSCI	0.004043	0.002953	0.004941	0.004043	0.002652	0.006409	0.003983	0.002968	0.000266
T-statistic (Z-value)	**1.3691**	**-**	**(1.425)**	**1.5244**	**-**	**(1.323)**	**1.3417**	**-**	**(0.990)**
P-value	**0.0868**	**-**	**0.1551**	**0.0650**	**-**	**0.1871**	**0.0911**	**-**	**0.3241**

The F-Score tested against the MSCI Nordic Index

	2001-2011			2003-2013			2005-2015		
	Mean	Std. Err.	Median	Mean	Std. Err.	Median	Mean	Std. Err.	Median
FS	0.024194	0.005856	0.029072	0.018793	0.006288	0.023125	0.010595	0.006108	0.011997
MSCI	0.010908	0.007385	0.012588	0.013268	0.006877	0.020161	0.008830	0.006571	0.010036
FS-MSCI	0.013286	0.004590	0.016484	0.005525	0.003464	0.002963	0.001765	0.003258	0.001962
T-statistic (Z-value)	**2.8946**	**-**	**(3.520)**	**1.5950**	**-**	**(2.127)**	**0.5417**	**-**	**(1.042)**
P-value	**0.0023****	**-**	**0.0004*****	**0.0567**	**-**	**0.0332***	**0.2945**	**-**	**0.2990**

	2007-2017			2009-2019			2011-2021		
	Mean	Std. Err.	Median	Mean	Std. Err.	Median	Mean	Std. Err.	Median
FS	0.003848	0.005820	0.003037	0.008603	0.004940	0.002955	0.006297	0.005402	0.001953
MSCI	0.003985	0.006488	0.004491	0.010214	0.005095	0.005164	0.006747	0.004641	0.006574
FS-MSCI	-0.000137	0.003164	-0.001454	-0.001611	0.002681	-0.002209	-0.000450	0.002996	-0.004621
T-statistic (Z-value)	**-0.0432**	**-**	**(0.320)**	**-0.6008**	**-**	**-(0.534)**	**-0.1501**	**-**	**-(0.262)**
P-value	**0.5172**	**-**	**0.7512**	**0.7255**	**-**	**0.5953**	**0.5595**	**-**	**0.7952**

Notes: This table presents the results for the univariate tests, paired sample t-test and Wilcoxon signed rank test, on monthly returns during 10-year rolling subperiods starting April 1st 2001, 2003, 2005, 2007, 2009, and 2011. In each subperiod there are 120 observation per variable. The variable *MF-MSCI* represents the difference between the variables *Magic Formula (MF)* and *MSCI Nordic Countries Net Total Return Index (MSCI).* The variable *FS-MSCI* represents the difference between the variables *F-Score (FS)* and *MSCI Nordic Countries Net Total Return Index (MSCI).* Significance levels are indicated by: * p<0.05; ** p<0.01; *** p<0.001.

The differences between the value investing strategies' mean and median monthly returns and the market index are fully statistically significant during the first subperiod, partially significant during the second and insignificant during the subsequent. Hence, we find no support to reject our second null hypothesis, $H_0 2$.

Our findings suggest that during the first decade of the 21st century the value investing strategies generated above-market returns. However, we identify a negative trend in performance development, where differences in mean and median monthly returns steadily have decreased during the last 20 years. This indicates that, sometime during our studied period, the value investing strategies have lost their ability to generate above-market returns. Furthermore, these findings imply that the rejection of our first null hypothesis, stating that over the last 20-years the value investing strategies generated above-market returns, was mainly driven by an exceptional performance during the first decade.

4.2.3 Null hypothesis 3

Table 7 shows the results of both univariate tests for the Magic Formula and the F-Score against their respective inverse portfolio over the full 20-year period. The mean monthly returns for the Magic Formula Inverse and F-Score Inverse portfolios were 0.69% and 0.39%. In comparison, the Magic Formula and the F-Score original portfolios yielded mean monthly returns roughly two respectively four times higher than their inverse portfolios. The differences in median monthly returns are even larger than for mean monthly returns. For the Magic Formula, the parametric test shows a significant difference between the mean monthly returns of the original portfolio and its inverse portfolio on a 5% significance level. The non-parametric test shows a significant difference between the median monthly returns on a 1% level. We find similar results for the F-Score. However, both the parametric and non-parametric tests show the differences to be statistically significant on a 1% level.

Table 7. Univariate analysis of full-period performance against inverse portfolios

Monthly returns	Mean	Std. Err.	Median	Obs	Monthly returns	Mean	Std. Err.	Median	Obs
MF	0.015812	0.004211	0.016003	240	*FS*	0.015245	0.004017	0.015110	240
MFI	0.006863	0.005983	0.004608	240	*FSI*	0.003893	0.005795	-0.004551	240
MF-MFI	0.008949	0.004418	0.011395	240	*FS-FSI*	0.011352	0.004570	0.019660	240
T-statistic (Z-value)	**2.1398**	-	**(2.889)**	**240**	T-statistic (Z-value)	**2.4841**	-	**(3.146)**	**240**
P-value	**0.0167***	-	**0.0039****	**240**	P-value	**0.0068****	-	**0.0017****	**240**

Notes: This table presents the results for the univariate tests, paired sample t-test and Wilcoxon signed rank test, on monthly returns over the full time period April 1st 2001 - April 1st 2021. The variable *MF-MFI* represents the difference between the variables *Magic Formula (MF)* and *Magic Formula Inverse portfolio (MFI).* The variable *FS-FSI* represents the difference between the variables *F-Score (FS)* and *F-Score Inverse portfolio (FSI).* Significance levels are indicated by: * p<0.05; ** p<0.01; *** p<0.001.

Over the full 20-year period, both strategies outperformed their respective inverse portfolios. Since the differences in mean and median monthly returns are significant on at least a 5% significance level for both strategies we can reject our third hypothesis, $H_0 3$, on a 5% significance level. These results indicate that during the last 20 years, the value investing strategies had the ability to predict future returns and separate stocks that will generate above-market from below-market returns. The F-Score Inverse portfolio's median monthly return was negative during the period, further indicating that it had the ability to identify stocks that will generate below-market returns in the future.

4.2.4 Null hypothesis 4

Table 8 shows the results of both univariate tests for the selected strategies against their respective inverse portfolios when dividing the full period into rolling 10-year subperiods. The Magic Formula had a mean and median monthly return greater than the inverse portfolio in all but the last subperiod, 2011-2021, where the difference in median monthly returns was negative. The differences in mean and median monthly returns are statistically significant on a 1% level in the first and third subperiod (2001-2011, 2005-2015). However, there is no statistical significance regarding the differences in the Magic Formula's monthly performance compared to its inverse portfolio in the second and final three subperiods (2003-2013, 2007-2017, 2009-2019, 2011-2021).

The F-Score performed returns greater than its inverse portfolios during the first four subperiods. During the fifth, only its mean monthly return was greater while the median monthly return was below its inverse portfolio. In the last subperiod, the F-Score was

outperformed by its inverse portfolio on both mean and median return. The differences in mean and median monthly returns are statistically significant on a 0.1% level during the first subperiod (2001-2011). During the second subperiod (2003-2013), the difference in mean monthly return is significant on a 5% and median monthly return on a 1% level. During the third subperiod (2005-2015), differences in monthly returns are significant on a 5% level according to the non-parametric test alone. There is no statistical significance regarding the differences in the F-Score's monthly performance compared to its inverse portfolio in the final three subperiods (2007-2017, 2009-2019, 2011-2021).

Table 8. Univariate analysis of subperiod performance against inverse portfolios

The Magic Formula tested against the Magic Formula Inverse portfolio

	2001-2011			2003-2013			2005-2015		
	Mean	Std. Err.	Median	Mean	Std. Err.	Median	Mean	Std. Err.	Median
MF	0.020895	0.006257	0.021808	0.018410	0.006489	0.021808	0.011842	0.006437	0.014307
MFI	0.003806	0.009430	0.002880	0.012101	0.008109	0.011713	0.001213	0.007581	0.003550
MF-MFI	0.017089	0.006374	0.018928	0.006309	0.004834	0.010095	0.010629	0.004453	0.010757
T-statistic (Z-value)	**2.6810**	-	**(3.088)**	**1.3053**	-	**(1.679)**	**2.3868**	-	**(2.663)**
P-value	**0.0042****	-	**0.0019****	**0.0972**	-	**0.0935**	**0.0093****	-	**0.0074****

	2007-2017			2009-2019			2011-2021		
	Mean	Std. Err.	Median	Mean	Std. Err.	Median	Mean	Std. Err.	Median
MF	0.008027	0.006291	0.009432	0.014257	0.005135	0.011573	0.010729	0.005625	0.006840
MFI	0.001189	0.007535	0.004141	0.008724	0.007172	0.005653	0.009921	0.007397	0.008052
MF-MFI	0.006838	0.004603	0.005291	0.005533	0.004753	0.005920	0.000808	0.005339	-0.001212
T-statistic (Z-value)	**1.4856**	-	**(1.812)**	**1.1640**	-	**(1.736)**	**0.1514**	-	**(0.875)**
P-value	**0.0700**	-	**0.0701**	**0.1234**	-	**0.0827**	**0.4400**	-	**0.3838**

The F-Score tested against the F-Score inverse portfolio

	2001-2011			2003-2013			2005-2015		
	Mean	Std. Err.	Median	Mean	Std. Err.	Median	Mean	Std. Err.	Median
FS	0.024194	0.005856	0.029072	0.018793	0.006288	0.023125	0.010595	0.006108	0.011997
FSI	0.007545	0.009383	0.003334	0.007186	0.008741	0.002558	0.001000	0.008415	-0.010348
FS-FSI	0.023952	0.007063	0.025738	0.011607	0.006182	0.020567	0.009595	0.006218	0.022345
T-statistic (Z-value)	**3.3913**	-	**(3.831)**	**1.8774**	-	**(2.587)**	**1.5431**	-	**(2.464)**
P-value	**0.0005*****	-	**0.0001*****	**0.0315***	-	**0.0094****	**0.0627**	-	**0.0134***

	2007-2017			2009-2019			2011-2021		
	Mean	Std. Err.	Median	Mean	Std. Err.	Median	Mean	Std. Err.	Median
FS	0.003848	0.005820	0.003037	0.008603	0.004940	0.002955	0.006297	0.005402	0.001953
FSI	-0.000682	0.007776	-0.001663	0.005900	0.006913	0.003334	0.007545	0.006829	0.003334
FS-FSI	0.004530	0.005594	0.004700	0.002703	0.005136	-0.000379	-0.001248	0.005598	-0.001381
T-statistic (Z-value)	**0.8098**	-	**(1.336)**	**0.5262**	-	**(1.103)**	**-0.2230**	-	**(0.301)**
P-value	**0.2098**	-	**0.1828**	**0.2999**	-	**0.2719**	**0.5880**	-	**0.7651**

Notes: This table presents the results for the univariate tests, paired sample t-test and Wilcoxon signed rank test, on monthly returns during 10-year rolling subperiods starting April 1st 2001, 2003, 2005, 2007, 2009, and 2011. In each subperiod there are 120 observation per variable. The variable *MF-MFI* represents the difference between the variables *Magic Formula (MF)* and *Magic Formula inverse portfolio (MFI).* The variable *FS-FSI* represents the difference between the variables *F-Score (FS)* and *F-Score inverse portfolio (FSI).* Significance levels are indicated by: * p<0.05; ** p<0.01; *** p<0.001.

The differences between the value investing strategies mean and median monthly and their respective inverse portfolios are full statistically significant during the first subperiod, partially significant during the second and third subperiod, and insignificant during the subsequent. Thus, we find no support to reject our fourth null hypothesis, $H_0 4$.

Our findings suggest that during the first decade the value investing strategies had the ability to predict future returns and separate stocks that will generate above-market from below-market returns. However, we identify the same negative trend in performance development as seen when comparing the portfolios to the market index. The similar results further indicates, that the value investing strategies have lost their ability to separate above-market from below-market returns, sometime during our studied period. Furthermore, our findings suggest that the rejection of our third null hypothesis, stating that over the last 20-years the value investing strategies had the ability to predict future returns, once again, was mainly driven by its exceptional performance in the first decade.

4.3 Robustness tests

The performed robustness tests yielded similar results and support the robustness of our model, as seen in Appendices F & G. Firstly, when we decreased portfolio sizes from a maximum of 30 to a maximum of 15 firms, the tests yielded similar results as presented in the hypotheses testing. Over the full 20-year period, the size adjusted value investing strategies had significant statistical support on beating the market index and their respective inverse portfolios. When dividing the full time period into subperiods, statistical support is only found in earlier subperiods while we found no support in the latter. Secondly, when substituting the one-year holding period for a longer two-year holding period, we found similar statistical evidence as for the original test and the previously mentioned robustness test. The results from the two performed robustness tests imply that our results are not heavily dependent on the number of selected firms in the portfolio or the selected holding period. Hence, we can be more confident in rejecting and not rejecting our null hypotheses and in the robustness of our model.

4.4 Research method analysis

In our study we have followed the methodologies of Greenblatt and Piotroski to the best our ability, and collected financial and accounting data from an external database. Therefore, our method should be relatively easy to duplicate and findings should be similar. Hence, we argue that the reliability of our method is high. However, when constructing the F-Score portfolio we

made some deviations. Firstly, we chose to include the top 50% in the high book-to-market sample instead of only the top 20%. Secondly, we included firms scoring an F-Score of 2 in our classification of low scoring firms. We made these two deviations to ensure that we could construct well diversified portfolios. Nevertheless, these deviations might have a negative impact on validity. Furthermore, there were some missing datapoints in the Capital IQ database leading to firms being excluded from consideration some years. The exclusion of such firms decreases the reliability of our methodology, as studies using other databases might not have excluded them.

Our study was naturally limited to testing the selected strategies which limits the validity of our method. Further impacting the validity of our findings is the conducted univariate analysis. The non-parametric test complemented the parametric test as the parametric test might show differences to be significant too often over longer periods of time. Further, the distribution of monthly returns might have been skewed in our study, causing the normality assumption not to hold, negatively impacting the reliability of the parametric t-test. However, when comparing the distributions of our results, we see that they were not drastically skewed, as mean and medians seldom differed to a large extent. In conclusion, we argue that the combination of both tests strengthens the reliability of our method.

4.5 Summary of results

To summarise our results, we found that both value investing strategies have outperformed the market index over the last 20 years, 2001 – 2021. Therefore, we find support to reject $H_0$1 on a 5% significance level. Secondly, the results over the 10-year periods show a statistical difference in mean and median monthly returns in the earlier subperiods but not in the latter. Thus, we cannot reject $H_0$2. Thirdly, our results show that the value investing strategies have outperformed their inverse portfolios over the full 20-year period, thus we find support to reject $H_0$3 on a 5% significance level. Lastly, the results indicate that the performance of the portfolios against their respective inverse portfolios has decreased over time and that the two original strategies no longer outperform their respective inverse portfolio in the later periods. Therefore, we cannot reject $H_0$4.

Table 9. Summary of rejections of our null hypotheses

	Null hypothesis	Results
$H_0$1	The value investing strategies have not outperformed the market index over the last 20 years	Rejected
$H_0$2	The value investing strategies have not outperformed the market index over a 10-year period regardless of the starting year	Not Rejected
$H_0$3	The value investing strategies have not outperformed their respective inverse portfolios over the last 20 years	Rejected
$H_0$4	The value investing strategies have not outperformed their respective inverse portfolios over a 10-year period regardless of the starting year	Not Rejected

5. Discussion

During our studied period our findings provide evidence in support of the value investing strategies generating superior returns compared to the market. In addition, the original portfolios have outperformed their respective inverse portfolio, further indicating that the value investing strategies had the ability to predict future returns using fundamental analysis. These findings are in line with our first hypothesis stated in section 2.3: that over the last 20 years, value investing strategies have outperformed the market index and their respective inverse portfolios. These findings are also in line with previous research conducted in overlapping geographic areas and time periods (Blackburn & Cakici, 2017; Davydov, Tikkanen & Äijö, 2016). Since the efficient market hypothesis in its semi-strong form states that investors cannot implement fundamental analysis to predict future returns, our findings support previous research in providing evidence against the efficient market hypothesis in its semi-strong form (Fama, 1970).

When dividing the full 20-year time period into 10-year subperiods, our findings indicate that value investing has performed differently over the past two decades. During the first decade of the 21st century the value investing strategies outperformed both the market and their respective inverse portfolio. However, the exceptional performance does not sustain over time as we identify a negative trend in performance. The results suggest that sometime during our studied period, value investing has lost its ability predict future returns using fundamental analysis and generate returns superior to the market. These findings are in line with our second hypothesis:

that value investing's performance over time should be greater towards the beginning of our studied period than towards the end. Our results contradicts with previous research on value investing on the Nordic market (Blackburn & Cakici, 2017; Davydov, Tikkanen & Äijö, 2016). We believe that a reason to our contradicting findings is a result of our subperiod analysis, not conducted by previous research. On the contrary, our findings confirm recent studies conducted in non-Nordic markets and provide supporting evidence for the recent failure of value investing. (Blackburn & Cakici, 2017; Lev & Srivastava, 2019; Maloney & Moskowitz, 2020).

We see several possible explanations to our findings. Firstly, one possible explanation could be that the efficient market hypothesis in its semi-strong form holds, and that fundamental analysis can no longer be employed to predict future returns. Secondly, another possible explanation could be that the characteristics of firms that will generate above-market return have changed during the studied time period. Thus, the selected value investing strategies no longer have the tools to identify stocks that will generate superior returns. Thirdly, a possible explanation may be the slow-down of mean reversion. Lev & Srivastava (2019) show that the phenomenon of mean reversion may have slowed down since the financial crisis in 2008. This is mainly believed to be driven by a fundamental shift in the economy where financial institutions have become more risk-averse when providing financing. This shift causes firms who have recently had lacking performance to have a hard time receiving financing. Therefore, the underperforming companies struggle with financing projects and lack the same opportunity to revert back to the sample mean. At the same time, recent overperformers have easy access to financing, which creates an advantage and possibility to remain an overperformer for an extended period. As the value investing strategies are dependent on underperformers improving their performance and overperformers losing their advantages over time, a slow-down of mean reversion would drastically cripple value investing's ability to generate above-market returns. Fourthly, an explanation could be that accounting deficiencies have had an increasing effect on fundamental analysis, and thus the accounting metrics that value investing is built upon have become less dependable. The facts that accounting deficiencies make balance sheets less comparable and that intangible assets are difficult to accurately valuate have made accounting metrics less dependable when calculating a firm's intrinsic value (Lev & Srivastava, 2019). This explanation would imply that the efficient market hypothesis does not need to hold in its semi-strong form and that an investor can use fundamental analysis to predict future returns. However, the metrics used to calculate intrinsic value are no longer comparable, which leads to systematic misidentification of value stocks. Another explanation could be the

decreasing effect of agency factors on the performance of value investing. Several studies suggest that agency factors and analyst coverage are important drivers to value investing (Piotroski, 2000; Louis & Lakonishok, 2004). However, in today's market where technology have made the average investor more independent, these might have had a decreasing effect.

In addition, when comparing the portfolios' descriptive statistics, we see that the original portfolios seem to target larger companies than their respective inverse portfolios. We do not perform any correlation studies in our thesis and therefore cannot draw any conclusion on firm size impact on returns. However, theory suggests that smaller firms are more prone to risk (Roll, 1981; Fama & French, 1992). The value investing strategies are designed to identify previous underperformers that are believed to be of higher quality and less risky than the sample mean. This implies that the methodologies incorporated by the value investing strategies align with the theory that smaller firms are more prone to risk. A possible explanation for the F-Score targeting larger firms, might be the criteria *CFO > Net Income*, leading to many younger and growing firms being excluded from the sample.

Summarising our findings, we find evidence suggesting that there are market anomalies during the full 20-year period and that the efficient market hypothesis does not need to hold in its semi-strong form. Furthermore, sometime during the last decade, the selected value investing strategies seem to have lost their ability to beat the market and separate stocks that will generate above-market from below-market returns. However, due to the limitation of the univariate analysis, we cannot determine which of the discussed explanations are the main drivers of our findings.

6. Conclusion

The conducted study aims to answer our research question: does value investing still generate superior returns relative to the market and possess the ability to predict future returns? Recent studies, mainly conducted on the US market, suggest that value investing has lost its ability to generate the superior returns it did during its glory days in the 20th century. Our study aims to investigate if the same trends can be observed in the Nordic market since they have not been found in previous research. Therefore, the study has been conducted on the Nordic market during 2001-2021 using the two value investing strategies: Greenblatt's Magic Formula and Piotroski's F-Score. We have compared the performance of the value investing strategies with the MSCI Nordic Countries Net Total Return Index and the original strategies' inverse

portfolios, designed to identify stocks that will generate below-market returns. In order to test the research question, we conducted a univariate analysis, including a parametric paired sample t-test and a non-parametric Wilcoxon signed rank test.

Previous research is not in consensus regarding the predicted performance of value investing in our studied geographic area and time period. Evidence suggests that the efficient market hypothesis holds in its semi-strong form. However, there is also evidence that discrepancies between market value and intrinsic value exist over shorter periods of time making it possible in theory for value investing to hold. However, recent studies provide evidence suggesting that the increased effect of accounting deficiencies combined with the slow-down in mean reversion, driven by financial institutions becoming more risk-averse after the financial crisis in 2008, have negatively impacted value investing.

Our findings suggest that value investing had the ability to generate statistically significant superior returns during the past 20 years. However, when dividing the full period into rolling 10-year subperiods, value investing's superior performance is only significant during the first decade. After which, value investing's above-market returns seem to have diminished. Thus, we identify a negative trend in performance, suggesting that sometime during our studied period value investing has lost its ability to predict future returns and generate returns superior to the market. While the Magic Formula continuously generated returns above the market, the F-Score has generated below-market returns in recent times. Our conclusion, that value investing has lots it ability to predict future returns, is further supported by the strategies' inability to generate returns superior to their respective inverse portfolios.

In relation to previous research and market theories, our findings suggest that during the full time period of the 20 years, there is evidence against the efficient market hypothesis in its semi-strong form, and there have been opportunities for investors to employ fundamental analysis to predict future returns. However, a more thorough analysis of our findings show that the evidence against the efficient market hypothesis has decreased over time, and in the most recent 10-year period, our study provides no evidence against the efficient market hypothesis in its semi-strong form. There are several possible explanations to our findings. Firstly, the efficient market hypothesis in its semi-strong form could hold to be true, and investors can no longer use fundamental analysis to predict future returns. Secondly, the characteristics of firms that will generate above-market returns could have changed, and the selected value investing

strategies no longer have the tools to identify such firms. Thirdly, a possible explanation may be the slow-down of mean reversion leading to the identified undervalued stocks no longer performing the expected above-market returns. Fourthly, accounting deficiencies could have had an increased effect on the accounting metrics that value investing are built upon, leading to systematic misidentification of value stocks. Lastly, the effect of agency factors may have decreased since investors have become more independent. Since no tests on correlation have been conducted in our study, we cannot state which of the possible explanations drive our results. Nonetheless, our findings contribute to previous literature by providing evidence that the value investing strategies, in recent times, have been undergoing a drastic decrease in performance and seem to be struggling in generating above-market returns in the Nordics. Hence, our study contributes to the existing literature by filling the gap that we have found in previous research. Our results are of particular interest to investors looking to beat the market, capital market actors currently using fundamental analysis and for future research within the area.

We acknowledge several limitations to our study, its method and the conclusions that can be drawn from our results and, as a result of them, present the following future research questions. Firstly, the use of a univariate analysis and not a test on correlation limits us from drawing conclusions further than if value investing strategies have beaten the market index during our time period. Therefore, a potential future research area could be to explain why value investing has experienced the negative trend in performance. Lev and Srivastava (2019) discussed explanations such as accounting deficiencies and a slow-down of the mean reversion in the US market. It would be of interest to test if these explanations are also applicable to the Nordic market or if there are other reasons for the recent failure. Furthermore, an interesting research question would be to test if a portfolio adjusted for accounting deficiencies, such as capitalised R&D and fair value of intangible assets, would generate superior returns compared to an unadjusted value investing portfolio. Lastly, in our attempt to study the performance of value investing as a whole, we are limited to investigating the performance of the selected strategies. In our study, Greenblatt's Magic Formula and Piotroski's F-Score have been selected as they are widely popular and relatively easy to follow. An interesting research area would be to test other value investing strategies or if an investor could combine two value investing strategies to generate superior returns.

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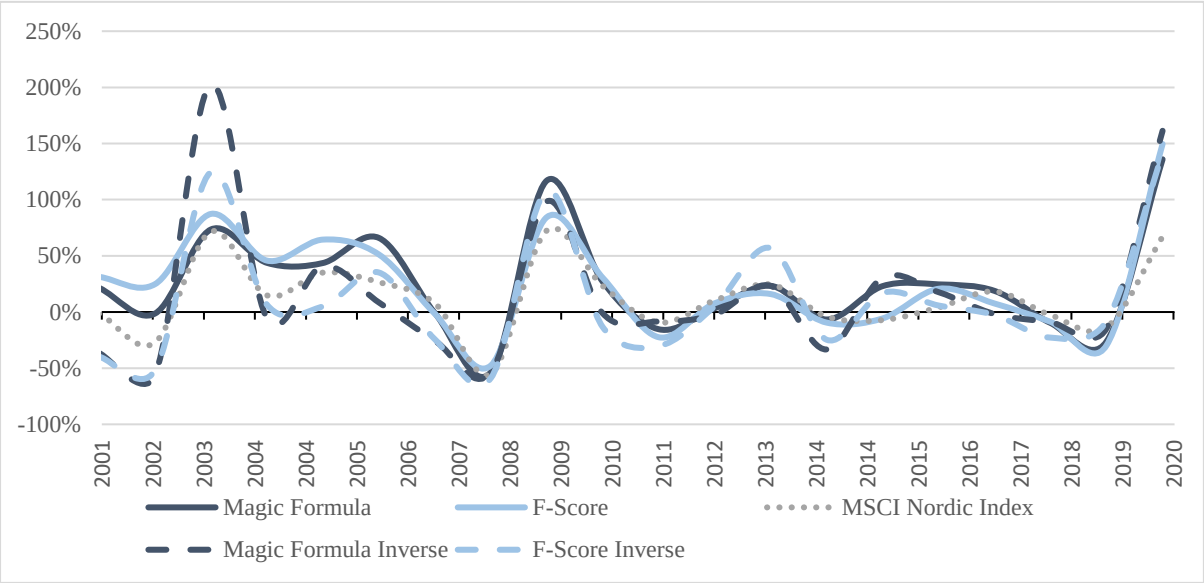
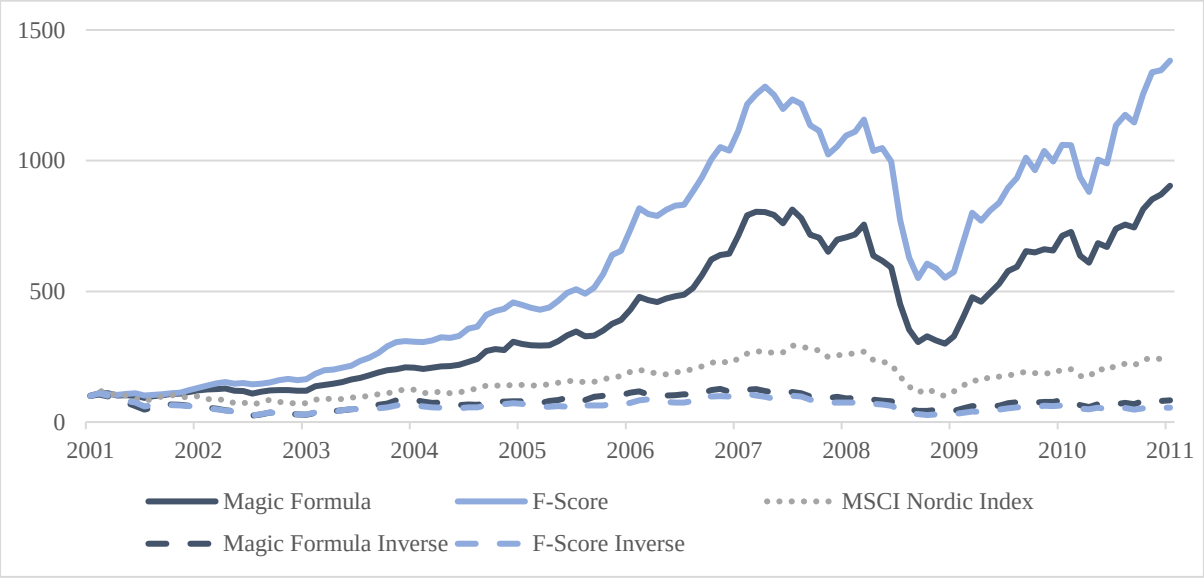
Appendix

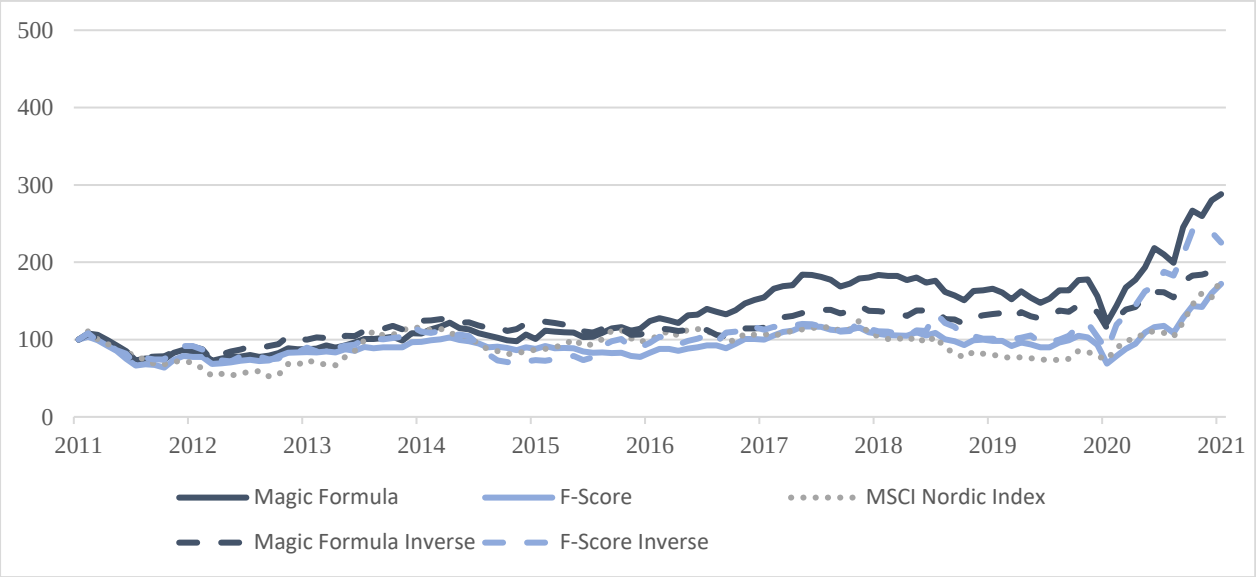
Appendix A: Annual Returns April 1st 2001 – April 1st 2021



Appendix B: Monthly Returns April 1st 2001 – April 1st 2011



Appendix C: Monthly Returns April 1st 2011 – April 1st 2021



Appendix D: Accumulated Annual Returns April 1st 2001 – April 1st 2011

Accumulated annual return	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	CAGR ('01-'11)
MF	100,0	121,5	119,9	208,0	299,1	429,5	712,8	706,6	328,2	712,4	904,1	24,6%
FS	100,0	131,3	163,9	307,0	447,5	736,0	1113,0	1096,2	574,7	1060,0	1382,7	30,0%
MFI	100,0	98,7	72,0	123,5	141,8	191,5	242,3	261,2	117,2	202,3	249,1	9,6%
FSI	100,0	63,5	27,8	84,3	79,7	112,4	122,0	90,9	42,2	83,7	82,7	-1,9%
MSCI	100,0	98,7	72,0	123,5	141,8	191,5	242,3	261,2	117,2	202,3	249,1	9,6%

Appendix E: Accumulated Annual Returns April 1st 2011 – April 1st 2021

Accumulated annual return	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	CAGR ('11-'21)
MF	100,0	84,7	87,5	107,9	100,7	123,9	154,4	183,4	165,5	122,1	288,0	11,2%
FS	100,0	77,6	83,6	97,0	87,8	82,8	99,9	107,5	98,1	68,9	172,0	5,6%
MFI	100,0	90,6	100,0	124,5	119,5	110,9	115,4	136,6	132,9	114,9	191,9	6,7%
FSI	100,0	91,5	89,5	110,3	73,5	95,9	112,9	110,9	101,0	86,2	225,3	8,5%
MSCI	100,0	90,6	100,0	124,5	119,5	110,9	115,4	136,6	132,9	114,9	191,9	6,7%

Appendix F: Robustness test – Portfolio size 15 firms

MF-MSCI	**T-stat**	**P-value**	**Z-value**	**P-value**
01-21	2.4972	0.0066	2.161	0.0307
01-11	2.3929	0.0091	2.506	0.0122
03-13	1.6644	0.0493	1.642	0.1010
05-15	0.8890	0.1879	0.841	0.4005
07-17	1.2644	0.1043	1.210	0.2263
09-19	1.5584	0.0609	1.257	0.2087
11-21	1.0895	0.1391	0.553	0.5806
FS-MSCI	**T-stat**	**P-value**	**Z-value**	**P-value**
01-21	2.3273	0.0104	2.106	0.0352
01-11	3.3188	0.0006	3.402	0.0007
03-13	1.9488	0.0268	2.255	0.0311
05-15	0.6048	0.2732	0.788	0.4305
07-17	-0.1747	0.5692	0.081	0.4353
09-19	-0.6880	0.7536	-0.770	0.4413
11-21	-0.7229	0.7624	-0.817	0.4139
MF-MFI	**T-stat**	**P-value**	**Z-value**	**P-value**
01-21	1.8437	0.0332	2.577	0.0106
01-11	2.5186	0.0066	2.910	0.0036
03-13	0.9264	0.1781	1.165	0.2439
05-15	1.5426	0.0628	1.619	0.1033
07-17	0.6523	0.2577	1.032	0.3021
09-19	0.3365	0.3686	0.820	0.4124
11-21	0.0283	0.4886	0.642	0.5211
FS-FSI	**T-stat**	**P-value**	**Z-value**	**P-value**
01-21	2.2085	0.0141	2.686	0.0072
01-11	3.4119	0.0004	3.816	0.0001
03-13	1.9153	0.0289	2.166	0.0303
05-15	1.8059	0.0367	2.318	0.0205
07-17	0.9327	0.1764	1.095	0.2737
09-19	0.9826	0.1638	1.176	0.2396
11-21	-0.4061	0.6573	-0.013	0.5052

Appendix G: Robustness test – 2-year holding period

MF-MSCI	**T-stat**	**P-value**	**Z-value**	**P-value**
01-21	2.3943	0.0087	2.291	0.0219
01-11	2.1740	0.0158	2.454	0.0138
03-13	1.4941	0.0689	1.710	0.0872
05-15	0.6103	0.2714	0.712	0.4763
07-17	0.9887	0.1624	1.055	0.2912
09-19	1.6280	0.0531	1.247	0.2129
11-21	1.0925	0.1384	0.644	0.5194
FS-MSCI	**T-stat**	**P-value**	**Z-value**	**P-value**
01-21	2.1552	0.0161	2.318	0.0204
01-11	2.5235	0.0065	3.145	0.0017
03-13	1.2800	0.1015	1.862	0.0626
05-15	-0.0433	0.5172	0.513	0.6077
07-17	-0.4765	0.6827	-0.115	0.6083
09-19	-0.4769	0.6828	-0.456	0.6486
11-21	0.0486	0.4806	-0.372	0.7100
MF-MFI	**T-stat**	**P-value**	**Z-value**	**P-value**
01-21	2.0510	0.0207	2.429	0.0151
01-11	1.7423	0.0420	2.142	0.0322
03-13	0.4582	0.3238	0.977	0.3286
05-15	1.8872	0.0308	2.284	0.0224
07-17	1.7408	0.0421	1.865	0.0622
09-19	1.7769	0.0391	1.846	0.0648
11-21	1.1020	0.1362	1.260	0.2078
FS-FSI	**T-stat**	**P-value**	**Z-value**	**P-value**
01-21	2.4806	0.0069	2.962	0.0031
01-11	2.8646	0.0025	3.185	0.0014
03-13	1.1034	0.0975	1.823	0.0683
05-15	1.2515	0.1065	2.030	0.0424
07-17	0.5305	0.2984	1.045	0.2961
09-19	0.6533	0.2574	1.061	0.2889
11-21	0.4775	0.3169	0.893	0.3718