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Does value investing yield abnormal returns?

A study on the performance of value investing strategies and the impact of intangibles

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Abstract

Studies suggest that value investing's performance has deteriorated due to the increasing share of intangibles, which has complicated the process of identifying value stocks. We study the value investing strategies Greenblatt's Magic Formula and Piotroski's F-score in the Nordic region from 2012 to 2022. We investigate whether value investing can yield abnormal returns and if the share of intangible assets affects the performance of the strategies. Our results show that value investing strategies achieve abnormal returns on a statistically significant level, when adjusted for risk using Fama and French's Three-Factor model. However, we do not find statistically significant differences in abnormal return between strategies applied to sets of stocks with different levels of Intangibles-to-Assets ratios.

Tutor: Katerina Hellström

Keywords: Value investing, Piotroski's F-score, Greenblatt's Magic Formula, Efficient Market Hypothesis, Intangible Assets

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1.0 Introduction

The Efficient Market Hypothesis states that the expected return of an investment is proportionate to the risk of the investment. In addition, investors should not, over time, be able to achieve returns greater than the expected return. However, some research opposing the Efficient Market Hypothesis suggests that it, in fact, is possible to outperform the expected return (Basu, 1977; Rosenberg et al., 1985). Return above the investment's expected return is referred to as abnormal return. To measure abnormal return, alpha is used. Alpha is defined as the difference between the actual return achieved and the expected return of the investment, in other words, the return in excess of the return the investor should and expects to receive based on the undertaken risk (Jensen, 1968).

Researchers have historically argued that value investing strategies can yield alpha (Basu, 1977; Rosenberg et al., 1985). Value investing separates a firm's intrinsic value and market value, where accounting information is used as a proxy for intrinsic value (Waldron, 2011). The relationship between intrinsic value and market value is measured with multiples such as Market-value-to-earnings, Market-value-to-Book-value, and Market-value-to-Dividend. Stocks with high intrinsic value in relation to their market value are called value stocks, while stocks with low intrinsic value in relation to their market value are called growth stocks (Dimson et al., 2017). Value investing assumes that the market value will adjust to the intrinsic value over time. Therefore, an investor can achieve positive returns by buying stocks with a low market value relative to their intrinsic value. In other words, value investing aims to exploit short-term market inefficiencies while relying on markets being efficient in the long term (Waldron, 2011).

Value investing strategies have historically been rather successful, both in generating returns above the market and generating returns in excess of the risk-based expected return (Rosenberg et al., 1985). Two well-known value investing strategies are Greenblatt's Magic Formula and Piotroski's F-score. Both strategies use accounting metrics and market value to identify value stocks. Piotroski and Greenblatt claim that their strategies generate returns above the expected return, and thus achieve alpha. Since their publications, several studies have found empirical evidence confirming their claims of generating abnormal returns (Woodley et al., 2011; Hyde, 2018; Walkshäusl, 2020; Davydov et al., 2016; Lambrechts and Roos, 2017; Blackburn and Cakici, 2017).

However, researchers argue that recently, value investing's ability to yield above-market returns and achieve alpha has deteriorated. An explanation presented in previous research suggests that the increasing share of intangible assets in companies could explain this phenomenon. Intangible assets are often expensed, and thus, the book value of intangible assets can appear undervalued. As a result, the market value of intangible intensive firms can seem high in relation to their book value. Therefore, such stocks tend to be misclassified as growth stocks, meaning that they are overvalued, which leads to them not being selected by value investing strategies. Research suggests that this misclassification issue of stocks has contributed to the recent deterioration of the performance of value investing strategies. (Lev and Srivastava, 2019; Arnott et al., 2021)

This thesis aims to investigate value investing strategies during the previous ten years to ascertain whether the strategies achieve alpha. Moreover, the purpose of this thesis is also to investigate if the performance of value investing strategies is affected by firms' share of intangible assets. We will do this by testing the value investing strategies Greenblatt's Magic Formula and Piotroski's F-score (Piotroski, 2000; Greenblatt, 2006). To the best of our knowledge, neither of the investment strategies has been tested based on intangible assets. Our study uses a multivariate time series regression model to analyze the returns of the portfolios.

Research questions

We aim to answer the following research questions:

> **Research question 1:** *Is it possible to achieve abnormal returns by applying Piotroski's F-score investment strategy?*
>
> **Research question 2:** *Is it possible to achieve abnormal returns by applying Greenblatt's Magic Formula investment strategy?*
>
> **Research question 3:** *Does abnormal return achieved by value investing strategies differ between subgroups of stocks with different Intangible-to-Assets ratios?*

This study contributes by testing the performance of value investing strategies in a Nordic and modern setting. We argue that these results are of interest to private and institutional investors using value investing strategies. We also aim to study if the performance of value investing strategies is affected by firms' share of intangible assets. As the share of intangibles and the misclassification issue have been identified as potential issues for value investing strategies, we argue that it is interesting for investors to know if strategy performance is affected by this.

The results show that portfolios constructed according to Greenblatt's Magic Formula and Piotroski's F-score have outperformed their risk-adjusted return and thus achieved alpha. This is true for all the three sets of stocks the strategies have been applied to: the Total Market, the high Intangibles-to-Assets subset, and the low Intangibles-to-Assets subset. While previous research argues that value investing fails in other markets (Lev and Srivastava, 2019), our study contradictorily implies that this is not the case in the Nordic region. Further, our analysis does not find a statistically significant difference in alpha between the strategy applications on the high Intangibles-to-Assets subset and strategy applications on the low Intangibles-to-Assets subset. In addition, the strategies surprisingly choose stocks with a higher share of intangible assets than the market average on a statistically significant level. This is surprising as research suggests that high intangible firms tend to be misclassified as growth stocks. (Arnott et al., 2021; Lev and Srivastava, 2019)

Our study is divided into five different sections. The second section presents previous research related to our thesis. In the third section, our method and sample are explained. In the fourth section, our results are presented and described. Whereas, in the fifth section, our conclusions are discussed.

2.0 Literature review

In this section, we will present literature relevant to our study. We will begin by explaining the Efficient Market Hypothesis. We will then continue with critique against the Efficient Market Hypothesis, the history of value investing, empirical evidence of the tested strategies, and lastly, present literature arguing for the recent failure of value investing.

2.1 The Efficient Market Hypothesis

The Efficient Market Hypothesis is based on the theory that assets are correctly priced considering all available information. When new information is released, asset prices immediately adjust to the new correct price. Future stock price fluctuations follow the Random Walk Phenomenon, meaning that fluctuations come randomly, independently, and are identically distributed as any historical information relevant to the future performance of stocks is instantaneously incorporated into the price. Consequently, there are no arbitrage opportunities. (Fama, 1970)

Fama argued that there are three different levels of market efficiency: weak form, semi-strong form, and strong form. In the weak form, all historical trade data is incorporated into the price of assets. Thus, investors cannot profit from a trading strategy based on analysis of historical data. In the semi-strong form, all public information, such as annual reports and news articles, is also incorporated into the price of assets. In the strong form of market efficiency, all public and private information is incorporated into the price of assets. (Fama, 1970)

The Efficient Market Hypothesis allows securities to have different returns, but returns are proportionate to the risk undertaken by the investor. There are several methods to estimate risk. A famous asset pricing model is the Capital Asset Pricing Model (CAPM), developed by several economists independently, including Sharpe (1964) and Lintner (1965). CAPM implies that an asset's expected return is proportionate to the asset's sensitivity to market volatility, which is the risk factor in the model. Sharpe differentiated between systematic and unsystematic risk, where systematic risk corresponds to general risks affecting all companies in a market. Unsystematic risk is unique to each asset. As diversification can eliminate unsystematic risk, the expected return is solely a function of systematic risk according to CAPM (Sharpe, 1964).

Fama and French (1993) argued that average stock returns were only partly explained by CAPM of Sharpe (1964) and Lintner (1965). Yet, several other variables, such as size, leverage, earnings/price ratio, and Book-to-Market ratio, were correlated with stock price performance. Fama and French therefore introduced a model with three factors; Rm – Rf, SMB, and HML, which captured the effects of sensitivity to market volatility, size, and the book-equity-to-market-equity ratio of stocks. Fama and French argued that these factors were proxies for common risk in stocks (Fama and French, 1993). Fama and French (2015) later expanded their Three-Factor model by adding two factors: profitability and investment. By doing so, Fama and French argued that the model captures two additional effects: that profitable firms perform better than unprofitable firms and that firms with high growth in book equity perform worse than firms with low growth in book equity.

In a recent study, Arnott (2021) argued that the traditional HML factor, as defined by Fama and French (1993), fails to capture intangible assets, which are becoming increasingly relevant. Arnott stated that intangible investments are expensed to a large extent, and that the book values of intangible assets are therefore understated. Thus, Arnott (2021) argued that the HML factor should be adjusted by artificially capitalizing intangible expenses and amortizing them over time. This would increase book values of intangibles to better reflect their true value. Arnott claimed that the adjusted HML factor outperforms the traditional factor (Arnott, 2021).

2.2 Critique against Efficient Market Hypothesis

Some researchers have opposed the idea of markets being efficient. Studies arguing against the Efficient Market Hypothesis have identified several anomalies that are in conflict with the hypothesis. Such anomalies include Calendar effects, the Size effect, Post-earnings-announcement drift, the Overreaction hypothesis, and the Value effect.

General arguments for inefficient markets

Shiller (1984) criticized the notion that markets are efficient. The article points out that the field of market psychology received limited attention after the 1950s, when the idea of expected utility and the Efficient Market Hypothesis became popular in economic and finance literature. Shiller argued that social trends influence people's decisions in various parts of life, even when people attempt to act rationally. As there is no consensus method of valuing stocks, stock prices are particularly likely to be vulnerable to social trends. (Shiller, 1984)

Black (1986) argued that there are inefficient aspects of the financial markets, and he distinguished between noise and information in the market. Black defined noise as the opposite of information and stated that, while noise makes markets imperfect, it is essential for them to function. In every trade, there will be a winning and a losing party. Thus, if all relevant information were known by both parties, few trades would be completed as investors would not want to partake in a deal with a losing outcome. Instead, Black argued that a model should capture differences in investor beliefs, which ultimately come from differences in information. Black further argued that stock prices will revert towards their true value over time, because information investors will see and take advantage of stocks they suspect are priced based on noise. However, stock prices will reflect both noise and information as even information traders cannot be sure that they are actually trading on information rather than noise. (Black, 1986)

Calendar effects

According to researchers such as Rozeff and Kinney (1976), De Bondt and Thaler (1985), and Jaffe et al. (1989), returns are higher in January than in other months. This is known as the January effect. Haug and Hirschey (2006) argued that the January effect is mainly a small-cap phenomenon and that it seriously challenges the efficient market hypothesis. However, recent findings indicate that the effect has decreased and that there is even an inverted January effect in some markets today (Perez, 2017).

Returns have also been found to vary depending on the day of the week. Jaffe and Westerfield (1985) studied the so-called Weekend effect – the pattern that returns tend to be large on Fridays and negative on Mondays. They found that the weekend effect exists in all five countries examined in the study. (Jaffe and Westerfield, 1985)

Size effect

Another phenomenon that questions the Efficient Market Hypothesis is the Size effect. Reinganum (1981) found that small-size firms outperform large-size firms with equivalent betas. He argued that the abnormal return originates from risk factors omitted by CAPM rather than market inefficiencies since the abnormal return is persistent over time. Similarly, Fama and French (1992) argued that small firms have historically had periods of poor earnings, not seen among large firms, which indicates that size is a risk factor.

Another potential explanation is that the effect is an econometric problem. Infrequent trading of small firms causes risk measurement methods, such as CAPM, to underestimate a portfolio's risk, which in turn overestimates a portfolio's risk-adjusted returns (Roll, 1981). However, Reinganum (1982) argued that the size effect is not simply a mismeasurement of risk in terms of beta, as not even the highest beta estimates in his study seem to account for small firms' superior returns. Reinganum further concluded that the small firm effect is a significant anomaly (Reinganum, 1982).

Post-earnings-announcement drift

Bernard and Thomas (1989) studied stock price reactions after quarterly earnings announcements. They examined the two competing explanations for the post-earnings-announcement drift; 1) there is a delayed market response to new information 2) CAPM, used to measure abnormal return, does not capture all risk. Bernard and Thomas found that post-earnings-announcement drift existed for both large and small companies, although the effect was larger for small companies. They concluded that their results "cannot plausibly be reconciled with arguments built on risk mismeasurement" but are consistent with a delayed response to new information. (Bernard and Thomas, 1989)

The Overreaction hypothesis

Another studied anomaly is stock markets' overreaction to recent news. Building upon Kahneman and Tversky's (1982) research, which concluded that most people tend to overreact to dramatic and unexpected news, De Bondt and Thaler (1985) applied these theories to the stock market. Their results support the market-overreaction hypothesis. Portfolios of prior "losers" earned 25% more over three years than prior "winners", although winners were found riskier when applying CAPM on the five years prior to portfolio construction (De Bondt and Thaler, 1985).

The contrarian investment strategy is based on this phenomenon and assumes that the stock market overreacts to news and thus that winning stocks are overvalued and losing stocks are undervalued. By selling well-performing stocks and buying poor-performing stocks, contrarian investors aim to achieve abnormal returns when these stocks return to their true value. Chan (1988) stated that investment strategies based on Price-to-Earnings or Book-to-Market metrics are variants of the contrarian strategy as they also consider past information. Any potential abnormal return thus violates the weakest form of market efficiency. The results found that contrarian investing yields small and "probably economically insignificant" abnormal returns when adjusted for risk using CAPM. He further concluded that there is "no strong evidence" supporting the market overreaction hypothesis. Chan also found that losers' betas tend to increase after a period of poor performance while winners' betas tend to decrease after a period of good performance, why returns should be adjusted with data post portfolio construction, not before, to properly capture risk. (Chan, 1988)

Ball and Kothari (1989) further examined the negative serial correlation of market-wide stock returns, referred to as the overreaction effect by De Bondt and Thaler (1985). Ball and Kothari's study found a negative serial correlation, also when controlling for risk using CAPM. However, they argued that the abnormal return is, although statistically significant, small and economically insignificant. Ball and Kothari stated that the negative serial correlation in relative returns is a result of variation in beta and expected return (Ball and Kothari, 1989).

Further research argued that the overreaction hypothesis can be explained by the size effect. Zarowin (1990) found that winners were twice as large as losers in De Bondt and Thaler's (1985) research. He discovered that losers outperformed winners when adjusted for relative risk. However, Zarowin also found that small losers outperformed large winners in subsequent periods and that small winners outperformed large losers in subsequent periods. Therefore, Zarowin concluded that the negative serial correlation of stocks is, in fact, caused by the Size effect and that his results disprove the market overreaction hypothesis (Zarowin, 1990).

In contrast, Chopra et al. (1992) found support for the overreaction effect. Returns adjusted with CAPM and for size effects showed a significant overreaction, in other words that losers outperform winners, of around 5% annually. The study also showed that the overreaction effect is stronger for small firms than for large firms. The authors stated that this indicates that the overreaction effect is stronger for individuals who are the main holders of small stocks than for institutions who are the main holders of large stocks. (Chopra et al., 1992)

Value effect

In previous research, a relationship between financial accounting metrics, used as proxy for intrinsic value, and the future performance of stocks has been established. The value effect implies that high intrinsic-value-to-market-value stocks outperform low intrinsic-value-to-market stocks (Waldron, 2011). Two examples of studies testing value investing strategies are

Basu (1977) and Rosenberg et al. (1985). Basu (1977) tested an investing strategy where stocks with low Price-to-Earnings ratios were purchased, and Rosenberg et al. (1985) tested an investment strategy where stocks with high Book-Equity-to-Market-Equity were purchased. Both strategies achieved abnormal returns after risk adjustment using CAPM, which conflicts with the Efficient Market Hypothesis.

However, opposing research suggests that the higher return achieved by value stocks must stem from higher risk not captured by CAPM. Fama and French (1992) stated that the historical pattern that high book-equity-to-market-equity stocks tend to have weaker earnings than low book-equity-to-market-equity indicates that the value effect is caused by increased risk. Dimson et al. (2017) also argued that value stocks are risker since those firms are typically financially distressed.

2.3 History of value investing

The field of value investing emerged in the 1920s when Dodd and Graham created an investment strategy based on accounting-based metrics. In *The Intelligent Investor,* Graham argued that technical trading solely based on market price fluctuations is rarely successful. Instead, Graham encouraged both aggressive and passive investors to evaluate stocks based on accounting fundamentals. (Graham, 2003)

The relationship between accounting information and market value was confirmed by Ball and Brown (1968). Their findings showed that accounting information, more specifically the annual income number, can explain movements in stock prices. This implies that an investor with superior knowledge about future earnings is able to achieve abnormal returns. (Ball and Brown, 1968)

Further studies focus on financial ratios in relation to stock price performance. Basu (1977) studied an investment strategy based on the metric Price-to-Earnings (P/E). The results concluded that firms with low P/E ratios outperformed those with high P/E ratios, also when adjusted for risk using CAPM. The findings imply a violation of the Efficient Market Hypothesis and Basu concluded that "Contrary to the growing belief that publicly available information is instantaneously impounded in security prices, there seem to be lags and frictions in the adjustment process" (Basu, 1977). Jaffe et al. (1989) studied Earnings-to-Price (E/P), the inverse of P/E. Like Basu, Jaffe et al. concluded that firms with high E/P ratios outperformed firms with low E/P ratios also when controlled for CAPM (Jaffe et al., 1989).

Rosenberg et al. (1985) also studied accounting-based investment strategies. They tested an investment strategy based on stocks' Book-to-Market ratios. The study found that investing in companies with a high Book-to-Market ratio and shorting companies with a low Book-to-Market ratio led to excess returns, also when adjusting for risk using CAPM (Rosenberg et al., 1985).

Moreover, there are research articles focusing on predicting future accounting items and metrics. These predictions are then used to select stocks to purchase. Ou and Penman (1989) analyzed several financial statement items to predict earnings changes one year into the future. Based on those predictions, they took long and short positions, keeping net investment at zero. The results showed that the strategy led to a 12.5% return. When adjusting for size, Ou and Penman's excess returns amounted to 7.0%. (Ou and Penman, 1989)

In 1998, Setiono and Strong replicated Ou and Penman's study on the UK market. The results showed evidence for abnormal return when using the indirect model of first predicting one-year ahead earnings and using those predictions to predict one-year ahead stock prices. Abnormal return was also achieved when adjusted for size. However, there was only "weak and inconsistent" evidence of abnormal returns when accounting information was used to directly predict one-year ahead stock returns. (Setiono and Strong, 1998)

Skogsvik (2008) studied historical data to predict future medium-term Return-on-Equity (ROE) and the return from trading on those predictions. Investing based on the ROE predictions generated excess returns in relation to the market but not when adjusted for CAPM. This implies that the return is a result of the investment strategy's risk. (Skogsvik, 2008)

2.4 Greenblatt's Magic Formula and Piotroski's F-score

Two important value investing strategies we use in our study are Piotroski's F-score and Greenblatt's Magic Formula.

Piotroski (2000) used several accounting metrics to evaluate companies. The proposed investment strategy divides stocks into winners (high F-score) and losers (low F-score), and the study finds that longing winners and shorting losers led to an annual return of 23%, not adjusting for risk. In short, Piotroski's strategy first screens for value stocks, defined as the quintile of stocks with the highest book-equity-to-market-equity (BM) ratio. Out of these, financially strong stocks, determined through analysis of various accounting metrics, are selected and invested in.

Although Piotroski agreed that high BM firms "tend to be financially distressed", he argued that the high return achieved by his strategy was not a function of additional risk. Piotroski claimed that among the high BM stocks, the healthiest firms yield the highest returns, which contradicts the risk argument posed by Fama and French (1993). Piotroski instead found that his results support the notion of a delayed stock price reaction to historical accounting information (Piotroski, 2000).

Greenblatt is a hedge-fund manager who published *The Little Book that Beats the Market* in 2006. In the book, Greenblatt presented the Magic Formula, which uses two accounting-based measures to evaluate stocks. The two metrics are Return on Capital (Earnings Before Interest and Taxes divided by Capital) and Earnings Yield (Earnings Before Interest and Taxes divided by Enterprise Value). By applying the Magic Formula, Greenblatt achieved annual returns of 30,8% compared to the market's return of 12,3% in the same period. (Greenblatt, 2006)

Greenblatt stated that many strategies claiming to beat the market had been criticized in various aspects. These include the selection of too small and thus untradable stocks as well as the selection of riskier stocks. However, Greenblatt argued that the Magic Formula does not have these problems. The strategy works on both small and large stocks, and it has generated above-market returns at below-market risk. (Greenblatt, 2006)

Empirical evidence of Piotroski's F-score

Piotroski's F-score has been tested in different markets. One example is Woodley et al. (2011), who tested Piotroski's F-score between 1976 to 2008. The authors concluded that during the period 1976 to 1996, high F-score stocks outperformed low F-score stocks. Woodley et al. also discussed risk but concluded that since the high F-score stocks had, on average, lower betas than the low F-score stocks, the higher returns are not simply compensation for higher risk. However, when analyzing the time-period 1997 to 2008, Woodley et al. found that low F-score stocks outperform high F-score stocks. In other words, the results confirm Piotroski's findings for the early time period but find opposing evidence for the later time period. (Woodley et al., 2011)

Hyde (2018) applied Piotroski's F-score to the Australian market. Hyde also compared index-weighted portfolios with equally weighted portfolios. Hyde found that high F-score portfolios, on average, generated higher returns than low F-score portfolios. Another finding was that equally-weighted portfolios outperformed index-weighted portfolios and that all returns were statistically significant. However, when risk adjusting, alphas were not statistically significant except for small-cap portfolios that were equally weighted. Further, Hyde argued that small-cap portfolios were in some cases to be considered uninvestable for institutional investors due to the lack of liquidity in some of the smaller stocks included in those portfolios. (Hyde, 2018)

Furthermore, Walkshäusl (2020) analyzed Piotroski's F-score on international non-US markets. Walkshäusl found that high F-score portfolios, on average, outperformed low F-score portfolios by 10% per year. The findings also showed that the difference in return remained statistically significant when controlling for Size, Book-to-Market, Momentum, Operating Profitability, and Investment. Walkshäusl concluded that his study confirmed the view that fundamental information is gradually, rather than directly, incorporated into securities prices. (Walkshäusl, 2020)

Empirical evidence of Greenblatt's Magic Formula

Davydov et al. (2016) tested Greenblatt's Magic Formula in relation to other traditional value investing strategies on the Finnish market. Other strategies included the use of ratios such as Cash Flow over Price, Earnings over Price, Book-value over Price, and Earnings Yield to identify value stocks. Their findings showed that all tested value investing strategies beat the market index during the tested period. The Magic Formula was not one of the best performing strategies initially. However, the authors modified the Magic Formula by adding a Cash Flow over Price metric, which turned out to be the highest performing value-based strategy tested during bull periods. The findings were also benchmarked using the Carhart Four-Factor model. Davydov et al. concluded that the abnormal returns were not simply compensation for higher risk levels as alpha was achieved. (Davydov et al., 2016)

Lambrechts and Roos (2017) studied the performance of Greenblatt's Magic Formula on the South African market. However, the authors used a modified version of The Magic Formula, which screened stocks based on their Price-to-Earnings and Return-on-Assets ratios. The findings showed that the investment strategy yielded average annual returns of up to 18.26%, which was higher than the market for the same time period. Several models were also used to adjust for risk, and statistically significant alphas were found. (Lambrechts and Roos, 2017)

Blackburn and Cakici (2017) tested Greenblatt's Magic Formula in four different regions: Japan, Asia, North America, and Europe. The study found abnormal returns for Europe, risk adjusting using the Fama and French-Carhart model, but not for any other region. The authors then replaced EBIT with Gross Profit in both the Earnings Yield and Return on Capital metrics. The new strategies were benchmarked against CAPM, Fama and French Three-Factor model, Fama and French Five-Factor model, and Fama and French-Carhart model and achieved statistically significant alphas for most regions. (Blackburn and Cakici, 2017)

2.5 Recent failure of value investing

Maloney and Moskovitz (2020) discussed the recent failure of value investing. The authors stated that value stocks, defined as stocks with high Book-to-Market ratios, were significantly outperformed by growth stocks between 2017 and 2020. They explored whether decreased interest rates could be an explanation for this. However, the authors did not find robust evidence for a relationship between interest rate variables and the value premium. (Maloney and Moskovitz, 2020)

Lev and Srivastava (2019) stated that since around 2007, research shows that value investing no longer yields abnormal returns. According to the article, investments in intangible assets have increased and were, as of 2017, twice as high as investments in tangible assets in the US, which has resulted in two effects. First, companies with large direct expensing of intangibles might falsely appear as overvalued on the capital markets as book values will be lower and understate the value of the companies' intangible assets. Secondly, the authors argued that companies with increasing investments in intangibles have an overstated P/E ratio due to the immediate expensing of intangible assets, which leads to understated earnings. (Lev and Srivastava, 2019)

To adjust for this, Lev and Srivastava (2019) artificially capitalized expensed intangibles and then amortized the investments over time. Consequently, the adjusted book values better reflected their actual value and increased comparability between companies with a high share of intangible assets and companies with a low share of intangible assets. The authors found that investing in stocks with the lowest Market-to-Book ratios, the inverse of Book-to-Market, using unadjusted book values, yielded negative returns between 2010 to 2018. However, using the adjusted Market-to-Book ratios yielded positive returns. Nevertheless, the authors concluded that the market still outperformed value stocks after 2007. The authors further found that value stocks that became misclassified as growth stocks during the studied period had substantially higher investments in intangible assets. (Lev and Srivastava, 2019)

Arnott et al. (2021) also argued that the increased share of intangibles is a possible explanation for the recent failure of value investing. Similar to Lev and Srivastava (2019), the study argues that due to the book value of intangibles not representing its actual value, companies with a high share of intangible assets appear to have a low Book-to-Market ratio. Consequently, stocks that would be classified as value stocks if intangibles were capitalized, are falsely classified as growth stocks. According to the article, this misclassification is one explanation for why value investing strategies have failed over the last few years. When intangible assets are artificially capitalized, value stocks still perform worse than growth stocks after 2007. However, with the adjustments, growth stocks outperform value stocks by 3,2% instead of 5,4% annually without the adjustments (Arnott et al., 2021).

Arnott et al. also found that intangibles are unevenly distributed between high and low Book-to-Market companies, as defined by Fama and French. Low Book-to-Market firms, called growth companies by Arnott, had substantially higher Intangibles-to-Book-Equity ratios than high Book-to-Market firms, called value companies. In 2020, value companies had capitalized intangibles equal to 20% of book equity, while growth stocks had more than 100%. Also, low Book-to-Market firms had more intangible-related expenses that, if capitalized, would increase the book value more than for high Book-to-Market firms. In short, there are two aspects of the uneven distribution of intangibles. First, growth stocks typically have a larger share of capitalized intangibles. Secondly, growth stocks also expense intangibles to a greater extent, which means that capitalization has a larger impact on their book values, which in turn implies that capitalization will reclassify traditional growth stocks as value stocks after adjustment. (Arnott et al., 2021)

3.0 Method

This study aims to analyze the performance of value investing strategies in a modern context. In addition, considering recent studies indicating that a high share of intangible assets is one explanation for the recent failure of value investing, this study also aims to test if value investing strategies' performance varies depending on if stocks have a high or low share of intangibles.

Hypotheses:

> **Hypothesis 1:** *It is not possible to achieve abnormal returns by applying Piotroski's F-score investment strategy*
>
> **Hypothesis 2:** *It is not possible to achieve abnormal returns by applying Greenblatt's Magic Formula investment strategy*
>
> **Hypothesis 3:** *Abnormal return using value investing strategies does not differ between subgroups of stocks with different Intangible-to-Assets ratios.*

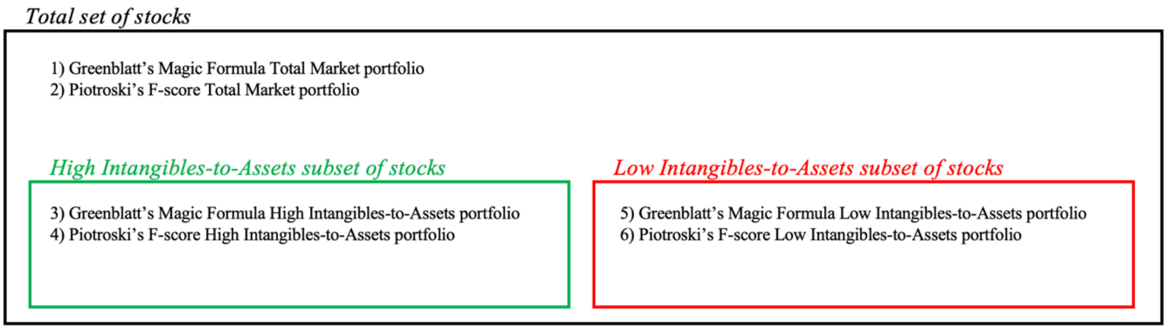
3.1 Research design

To test the hypotheses mentioned above, we have applied Piotroski's F-score and Greenblatt's Magic Formula to a set of stocks. First, to analyze the effect of intangibles on strategy performance, the stocks were divided into two subsets based on their share of intangible assets in relation to total assets according to their latest financial report. 50% of stocks with the highest Intangibles-to-Assets ratio constitute the first subset (High Intangibles-to-Assets), and the bottom 50% of stocks constitute the second subset (Low Intangibles-to-Assets). As a result, we have three sets of stocks: 1 set including all stocks and two subsets including half of the stocks each. These sets are named *Total set of stocks*, *High Intangibles-to-Assets subset of stocks*, and *Low Intangibles-to-Assets subset of stocks* in figure 1.

We use the metric Intangibles-to-Assets as Arnott et al. (2021) argue that the firms with the highest Intangibles-to-Assets ratios are also the firms that immediately expense the most intangible investments, and thus have understated book values. Hence, the metric divides the set of stocks into one group where the book value reflects the true value and another where the book value is understated.

Both Piotroski's F-score strategy and Greenblatt's Magic Formula strategy are applied to each of the three sets of stocks. In total, six portfolios are created: two portfolios able to choose between all stocks (portfolios 1 and 2 in figure 1), two portfolios able to choose between stocks in the High Intangibles-to-Assets subset of stocks (portfolios 3 and 4), and two portfolios able to choose between stocks in the Low Intangibles-to-Assets subset of stocks (portfolio 5 and 6)

Figure 1. Overview of subsets and portfolios



After creation, subsets and portfolios are updated on a quarterly basis to ensure that the latest available information is considered. First, a new cut-off point for the Intangibles-to-Assets subsets (the Intangibles-to-Assets median) is calculated, and stocks that have changed subsets during the past period are reclassified. When subsets are updated, all stocks receive a new rank and score based on Greenblatt's and Piotroski's investment strategies, and new selections of stocks are made to the portfolio. The selected stocks constitute the portfolios until the next update.

The return of each portfolio is the equally weighted return of the stocks in the portfolio. The return of each stock is calculated as the dividend-adjusted stock price at the end of the period in relation to the stock price at the beginning of the period. Stocks that qualify for the portfolio for multiple consecutive quarters are rebalanced during the update process.

Portfolio sizes vary between the two strategies. The Greenblatt portfolios consist of the 30 best ranking stocks each period, in line with Greenblatt's suggestions. Piotroski's strategy, however, suggests purchasing stocks based on F-scores and not relative comparison of stocks' metrics. Therefore, the F-score portfolios consist of all stocks scoring a high F-score (8 or 9) for a particular period, which means that the portfolio size varies throughout the investment period. (Greenblatt, 2006; Piotroski, 2000)

To avoid look-ahead bias, purchasing of stocks is delayed two months and one day. For example, portfolios purchased on the 1st of March 2012 are based on accounting information for the calendar year ending 31st of December 2011. These portfolios are held for three months until the 1st of June 2012, when portfolios are updated based on accounting data for the latest twelve months ending 31st of March 2012.

Finally, we conduct a time-series regression on all portfolio returns, where the number of observations is the 40 quarters the portfolios are held. Jensen's alpha is used to determine the abnormal return, using the independent variables from Fama and French's Three-Factor model as risk factors. Time-series regressions are also conducted on the returns of the low Intangibles-to-Assets portfolios subtracted by the returns of the high Intangibles-to-Assets portfolios, to analyze the impact of intangibles. For Greenblatt's Magic Formula, this corresponds to the returns of portfolio 5 subtracted by the returns of portfolio 3 as seen in figure 1, and for Piotroski's F-score, this corresponds to the returns of portfolio 6 subtracted by the returns of portfolio 4 as seen in figure 1.

3.2 Sample and delimitations

This study focuses on the Nordic financial markets, in other words, Sweden, Norway, Denmark, Finland, and Iceland combined. We include multiple markets to ensure that there are enough firms in each Intangible-to-Assets subset. From these markets, we have initially included all listed firms incorporated in any of the five countries over the studied period.

The study analyzes a 10-year investment period starting 1st of March 2012 and ending 1st of March 2022. This time frame is motivated by the fact that the analysis aims to investigate a recent time period, as research suggests that the strategies have failed in recent years.

The data used in this study has been gathered from Bloomberg and Capital IQ. Capital IQ is a well-established database used both in research and the finance sector. Capital IQ has been used to obtain accounting data, market capitalizations, and dividend-adjusted stock prices. Bloomberg has been used to obtain intrabank offered rates, which are used as proxies for risk-free rates.

There are 1777 Danish, Swedish, Norwegian, Finnish, and Icelandic firms listed during the studied period. Of these, 163 financial and utility companies were then filtered out, based on Greenblatt's suggestions (Greenblatt, 2006), reducing the sample to 1614 companies. Then, 172 companies with a market capitalization below 50 million SEK were excluded. Finally, five more companies with missing stock price data were also excluded, bringing the final number of companies in the sample to 1437. Stock price data and market capitalization vary for companies throughout the studied period. The number of firms in the final sample in figure 2 corresponds to all firms that, at one point in time during the studied period, have had both available stock data and a market capitalization above 50 million SEK. As companies have been listed and delisted throughout the studied period, the number of evaluated stocks at any point in time is lower than the final sample size. The fewest number of stocks being assessed is 463 for the purchase dates in March, June, and December of 2012, and the greatest number of evaluated stocks is 1298 for the purchase date in December 2021.

Figure 2. Sample size

Sample	Stocks in sample
Initial sample from Capital IQ	1777
Excluded financial and utility companies	-163
Excluded companies with <50 mSEK market capitalization	-172
Excluded due to missing stock data	-5
Stocks in the final sample	1437

3.3 Model

To test the hypotheses, we will use a multivariate regression model. We risk adjust the returns of the portfolios (the dependent variable) by using the factors in Fama and French Three-Factor Model as the independent variables. The independent variables are excess market return, SMB, and HML, which proxy for risk. To test abnormal returns, we analyze the intercept α, in line with Jensen's (1968) method. If the null hypotheses hold, the intercept α will not significantly deviate from 0. The regression model used is:

$$r_t - rf_t = \alpha + \beta_1 * (rm_t - rf_t) + \beta_2 * SMB_t + \beta_3 * HML_t + \epsilon_t$$

Dependent variable 1: Portfolio risk premium

The dependent variable 1 is defined as the portfolio risk premium, in other words, the portfolio returns for period t (r_t) subtracted by the risk-free rate for period t (rf_t), as Jensen (1968) suggests. This dependent variable is used to determine alpha for the six portfolios. In each of the 40 holding periods, the portfolio returns are the quarterly, equally-weighted returns of the stocks selected through Greenblatt's Magic Formula or Piotroski's F-score. Dependent variable 1 is calculated as:

$$r_t - rf_t = Portfolio\ return_t - Riskfree\ rate_t$$

Dependent variable 2: Portfolio comparison

To analyze how the performance of the strategies is affected depending on which Intangibles-to-Assets subset they are applied to, the model is slightly modified. The independent variables are identical, but the dependent variable ($r_t - rf_t$) is replaced by the return of the low Intangibles-to-Assets portfolio subtracted by the return of the high Intangibles-to-Assets portfolio ($\mathrm{r}_{Low,t} - \mathrm{r}_{High,t}$). This dependent variable is used to conduct two more regressions in addition to the six portfolio regressions. The first regression compares the low Intangibles-to-Assets portfolio with the high Intangibles-to-Assets portfolio of Greenblatt's Magic Formula, and the second regression compares the low Intangibles-to-Assets portfolio with the high Intangibles-to-Assets portfolio of Piotroski's F-score. Dependent variable 2 is calculated as the difference between dependent variable 1 of the two portfolios compared. The calculations of how dependent variable 2 is derived are shown below, where row (3) is dependent variable 2 used in the regressions:

(1)	$\mathrm{r}_{Low,t} - rf_t$
(2)	$\mathrm{r}_{High,t} - rf_t$
(1) – (2)	$(\mathrm{r}_{Low,t} - rf_t) - (\mathrm{r}_{High,t} - rf_t)$
(3)	$\mathrm{r}_{Low,t} - \mathrm{r}_{High,t}$

Independent variable 1: Excess market return

The independent variable excess market return is derived from the weighted return of the market for period *t* subtracted by the risk-free rate for period *t*. Previous research has found that the market return tends to exceed the risk-free rate (Fama and French, 1993). Therefore, we expect the independent variable Excess market return to be positive. The variable is calculated as:

$$(rm_t - rf_t)$$

Independent variable 2: SMB

The independent variable SMB is derived from the difference in return between small companies and large companies during period *t*. As previous research has identified a size effect (Reinganum, 1981; Fama and French, 1992), where small firms tend to have higher returns than large firms, we expect the SMB factor to be positive. The variable is calculated as:

$$SMB_t = r_{small,t} - r_{large,t}$$

Independent variable 3: HML

The independent variable HML is derived from the difference in return between companies with a high Common-Equity-to-Market-Capitalization ratio and companies with a low Common-Equity-to-Market-Capitalization ratio during period *t*. Historically, research has found support for the HML factor being positive (Fama and French, 1993). However, recent studies suggest that the HML factor has been negative in recent times (Arnott, 2021). Since recent studies find the factor to be negative, our expectation is that the factor will be negative. The factor is calculated as:

$$HML_t = r_{high,t} - r_{low,t}$$

3.4 Greenblatt's Magic Formula

Greenblatt's Magic Formula is a value investing strategy based on two accounting-based metrics, Return on Capital (RoC) and Earnings Yield (EY). First, Greenblatt excluded financial and utility companies and companies with too small market capitalization. Therefore, we excluded financial and utility companies and all companies with a market capitalization below 50 million SEK. The second step is to calculate RoC and EY for all stocks. These metrics are defined as:

1. Return on Capital (RoC)

$$Return\ on\ Capital = \frac{Earnings\ Before\ Interest\ and\ Taxes}{Net\ working\ capital + Net\ fixed\ assets}$$

Where:

$Net\ working\ capital = Current\ assets - Current\ liabilities$

$Net\ fixed\ assets = Asset - Current\ Assets - Intangibles\ and\ Goodwill$

2. Earnings Yield (EY)

$$Earnings\ Yield = \frac{Earnings\ Before\ Interest\ and\ Taxes}{Enterprise\ Value}$$

Where:

$Enterprise\ Value = Market\ Capitalization + Net\ debt$

The strategy suggests investing in stocks considering both the RoC and EY metrics. Each stock is given a rank of 1 to *n* in both metrics, where *n* is the number of stocks in the sample. Each firm will thus have two separate rankings, one RoC rank, and one EY rank. The firm with the highest (lowest) RoC receives rank 1 (*n*) in the RoC ranking, and the firm with the highest (lowest) EY receives rank 1 (*n*) in the EY ranking. (Greenblatt, 2006)

Lastly, the sum of the two ranks is calculated for each firm. The strategy suggests that an investor should choose the stocks with the lowest combined ranks. Greenblatt (2006) used portfolios with around 30 stocks and suggested holding at least 20 stocks in a portfolio. We constructed portfolios of 30 stocks. Furthermore, Greenblatt (2006) held selected stocks for one-year periods, either selling a few days before or after the one-year holding date depending on if the stock generated a profit or loss to benefit from taxation regulation. As accounting information is typically released on a quarterly basis in the studied region, we deemed it more appropriate to update portfolios quarterly. We argue that this is a more realistic approach as investors arguably would use the latest available information.

3.5 Piotroski's F-score

Piotroski's F-score strategy (2000) is based on nine metrics aimed at capturing three aspects of a firm's financial condition: Profitability, Financial leverage, and Operating Efficiency. With the purpose of keeping the sample the same for both strategies, we have excluded financial and utility companies and companies with a market capitalization below 50 million SEK as we did in Greenblatt's Magic Formula.

First, all stocks are ranked based on their respective Book-Equity-to-Market-Equity ratio. Piotroski's then selected the quintile, or the 20%, of stocks with the highest Book-Equity-to-Market-Equity ratio. We deviated slightly and selected 50% of the stocks with the highest Book-Equity-to-Market-Equity ratio to ensure enough stocks in our sample to construct diversified portfolios. Each stock is then evaluated on nine metrics, receiving 1 point if it meets a threshold requirement and 0 points if it does not. The stock receives 1 point for each of the following conditions that are satisfied:

1. ROA: Net Income before extraordinary items > 0
2. CFO: Cash flow from operations > 0
3. ΔROA: $\mathrm{ROA_t} - \mathrm{ROA_{t-1}} > 0$
4. ACCRUALS: $\mathrm{CFO_t} - \mathrm{ROA_t} > 0$

5. ΔLEVER: $\frac{\text{Longterm debt}}{\text{average total assets}_{t-1}}$ - $\frac{\text{Longterm debt}}{\text{average total assets}_{t}} > 0$

6. ΔLIQUID: $\frac{\text{Current assets}}{\text{Current liabilities}_{t}} - \frac{\text{Current assets}}{\text{Current liabilities}_{t-1}} > 0$

7. EQ_OFFER: The stock did not issue any common stock during the fiscal year

8. ΔMARGIN: $\text{Gross margin}_{t} - \text{Gross margin}_{t-1} > 0$

9. ΔTURN: $\frac{\text{Sales}_{t}}{\text{Total assets}_{t-1}} - \frac{\text{Sales}_{t-1}}{\text{Total assets}_{t-2}} > 0$

After assigning scores, each stock has an F-score between 0 and 9. Piotroski's (2000) investment strategy is based on investing in stocks with high F-scores, which Piotroski's study defines as stocks with an F-score of 8 or 9. In Piotroski's (2000) study, returns were analyzed on a one-year and two-year holding period. As accounting information is typically released on a quarterly basis in the studied region, we deemed it more appropriate to update portfolios quarterly. We argue that this is a more realistic approach as investors arguably would use the latest available information.

3.6 Fama and French Three-Factor model

Fama and French (1993) presented the procedure used to calculate the excess market return, SMB, and HML factors in their study. We have not been able to find Fama and French Factors for all the studied markets in the Nordic region. Therefore, we have calculated the factors based on our data set, which is described below:

Fama and French (1993) divided stocks listed on NYSE, Amex, and Nasdaq into portfolios based on book common equity divided by market equity (BE/ME) and size. Firms with negative book common equity were excluded when creating size and BE/ME portfolios. Naturally, stocks used in our study are listed on the Nordic stock exchanges instead of the American ones.

First, Fama and French (1993) calculated the median firm size (shares times share price) on the main stock exchanges. All stocks are then classified as either small or big depending on whether they are smaller or bigger than the median size of the main stock exchange. As main stock exchange firms are typically larger than firms listed on other exchanges, more stocks are classified as small, but most of the value lies in the portfolios with big companies. We derived the median size by combining the main stock exchanges from each country in the Nordics and calculating the median size.

Secondly, Fama and French (1993) classify stocks according to their BE/ME ratio as high (top 30% of companies), medium (middle 40% of companies), or low (bottom 30% of companies).

Then, six portfolios are created based on the size and BE/ME classification: Small/Large, Small/Medium, Small/High, Big/Low, Big/Medium, and Big/High. For example, Big/Low includes the stocks with big size and low BE/ME. Fama and French (1993) update portfolios with new break-off points for size and BE/ME annually. To match the quarterly updates of our investment strategies, we also update our Fama and French portfolios quarterly.

To calculate the small minus big factor (SMB), Fama and French (1993) take the simple average of the small portfolios (Small/Low, Small/Medium, Small/High) subtracted by the simple average of the big portfolios (Big/Low, Big/Medium, Big/High). To calculate the high minus low factor (HML), the simple average of the high portfolios (Small/High, Big/High) is subtracted by the simple average of the low portfolios (Small/Low, Big/Low). To calculate the excess market return factor (Rm - Rf), market return (Rm) is subtracted by the risk-free rate (Rf). Rm is calculated as the value-weighted return for all stocks, both the stocks in the size and BE/ME portfolios and the negative book equity stocks are included. Rf is the interest rate of a one-month Treasury bill. We have replicated this, but we use the weighted three-month Interbank Offered Rates for the five markets instead of the one-month Treasury bill as a proxy for the risk-free rate. The reason for this is the lack of liquidity in Nordic treasury bills potentially causing mismeasurements.

4.0 Results

In this section, we present the findings of our study and answer our research questions. The result from our study implies that specific value investing strategies still yield risk-adjusted abnormal returns. We find no robust evidence for differences in risk-adjusted return for investment strategies applied to different Intangibles-to-Assets subsets.

4.1 Descriptive statistics

In figure 3, descriptive statistics of the dependent and independent variables are presented. The dependent variables consist of 6 portfolios, which differ on the investment strategy and the subset of stocks used. Also, the two comparisons of high and low Intangibles-to-Assets portfolios are included.

As seen in the dependent variables in figure 3, the average quarterly returns of the portfolios are quite consistent at 5,5-6,5 %. There also seems to be high volatility in returns, with a standard deviation of quarterly returns being larger than 7% for all portfolios. Focusing on investment strategies, Greenblatt's Magic formula has slightly lower average and median returns compared to Piotroski's F-score, comparing similar subsets. Focusing on the different subsets, low intangible-to-assets portfolios seem to have a slightly higher average and median return than high Intangibles-to-Assets portfolios for both investment strategies. Greenblatt's Magic Formula's cumulative returns throughout the whole investment period of 10 years were 754%, 625%, and 829% for the Total Market portfolio, high Intangibles-to-Assets portfolio, and low Intangibles-to-Assets portfolio, respectively. This corresponds to compounded annual growth rates of 22,40% for the Total Market portfolio, 20,12% for the high Intangibles-to-Assets portfolio, and 23,56% for the low Intangibles-to-Assets portfolio. For F-score, the cumulative returns throughout the whole investment period of 10 years were 954%, 838%, and 1003% for the Total Market portfolio, high Intangibles-to-Assets portfolio, and low Intangibles-to-Assets portfolio, respectively. This corresponds to compounded annual growth rates of 25,31% for the Total Market portfolio, 23,69% for the high Intangibles-to-Assets portfolio, and 25,93% for the low Intangibles-to-Assets portfolio. Cumulative returns are presented in appendices 4 and 6.

The descriptive statistics of the independent variables are generally in line with our expectations. The average SMB and HML factors are 0,06% and -0,42% with a standard deviation of 4,52% and 5,71% respectively. The excess market return factor, Rm-Rf, is 3,22% on average with 6,13% in standard deviation. SMB is positive as expected, HML is negative as expected, and Rm – Rf is positive as expected. SMB is however surprisingly small, indicating that the size effect is not that large in the Nordic region during the studied period.

Figure 3. Descriptive statistics of dependent and independent variables

Obs = 40	*Mean*	*Std. Dev.*	*Min*	*25th*	*median*	*75th*	*max*
Dependent variables							
FS Total Market	0,0631	0,0757	-0,1064	0,0094	0,0758	0,1061	0,2050
FS high Intangibles-to-Assets	0,0603	0,0801	-0,1108	0,0051	0,0677	0,1082	0,2135
FS low Intangibles-to-Assets	0,0651	0,0875	-0,1291	-0,0016	0,0737	0,1236	0,2319
FS low minus high Intangibles-to-Assets	0,0049	0,0678	-0,0855	-0,0392	-0,0051	0,0229	0,1988
MF Total Market	0,0575	0,0772	-0,0874	-0,0009	0,0474	0,1111	0,2765
MF high Intangibles-to-Assets	0,0531	0,0752	-0,0662	-0,0077	0,0356	0,1018	0,2242
MF low Intangibles-to-Assets	0,0604	0,0852	-0,1135	0,0036	0,0363	0,1353	0,2134
MF low minus high Intangibles-to-Assets	0,0073	0,0563	-0,0992	-0,0395	0,0096	0,0481	0,1357
Independet variables							
SMB	0,0006	0,0452	-0,0865	-0,0323	0,0027	0,0287	0,1261
HML	-0,0042	0,0571	-0,1644	-0,0402	-0,0024	0,0224	0,1343
Rm – Rf	0,0322	0,0613	-0,1039	0,0068	0,0465	0,0766	0,1598

Note: This table presents returns on a quarterly basis for a Portfolio constructed using Piotroski's F-score. SMB represents the independent variable Small – Big, HML represents the independent variable High – Low, and RM – RF represents Market return – Risk-Free Rate. "FS" refers to Piotroski's F-Score, and "MF" refers to Greenblatt's Magic Formula.

4.2 Hypothesis testing

Hypothesis 1: *It is not possible to achieve abnormal returns by applying Piotroski's F-score investment strategy*

As seen in figure 4, the intercept (α) of the regression conducted on the returns of the Total Market application of Piotroski's F-score and the Fama and French Three-Factor model is 3,02%. This alpha corresponds to quarterly return figures. In other words, using Piotroski's F-score to construct portfolios between March 2012 to March 2022 leads to an abnormal and unexplained return of 3% quarterly when risk adjusting using the Fama and French Three-Factor model. Furthermore, the α is statistically significant, with a P-value of 0,0008. With 95% statistical significance, α is larger than 1,35%. The hypothesis can therefore be rejected on a statistically significant level.

Figure 4 also displays that all three independent variables, the risk factors, are statistically significant. All factors, therefore, contribute to explaining the returns of the portfolios with more than 95% probability.

Figure 4. Piotroski's F-score applied to the Total Market

Piotroski's F-score Total market

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,0302	0,0082	3,6702	0,0008	0,0135	0,0470
SMB	0,4915	0,1780	2,7613	0,0090	0,1305	0,8525
HML	0,3142	0,1364	2,3031	0,0272	0,0375	0,5908
RM - RF	1,0489	0,1247	8,4091	0,0000	0,7959	1,3019

Notes: This table presents the alpha, the level of statistical significance (P-value), and the confidence interval of the alpha on a quarterly basis. Intercept represents the alpha, SMB represents the independent variable Small – Big, HML represents the independent variable High – Low, and RM – RF represents Market return – Risk-Free Rate.

Hypothesis 2: *It is not possible to achieve abnormal returns by applying Greenblatt's Magic Formula investment strategy*

Hypothesis 2 focused on Greenblatt's Magic Formula and whether it is possible to achieve risk-adjusted excess return with the strategy. Figure 5 shows that the intercept (α) of the regression conducted on quarterly returns is 2,63%. The Total Market application of Greenblatt's Magic Formula has therefore generated excess return not explained by the risk factors in Fama and French Three-Factor model. The α are statistically significant, with a P-value of 0,0049. The hypothesis can therefore be rejected on a statistically significant level.

Figure 5 also displays that all three independent variables, the risk factors, are statistically significant. All factors, therefore, contribute to explaining the returns of the portfolios with more than 95% probability.

Figure 5. Greenblatt's Magic Formula applied to the Total Market

Greenblatt's Magic Formula Total market

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,0263	0,0088	2,9994	0,0049	0,0085	0,0441
SMB	0,8822	0,1893	4,6605	0,0000	0,4983	1,2661
HML	0,3387	0,1451	2,3348	0,0252	0,0445	0,6329
RM - RF	0,9959	0,1326	7,5077	0,0000	0,7269	1,2649

Notes: This table presents the alpha, the level of statistical significance (P-value), and the confidence interval of the alpha on a quarterly basis. Intercept represents the alpha, SMB represents the independent variable Small – Big, HML represents the independent variable High – Low, and RM – RF represents Market return – Risk-Free Rate.

Hypothesis 3: *Abnormal return using value investing strategies does not differ between subgroups of stocks with different Intangible-to-Assets ratios.*

First, in Figure 6, both the high and low Intangible-to-Assets portfolios of Piotroski's F-score achieve significant α when adjusted for Fama and French's three risk factors. F-score applied to high and low Intangible-to-Assets subsets generates quarterly α of 2,14% and 3,91%, respectively, over the 10-year investment period, implying a potential difference. However, the regression of the portfolio returns of the low Intangible-to-Assets portfolio subtracted by the high Intangible-to-Assets portfolio shows that the intercept has a P-value of 0,1264, which is not significant on conventional levels. This means that the α in the low Intangible-to-Assets portfolio is not, on a statistically significant level, different from the α of the high Intangible-to-Assets portfolio. These results do not support the rejection of the hypothesis.

Figure 6 also displays that all three independent variables are statistically significant for the high Intangibles-to-Assets portfolio. For the low Intangibles-to-Assets portfolio, all variables except SMB are statistically significant. This implies that the SMB factor does not contribute to explaining the returns of the portfolio. None of the independent variables, except the Rm – Rf factor, is statistically significant in the regression conducted on the difference in returns between the high and low Intangibles-to-Assets portfolios. In other words, comparing the two portfolios, we can only conclude that the low Intangibles-to-Assets portfolio is less sensitive to market volatility than the high Intangibles-to-Assets portfolio.

Secondly, Figure 7 displays the high and low Intangibles-to-Assets portfolios using Greenblatt's Magic Formula. Both the high and low Intangibles-to-Assets portfolios constructed using Greenblatt's Magic Formula achieve a positive quarterly α over the 10-year period when benchmarked against Fama and French Three-Factor model. Magic Formula applied to high and low Intangibles-to-Assets subsets generates α of 1,97% and 2,33%, respectively. Regression of the low Intangibles-to-Assets portfolio returns subtracted by the returns of the high Intangibles-to-Assets portfolio shows that the intercept has a P-value of 0,7176. The α of the low and high Intangibles-to-Assets portfolio is therefore not different on a statistically significant level. These results do not support the rejection of the hypothesis.

Figure 7 also shows that the HML factor is not statistically significant for the high Intangibles-to-Assets portfolio. However, SMB and Rm - Rf are statistically significant and have explanatory power. All independent variables are statistically significant for the low Intangibles-to-Assets portfolio. In the regression conducted on the difference between the high and low Intangibles-to-Assets portfolios, only the HML factor is statistically significant.

To summarize, when observing the regressions of the difference in returns of the high and low Intangibles-to-Assets portfolios, neither of the two strategies showed a statistically significant difference in α between the two portfolios when tested. The results for Piotroski's F-score indicated that the α of the low Intangibles-to-Assets portfolio was higher than the α of the high Intangibles-to-Assets portfolio. However, when tested, the noted difference was not statistically significant.

Figure 6. Piotroski's F-score applied on stock subsets

Piotroski's F-score High Intangibles

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,0214	0,0067	3,1981	0,0029	0,0078	0,0350
SMB	0,6774	0,1448	4,6775	0,0000	0,3837	0,9711
HML	0,2266	0,1110	2,0417	0,0486	0,0015	0,4517
RM - RF	1,2208	0,1015	12,0293	0,0000	1,0150	1,4266

Piotroski's F-score Low Intangibles

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,0391	0,0128	3,0498	0,0043	0,0131	0,0651
SMB	0,3477	0,2771	1,2549	0,2176	-0,2142	0,9096
HML	0,5154	0,2123	2,4270	0,0204	0,0847	0,9460
RM - RF	0,8668	0,1942	4,4642	0,0001	0,4730	1,2606

Piotroski's F-score Low Intangibles subtracted by High Intangibles

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,0177	0,0113	1,5647	0,1264	-0,0052	0,0406
SMB	-0,3297	0,2441	-1,3508	0,1852	-0,8247	0,1653
HML	0,2888	0,1870	1,5438	0,1314	-0,0906	0,6681
RM - RF	-0,3540	0,1710	-2,0697	0,0457	-0,7008	-0,0071

Notes: This table presents the alpha, the level of statistical significance (P-value), and the confidence interval of the alpha on a quarterly basis for portfolios constructed using Piotroski's F-score. The upper section presents the portfolio consisting of stocks with high share intangible assets, and the lower section presents the portfolio consisting of low share intangible assets. Intercept represents the alpha, SMB represents the independent variable Small – Big, HML represents the independent variable High – Low, and RM – RF represents Market return – Risk-Free Rate.

Figure 7. Greenblatt's Magic Formula applied on stock subsets

Greenblatt's Magic Formula High Intangibles

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,0197	0,0081	2,4232	0,0205	0,0032	0,0361
SMB	0,6257	0,1754	3,5676	0,0010	0,2700	0,9814
HML	0,1065	0,1344	0,7920	0,4336	-0,1662	0,3791
RM - RF	1,0374	0,1229	8,4410	0,0000	0,7882	1,2867

Greenblatt's Magic Formula Low Intangibles

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,0233	0,0087	2,6923	0,0107	0,0057	0,0408
SMB	0,8014	0,1869	4,2882	0,0001	0,4224	1,1804
HML	0,4587	0,1432	3,2028	0,0028	0,1683	0,7492
RM - RF	1,1944	0,1310	9,1206	0,0000	0,9288	1,4600

Greenblatt's Magic Formula Low Intangibles subtracted by High Intangibles

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,0036	0,0099	0,3646	0,7176	-0,0165	0,0237
SMB	0,1757	0,2143	0,8196	0,4178	-0,2590	0,6104
HML	0,3523	0,1643	2,1444	0,0388	0,0191	0,6854
RM - RF	0,1570	0,1502	1,0451	0,3029	-0,1476	0,4616

Notes: This table presents the alpha, the level of statistical significance (P-value), and the confidence interval of the alpha on a quarterly basis for portfolios constructed using Greenblatt's Magic Formula. The upper section presents the portfolio consisting of stocks with high share intangible assets, and the lower section presents the portfolio consisting of low share intangible assets. Intercept represents the alpha, SMB represents the independent variable Small – Big, HML represents the independent variable High – Low, and RM – RF represents Market return – Risk-Free Rate.

4.3 Summary of results

To summarize, our results show that both Piotroski's F-score and Greenblatt's Magic Formula have outperformed their expected return based on the Fama and French Three-Factor model. Hence, abnormal return or alpha can be achieved using both investment strategies. Therefore, our study supports a rejection of Hypothesis 1 and Hypothesis 2. Moreover, our findings show no robust evidence that there is a difference in performance between high and low Intangibles-to-Assets portfolios for any of the strategies. Hence, our study does not support a rejection of hypothesis 3.

Figure 8. The result's implication for hypotheses

Hypothesis 1:	*It is not possible to achieve abnormal returns by applying Piotroski's F-score investment strategy*	Rejected
Hypothesis 2:	*It is not possible to achieve abnormal returns by applying Greenblatt's Magic Formula investment strategy*	Rejected
Hypothesis 3:	*Abnormal return using value investing strategies does not differ between subgroups of stocks with different Intangible-to-Assets ratios.*	Supported

5.0 Discussion and Conclusion

In this section, we will discuss the results of our study and its possible implications. We will also present our conclusions from the results and discuss areas for further research related to our study.

5.1 Performance of value investing strategies

The application of Piotroski's F-score and Greenblatt's Magic Formula generates significant returns. The strategies yield annual returns of 25,31% and 22,40%, respectively, over the studied 10-year period from March 2012 to March 2022. Controlled for the risk factors size, value, and sensitivity to market volatility, both strategies generate statistically significant alphas, indicating that the strategies are able to achieve abnormal returns in excess of the estimated risk of the investments. Recent research suggests that value investing no longer yields abnormal returns (Lev and Srivastava, 2019; Arnott et al., 2021). Our study contradicts this, as abnormal returns are achieved. We have identified a few possible explanations as to why our study contradicts previous findings.

Contradictory findings of abnormal return and misclassification issue

Some studies suggest that the increasing investment in intangible assets negatively affects the performance of value investing. The traditional metrics to identify value stocks misclassify stocks with high Intangibles-to-Assets as growth stocks, while these stocks would, in fact, be considered value stocks if the full value of their intangible assets were reflected in their book value. Due to this misclassification issue, the value investing strategies primarily select stocks with low Intangibles-to-Assets and reject stocks with high Intangibles-to-Assets as their market value appears overvalued compared to their book value (Lev and Srivastava, 2019; Arnott et al., 2021). However, as shown in appendix 1, we contradictorily find that Greenblatt's Magic Formula and Piotroski's F-score both select stocks with higher Intangibles-to-Assets than the market average. Therefore, the issue of misclassification does not seem to apply to these specific strategies on the Nordic market.

A possible explanation to why we do not seem to have a misclassification issue could be that the issue simply does not exist. In other words, that the value of intangible assets is accurately reflected in the book value and arguably even better reflected than tangible assets as the strategies favor companies with high Intangibles-to-Assets, as seen in appendix 1. However, as seen in appendix 2, firms with high Intangibles-to-Assets have lower Book-to-Market ratios than firms with low Intangibles-to-Assets on a statistically significant level. This shows that there is a relationship between high Intangibles and low Book-to-Market, implying that high Intangibles-to-Assets firms are indeed classified as growth stocks rather than value stocks when measured on Book-to-Market. These findings in appendix 2 are consistent with the findings of Arnott et al. (2021) and rejects the argument that the misclassification issue does not exist.

While the misclassification issue seems to exist, the tested strategies select stocks with high intangibles and yet achieve abnormal returns, which is contradictory. A potential explanation is that the value investing strategies Greenblatt's Magic Formula and Piotroski's F-score consider and capture other effects than the value effect. Evidently, Greenblatt (2006) uses RoC, and Piotroski (2000) uses nine accounting criteria, which do not measure the relationship between market value and book value that the value effect is based upon. If these metrics can identify stocks that perform well in the future, it would explain the abnormal returns we find.

Also, in the case of Piotroski's F-score, firms in the top 50% of high Book-to-Market ratios have been included, compared to the 20% that Piotroski (2000) suggested. This could lead to firms with a higher share of intangible assets and perhaps an understated Book-to-Market ratio being included in the portfolios.

The risk adjustment model's potential impact on results

Furthermore, there is a possibility that the risk adjustment model used, Fama and French Three-Factor model, omits risk factors able to explain the abnormal return. More complex models include factors like profitability and investment (Fama and French, 2015), which are not adjusted for in this study. If such additional factors are proxies for risk and can explain the excess return, the actual alphas of the value investing strategies tested might be smaller than what our tests indicate or be statistically indistinguishable from 0.

There is also a possibility that Fama and French Three-Factor model does not sufficiently capture the risk factors it intends to capture. Arnott argues that the HML factor used by Fama and French is also affected by the increasing share of intangibles. Our study uses the factors Fama and French (1993) present in their article. Figure 3 shows that the HML factor is -0,42%, with a standard deviation of 5,71% on a quarterly basis. For our period, HML is therefore negative, close to 0, and rather volatile. This implies that the value effect no longer exists or is not captured in Fama and French's HML factor. If the value effect no longer exists, this would contradict our findings of generating abnormal returns using value investing strategies. However, as discussed previously, these strategies might capture other effects than the value effect, which could explain the abnormal return. If the value effect exists, perhaps the proxy proposed by Fama and French is becoming outdated and fails to capture it. An adjusted factor, like the adjusted HML suggested by Arnott (2021), would be able to explain the returns to a greater extent.

5.2 The impact of intangibles on strategy performance

To analyze intangibles' effect on value investing strategies, we apply the tested value investing strategies to the subset of stocks with different Intangibles-to-Assets ratios. While the application of F-score indicated a difference in performance with a 3,91% alpha for the low Intangibles-to-Assets application compared to the alpha of 2,14% in the high Intangibles-to-Assets application, there was no statistically significant difference in alpha when tested. Whether increased intangibles in companies are causing stocks to be misclassified or not, this effect does not seem to affect the performance of value investing strategies in the Nordic region.

Confirmed intangibles and value relationship does not seem to affect returns

As shown in appendix 2, firms with low Intangibles-to-Assets have higher Book-to-Market ratios than firms with high Intangibles-to-Assets on a statistically significant level, which is in line with the findings of Arnott et al. (2021). Historically, High Book-to-Market firms have achieved higher risk-adjusted returns than low Book-to-Market firms (Lev and Srivastava, 2017). Nevertheless, our study finds no statistically significant difference in risk-adjusted returns between high Intangibles-to-Assets portfolios and low Intangibles-to-Assets portfolios. Instead, all portfolios achieve statistically significant alpha on similar levels.

We see two possible explanations as to why our portfolios perform similarly despite low Intangibles-to-Assets stocks having higher Book-to-Market ratios. First, as Arnott et al. (2021) argue, firms with high intangible assets have lower unadjusted Book-to-Market ratios due to intangibles being expensed rather than capitalized (Arnott et al., 2021). However, if all intangible investments are artificially capitalized, the adjusted Book-to-Market ratio might not differ between high Intangibles-to-Assets firms and low Intangibles-to-Assets firms. In this case, we would not expect to find differences in risk-adjusted returns as the subsets would consist of stocks with similar intrinsic value to market value ratios.

Secondly, as mentioned earlier, another possible explanation is that Greenblatt's Magic Formula and Piotroski's F-score consider additional metrics other than the classic Book-to-Market ratio. This might explain why the difference in Book-to-Market between the samples of companies with high/low Intangibles-to-Assets does not lead to any significant difference between the performance of the portfolios, as the strategies in fact capture other effects than the value effect.

5.3 Data and Method discussion

In terms of reliability, data has been collected from the databases Bloomberg and Capital IQ, databases which are used both in research and by finance professionals to retrieve financial information on companies. The wide use of the database in professional settings implies its reliability, and therefore, we argue that the data that this study is based upon is reliable.

Furthermore, we have followed the strategies Greenblatt's Magic Formula and Piotroski's F-score. However, we have applied a few minor modifications. We updated portfolios quarterly instead of annually, to use all available information. Moreover, we included 50% of the firms with the highest Book-to-Market, rather than the top 20% as the original F-score strategy states (Piotroski, 2000). This adjustment was applied to make sure enough companies were included in the sample to ensure diversified portfolios. These changes might affect the results, which could reduce validity in terms of testing the specific strategies. However, we argue that these changes are minor and do not change the nature and purpose of the strategies.

5.4 Conclusion

To conclude, this study's findings support that the tested value investing strategies can generate abnormal returns when controlled for size, value, and market volatility sensitivity risk factors. When applied to subsets of stocks based on different Intangibles-to-Assets ratios, strategies still achieve significant alphas in all tested scenarios. We cannot find evidence for strategies applied on low Intangibles-to-Assets stocks performing better or worse than when applied on high Intangibles-to-Assets stocks.

Moreover, the results show that 1) firms with high Intangibles-to-Assets tend to have lower Book-to-Market ratios and that 2) both Greenblatt's Magic Formula and Piotroski's F-score select stocks with higher Intangibles-to-Assets than the market average. This is contradictory, as these strategies are regarded as value investing strategies and should arguably select stocks with high Book-to-Market ratios. This, together with the fact that controlling for value does not explain the returns, indicates that these strategies consider other characteristics apart from value.

If our results are true in general and continue to hold true, there are practical implications for investors. First, historical accounting information can be used to achieve abnormal returns, emphasizing the relevance of financial statements to investors. Secondly, widespread and relatively simplistic models are sufficient to achieve abnormal returns, which means that these strategies can easily be adopted by the general investor.

We excluded firms with a market capitalization below 50 million SEK to avoid firms with illiquid trading. However, some firms may still be too small and lack liquidity for investors managing large investments, for example, institutional investors. On the other hand, the strategies are quite simplistic and, therefore, relevant for private investors with smaller investment stakes.

5.5 Future research

We have acknowledged several interesting possibilities for future research within the specific area. Firstly, in our study, portfolios are updated on a quarterly basis in contrast to the original strategies that update portfolios annually (Greenblatt, 2006; Piotroski, 2000). As our results contradict previous research suggesting that value investing no longer yields excess return (Lev and Srivastava, 2019; Arnott et al., 2021), it would be interesting to test if the frequency of portfolio updates affects the return and the alpha achieved. Even though financial information is not released more frequently than quarterly, capital markets information is updated daily.

Moreover, our study is limited to Greenblatt's Magic Formula and Piotroski's F-score. To further study the performance of value investing, it would be interesting to test other value investing strategies. This would add more evidence and robustness to the debate of whether value investing strategies still yield abnormal returns. Further, our study is limited to the Nordic markets. Testing value investing strategies and if they are impacted by intangible assets on other markets would add more evidence and robustness to our findings.

Furthermore, the risk adjustment in our study is limited to Fama and French Three-Factor model. As we have discussed, there is a possibility that the Fama and French Three-Factor model might omit relevant risk factors. Testing the strategies against other factors might lead to a greater understanding and explanation of the returns achieved.

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7.0 Appendices

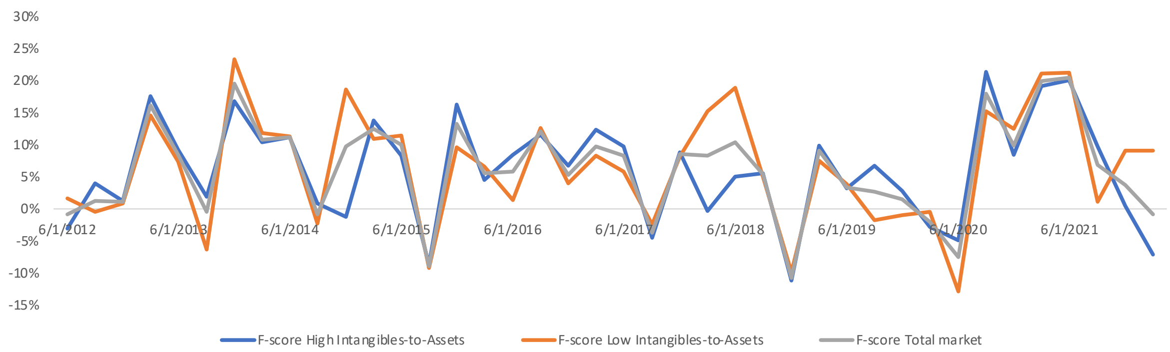
Appendix 1. t-test of the market's mean Intangibles-to-Assets ratio minus Total Market portfolio's mean Intangibles-to-Assets ratio

Test	*Mean*	*Std. err.*	*std. dev.*	*Lower 95%*	*Upper 95%*	*P-value (two-sided)*
Magic Formula	- 0,0822	0,0055	0,0350	- 0,0934	- 0,0710	0,0000
F-score	- 0,0289	0,0081	0,0515	- 0,0454	- 0,0125	0,0010

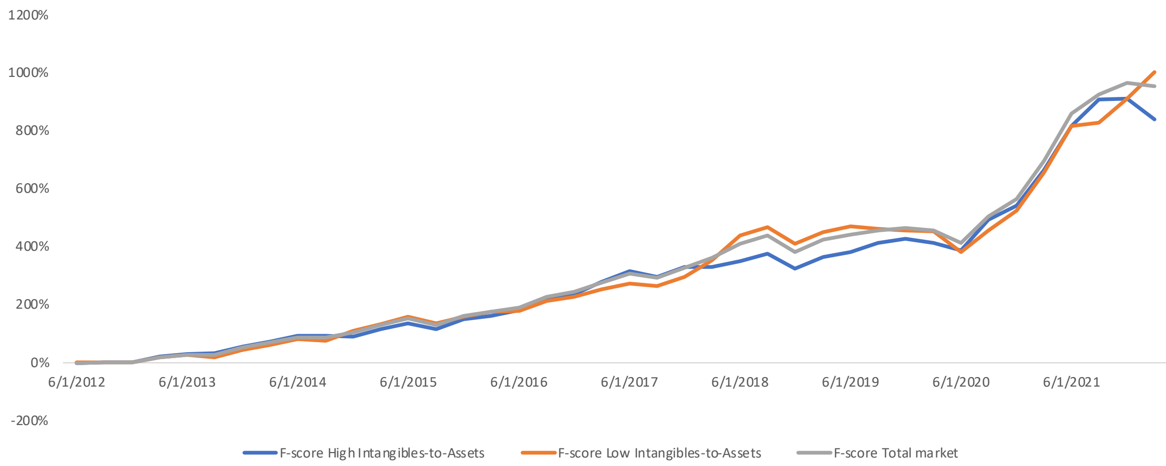
Appendix 2. t-test of High Intangibles-to-Assets subset's median Book-to-Market ratio subtracted by Low Intangibles-to-assets subset's median Book-to-Market ratio

Test	*Mean*	*Std. err.*	*std. dev.*	*Lower 95%*	*Upper 95%*	*P-value*
High minus low	- 0,0502	0,0081	0,0513	- 0,0666	- 0,0338	0,0000

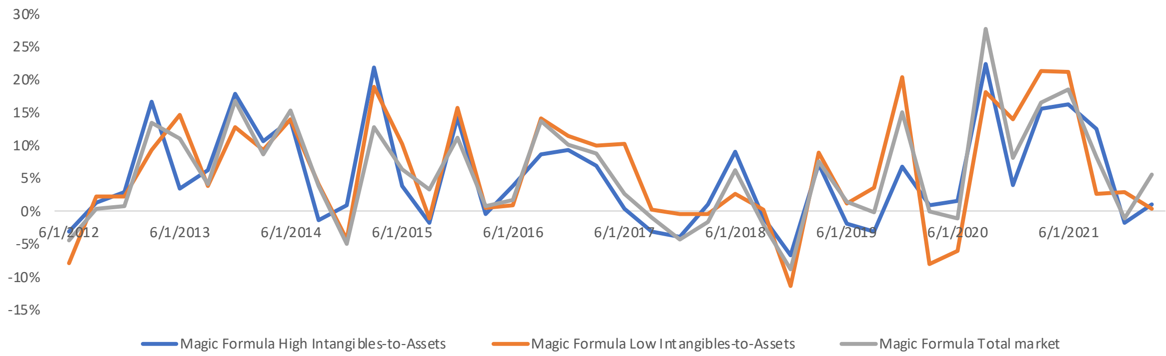
Appendix 3. F-score portfolios' quarterly returns



Appendix 4. F-score portfolios' cumulative returns



Appendix 5. Magic formula portfolios' quarterly returns



Appendix 6. Magic formula portfolios' cumulative returns