Magic Formula has its magic and Momentum has its moments.

-A study on magic formula and momentum on the Swedish stock market.

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Abstract

The study examines how the investment strategy Magic Formula (Greenblatt, 2006) has performed on the Swedish stock market. It is also investigated how the performance is affected when the strategy is combined with momentum. Since the expected pension for future generations is expected to decline it is important to have private savings with as high return as possible. Therefore, it is relevant to investigate if simple investment strategies can be used to achieve higher return. The purpose with this study is to find out if the investment strategies Magic Formula and Magic Formula combined with momentum has had a higher risk-adjusted return than the benchmark index OMX30. The results show that both Magic Formula and Magic Formula combined with momentum yielded a higher risk-adjusted return than the benchmark index. The results also showed that Magic Formula yielded an even better risk-adjusted return when it was combined with momentum. We wish that the result that was found in this study will give inspiration to private investors in order to achieve a higher return in their savings and a more satisfactory pension in the future.

Key words

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1. Introduction

1.2 Background

The expected pension is expected to decline more for each future generation and to be able to have a decent pension in the future we have to save more by our self. The reason for this decline is that we are expected to live longer but not work longer (DI, 2018). For people who lack the time and knowledge to manage their savings by themselves, the alternative is usually to use either a regular savings account, which at present hardly gives any interest at all, or save in funds (Affärsvärlden, n.d.). When comparing the most popular forms of saving, which is savings in regular bank accounts, savings in bonds and savings in stocks, it is the stock market that have given the highest return historically (Bodie et.al 2018).

The Efficient Market Hypothesis (EMH) is a well-known economic theory which, in simple terms, means that the stock market is always correctly priced. The reason for this is that all available information about the companies is reflected in the stock prices and that the information about the companies comes randomly. According to the theory, stock prices react directly to new information, and because it is random, it also means that the movements of stock prices is random. If the stock prices move randomly, there is no reason to try to over-perform the market since the stock's price is determined by random information (Bodie et al. 2018). Patell & Wolfson (1984) showed that most of the stock prices reacted to information that companies released about dividends and profits within 10 minutes, which supports the theory that the market is effective. According to EMH, the best strategy is to be passive as an investor, as there is no point in trying to outperform the market. Therefore, it is best to buy broad index funds with as low fees as possible and get the return that the market provides (Bodie et al. 2018).

However, the theory about efficient markets is not accepted by all and there are several quantitative investment strategies that has been tested in different markets that has yield an excess return compared to the market. This is usually referred to as market anomalies because in an efficient market it should not be possible to get an excess return on the market (Brown et al. 2014). A quantitative investment strategy is a portfolio that is put together with companies

that has the highest rank based on one or more predetermined parameters. Banz (1981) tested how the size of the companies affected the return. In his study, he found that companies with low market capitalization outperformed large companies on the New York Stock Exchange (NYSE) between 1936- 1977. There are also several studies that shows that strategies using market to book value has over-performed the market. Lakonishok et.al. (1993) showed that a portfolio that invested in companies with the highest book to market value performed better than the companies with the lowest book to market value. Brown et al. (2014) showed in their study that this applies regardless of whether it was small companies or large companies that was measured.

One well-known quantitative investment strategy is Magic Formula (MF), which also has proved to be a good investment strategy and has over-performed the market in several studies done on different markets. MF was introduced by Joel Greenblatt in his book *"a little book that beats the market"* (2006). The strategy is to buy a portfolio with the top ranked stocks according to two predetermined parameters (Return on Capital Employed and Earning Yield). In Greenblatt's studies (2006, 2010), the strategy over-performed its benchmark index S&P 500 by a good margin. In addition to Greenblatt's surveys, the strategy has been tested in different studies in several different markets.

The momentum effect has also been studied frequently. Jagadeesh and Titman (2001) found in their study that good or poor development in the stock prices for the past 3-12 months often continued over time. They found that the momentum effect in stocks that have gone up in the past 3-12 months tended to continue to yield an excess return for up to one year. In their study, the decile of stocks was bought that had yielded the highest returns over the past six months and was hold for six months, after which the portfolio was rebalanced. The strategy yielded a much higher return between the years 1965-1998 than the market, and it turned out that the return was higher for each decile in the ranking, which further supported the thesis that better momentum gives better returns in the short term.

Small stocks, firms with high book-to-market value, Magic Formula and momentum has historically yielded a higher return than the market. However, it is of great importance to evaluate what risk the strategies have taken on compared to the market. A higher return may be because the strategy perform better than the market, but it may also be because a higher

risk has been taken on. Therefore, different risk measures will also be used in the thesis to measure the performance on a risk-adjusted basis.

Previous studies thus show that these simple investment strategies can be used by private investors to achieve a higher return than the market. We intend through our study test how the strategies Magic Formula and Magic Formula combined with momentum have performed historically by measuring the return and the risk on the Swedish stock exchange. If the study shows that it has been profitable strategies it could provide inspiration for private investors to save in such a strategy for their pension to get a higher return compared to savings in bank accounts or funds.

1.3 Purpose

Since the expected general pension for future generations is expected to decline significantly, it is important to have private savings with as high a return as possible. Therefore, it is relevant to investigate if simple investment strategies can be used to achieve higher returns compared to an investment in an index fund. The purpose with this study is to find out if the investment strategies Magic Formula (MF) and Magic Formula combined with momentum (MFM) has had a higher risk-adjusted return than the benchmark index OMX30.

1.4 Problem definition

October. This is one of the most dangerous months to speculate in stocks. The others are July, January, April, November, May, March, June, December, August, February.

- Mark Twain

In Sweden, most of the people have their savings in regular savings accounts or in funds. Those who save in funds make it about 90 percent in actively managed funds (Affärsvärlden, 2018). This is an ineffective strategy since most active managers underperform the index and those who over-perform the markets do it by luck (Fama, 2013). Therefore, a good strategy for the average saver would be to buy index funds with low fees instead of an active managed fund.

Since it is easy and in general cheap to buy stocks today, funds may not be the best investment strategy. Instead of having your savings in a fund there could be a good alternative to buy your own portfolio of stocks. In this study we will examine whether there are alternatives to funds for a private investor to get a good risk-adjusted return on their savings. Earlier studies have shown that it is possible to yield a higher return has than the market. An example of such a strategy is Joel Greenblatt's (2006) Magic Formula (MF) and momentum (Jagadeesh & Titman, 2001). This study will test whether MF and MFM are better investment strategies compared to savings in an index fund. If it is, MF and MFM could be a good option for those who want to achieve a higher return and consequently a higher pension.

1.5 Research questions

To answer the purpose, the study will examine how Magic Formula (MF) has performed on a risk-adjusted basis is Sweden compared to the benchmark index OMX30.

How has Magic Formula performed historically compared to the benchmark index OMX30?

To further investigate whether there are ways to achieve a higher risk-adjusted return then the benchmark index OMX30, the study will examine how momentum has affected the risk-adjusted return on the Magic Formula strategy.

How does the momentum affect the risk-adjusted return on Magic formula?

1.6 Limitations

We have chosen to delimit the study into the Swedish stock market, where we will use all available stocks on the Stockholm stock exchange (our universe). The portfolios constructed will then be compared with the benchmark index OMX30. To make this study as strong and reliable as possible, the MF and MFM strategies will be tested between the years 2004-2018 since the market has years of big declines and big increases during that period. Because of the extensive time period the result will hopefully be robust and not affected by short-term fluctuations.

2. Theory

2.1 Magic Formula

Joel Greenblatt (2006) wrote the book *"The little book that beats the market"* in which he presented the investment strategy Magic Formula. In 2010 he wrote the sequel to the book "*the little book that still beats the market*". Greenblatt (2006) introduces his theory that aims to find good companies when they are available at a good price. He defines good companies as companies that has an efficient management of the capital employed and these companies should be bought when they are cheap. To find the right companies to invest in, Greenblatt uses two key metrics. The first is *Return on Capital Employed* (ROCE) and that is the key figure that Greenblatt uses as a measure of the company's quality. The second is *Earnings Yield* (EY) which measure if the company is expensive or cheap. To construct a MF-portfolio all the companies in your universe are ranked by these two variables. Greenblatt claims that this strategy is not *magical* and that all the companies in a MF portfolio will not overperform the market. But on average, he claims that this is the best way to find good companies at a good price which will give a portfolio that overperform the market. The ranking that takes place when constructing the portfolios are based on historical financial measures (Greenblatt, 2010).

2.1.1 Indicators for Magic Formula

Greenblatt (2010) uses two key ratios to find good companies at a favorable price. The key metrics are based on figures collected from the income statement on a 12-month rolling basis and balance sheet measurements from the latest available reports. One of the key metrics is ROCE.

$$Return\ on\ Capital\ Employed = \frac{Earnings\ Before\ Interests\ and\ Taxes}{(Net\ Working\ Capital + Net\ Fixed\ Assets)}$$

Figure 1.

In order to obtain ROCE the operating profit (EBIT) is divided by the company's capital employed (figure 1). This valuation method differs slightly from the more traditional return measures as Return on Assets (ROA) and return on equity. Greenblatt (2010) claims that ROCE is a better indication of the future and argues that the capital employed is the most

important thing since it is needed to finance the current business. That is, *finance accounts receivable*, *inventories* and hold a base with *tangible assets* for ongoing operations. However, ROCE does not take into account the intangible assets such as ROA does. But since there is no cost for the ongoing finance of the intangible assets, Greenblatt prefer ROCE. EBIT is used instead of the net profit for the year because it is not affected by the company's capital structure or if the tax rate varies between countries and periods. This makes it possible to compare the company between countries regardless of capital structure or tax rate. In summary, the purpose of ROCE is to compare the operating result with the capital needed to generate the current result (Greenblatt 2010).

The other key metric in MF is *Earnings Yield* (EY). The key metric is defined in figure 2.

$$Earnings\ Yield = \frac{EBIT}{(Market\ Capitalization + Net\ Debt)}$$

Figure 2.

The primary purpose of EY is to compare how much the company earns in relation to how much investors pay for it. Greenblatt prefers this key figure over the more favored price earnings yield since EY take into account both the companies loans and equity. This becomes relevant as both are used in the day-to-day operations to generate operating profit. Just as with ROCE, EY also compare the companies independently of capital structure and tax rate so that companies easily can be compared from different countries (Greenblatt, 2006).

2.1.2 Risks with Magic Formula according to Greenblatt

During the years 1998-2008, Greenblatt tested MF for two portfolios. One portfolio constructed by ranking the 1000 largest companies in US (market capitalization over $ 1 billion) and that portfolio yielded an average annual return of 19.7%. The other portfolio was constructed by ranking the 3500 largest companies (market capitalization over $ 50 million) and that portfolio yielded an average annual return of 23.8%. During the same time, the benchmark index S&P 500 yielded an average annual return of 9.5%. Despite an excess return in the example, Greenblatt (2010) argues that there are two potential risk factors when investing according to MF. The first is that the MF portfolio does not succeed in generating an excess return in the first years of holding the portfolio and the second risk is that an

alternative investment had generated higher returns during the same period. This may result in investors abandoning the strategy at an early stage due to the "poor" returns. He argues that MF is a long-term strategy and it should be used for at least five years to obtain a satisfactory result. So even if the strategy could perform worse than the market in short-term periods, the return for long-term investors will exceed the market return (Greenblatt, 2010).

2.2 Momentum

2.2.1 Theory about momentum

Momentum is a concept meaning that your investment decision is based on fluctuations in the stock market, which means that the stocks that goes down are sold and the stocks that goes up are bought. The basic idea behind the theory is that the market and the economy are acting slow. Simply explained, momentum means that if a stock goes well, it usually goes well over a period of time. The theory is also based on behavioral deficiencies in humans. One is that investors are backward looking, which means that if a stock has gone up for a long time, investors expect it to continue going up and vice versa for decline. This phenomenon is called recency bias. Another behavior is that people often keep stocks in their portfolio that has been going bad to avoid loss and sell when things are going well and the earn a profit.

According to a study made by Jagadeesh & Titman (1993), stocks that have gone up during the last 3-12 months tend to keep going up for the coming 12 months. A portfolio that invests in companies that have gone up and sells those who have gone down, overperforms the market by about one percent a month during the coming year. Some interpret the results of these studies as strong evidence that the market is not efficient according to EMH, while others argue that the higher return from momentum strategies is actually a compensation for a higher risk. The behavioral models imply that the abnormal returns can be explained by a delayed overreaction to information. This means that the price of the stocks that have gone up is traded up to levels above their long-term values. On the contrary, the stocks that have gone down continue to be traded down to levels below their long-term value. This applies in the short term, which is defined as periods up to 12 months. In the long term (periods longer than 12 months) previously winners tend to perform worse than previous losers as the stocks in general move towards their long-term fundamental value. This was confirmed in a study where the companies that performed best according to the momentum for the last 3-12 months

was held for 5 years. In the first year, as mentioned earlier, the companies with the best momentum performed significantly better than the companies with the worst momentum, but in the years 2-5, they performed worse, which is explained by that the companies move towards their long-term fundamental value (Jagadeesh & Titman).

2.2.2 Behavioral Models to Explain Momentum Effects

There is a lot of research regarding momentum and why it works. *Representative Heuristic* means the tendency that investors identify an uncertain event or a selection to a level that causes that event or selection to be seen as normal. When it comes to stock prices, the phenomenon means that investors for wrong reasons assume that companies that for some reason have had extraordinary profit growth in the past will continue with the same growth in the future. This means that companies whose stocks have gone up very much in the short term can have a negative long-term return (Barberis, 1998).

Another phenomenon that affects the short-term movement of stocks is "*self-attribution*" bias. This means that investors who evaluate the stocks they purchased will attribute the stocks that have gone well to their own precision in their evaluations and the stocks that has been going bad they blame on bad luck. As a result, investors become over-confident about their ability to choose stocks and then overestimate their precision around the stocks they have chosen. Based on their increased self-confidence, they buy even more of their previous winners, driving up prices in the stocks that have gone well recently to even higher levels. This leads to extra profits in companies with good momentum in the short term. In the long term these companies eventually go down when the stock prices of the companies reach their correct long-term fundamental value (Daniel et al, 1998).

Hong and Stein (1999) argue that there are two groups of investors. The first group in their model uses signals on how future cash flows will look but ignores information about previous stock prices. The other group in the model chooses stocks based on limited history about past stock prices and does not use any fundamental information. The information captured by the first group is transmitted with delay and is therefore only partially included in the stock prices when the information reaches the market. This part of the model contributes to sub-reaction which results in momentum profits. The other group trading stocks based on historical prices tends to trade up previous winners at higher prices than their fundamental value, which also

contributes to the momentum giving an abnormal return. Both groups of investors act rationally when it comes to updating their decision data, but since each group only uses some of the available information, momentum can give a abnormal return (Jagadeesh & Titman, 2001).

2.3 Efficient Market Hypothesis

Efficient Market Hypothesis (EMH) suggest that financial markets are efficient which means that stock prices at any time fully reflects all available information. According to EMH, the only way investors makes superior returns is out of luck or if they have taking on an excess risk. The only thing that can affect the price of the stock is new information such as new acquisition or higher earnings than expected. However, this is something that is impossible to predict for an investor since new information comes randomly (Fama, 1970).

There are three levels of market efficiency. The first one is *weak market efficiency* which means that previous movements of a stock do not affect its future movements. The weak market efficiency also suggests that figures in a company's balance sheet, income statement and other fundamentals doesn't always reflect the price of the stock (Fama, 1970).

The second level of market efficiency is *semi-strong* efficient market, which means that the market is reflecting all publicly available information. This means that figures from the income statement, balance sheet and other fundamentals are incorporated in the price of the stock. Hence, the only way to achieve higher returns than the market is to have information that is not known to the public yet (Fama, 1970). This is known as inside information and it means that a few people within a company whom have access to information that is not yet reflected in the stock price could potentially use this information to purchase undervalued companies.

The last level of efficiency is called *strong* market efficiency. It suggests that that the market is strongly efficient, and that all information is reflected in the price of the stock. This goes for both public and private information which leads to that neither public nor inside information can be used to gain a larger return than the market (Fama, 1970).

2.4 Criticism against EMH

The question whether the market is efficient or not is something that is well discussed in the literature. Damodaran (2012) suggests that the market is not always fully effective. By implementing different investing strategies there is a way to beat the market and yield an excess return. The price of a stock will not necessary be reflected on the fundamental value of the company's assets in the short-term. The price of the stock will fluctuate around the true value, making the market efficient at some periods and over-or undervalued at some (Damodaran, 2012). This is called the *random walk theory* which imply that changes in stock prices should be random and unpredictable since the information that becomes available is random and unpredictable (Bodie, Kane & Marcus, 2018). Damodaran (2012) suggest that you can yield an excess return out of buying undervalued stocks and also that some stocks are more likely to be undervalued depending on how well they are monitored by investors. Hence, the market for bigger companies will be more effective and harder to find undervalued companies since they in general is more frequently monitored and analyzed (Damodaran, 2012).

A lot of the critic aimed at the EMH comes from anomalies in the market and one of these anomalies is the *random walk theory* (Bodie, Kane & Marcus, 2018). According to Fama (1970) this is something that shouldn't exist if the market is efficient.

Both people who agree and disagree with the EMH more or less agrees on that random walks exists in the market, but their explanations differ. Advocates for the EMH means that the abnormalities are small, rarely happens and that they are insignificant. Behavior economists say the opposite and mean that the *random walks* are big and can last during long periods of time. The behavior economists say that the anomalies can be explained by mistake investors make when they act on new information. The mistakes investors often do depend on that the investors acting on feeling rather than rationally when they trying to maximize profit (Shefrin 2005). Damodaran (2012) suggest that EMH is not in line and suggest that by making a fundamental analysis you can find undervalued stock and make a profit.

2.4.1 Small-Firm Effect

Banz (1981) divided all stocks on the New York Stock Exchange (NYSE) in to 10 portfolios based on their Market Value and measured the average annual return. The return from small-firm portfolios are consistently higher than for large-firm portfolios. The difference in average annual return between the portfolios consisting of the decile with the smallest firms compared to the portfolio consisting the decile with the largest firms was 8, 57 percent. Small-firm portfolios tend to be riskier, but even when the risk is taken in to account using Capital Asset Pricing Model (CAPM), there is still a consistent premium for smaller-sized portfolios (Bodie et al. 2011).

2.4.2 Book-to-Market Ratios

Fama and French (1992) showed that a powerful predictor of returns across securities is the ratio of the book value of the firm's equity to the market value of equity. In their study they divided the stocks in to 10 groups according to book-to-market ratio and examined the average monthly rate of return for each group. The group consisting with the 10 percent highest book-to-market ratio had an average annual return of 16,78 percent compared to the group with the 10 percent lowest book-to-market ratio that had a return of 10,51 percent. The big difference in return between the companies with the highest book-to-market value and the companies with the lowest book-to-market value is independent of the systematic risk (beta), suggesting either that high book-to-market firms are relatively underpriced or that the ratio in serving as a risk factor that affects the expected return. When the portfolios was controlled for size, beta had no power explaining average security returns.

This finding is an important challenge to the notion of EMH because it seems to imply that a factor that should affect return, beta, seems to not do so and a factor that should not affect return, book-to-market ratio, seems to do so (Bodie et al. 2011).

2.5 Value Investing

Value investing is essentially finding and identifying companies that sell at a lower price than their fundamental value. This method could be described to any sort of active investing but what makes value investing different is that traditionally you find undervalued stocks by some sort of fundamental analysis. In value investing there is two different categories which is

growth and value investing. Value investing is the act of looking into a company's fundamentals such as the balance sheet or income statement and thereby deciding if the company appears to be undervalued (Graham & Dodd, 1934). Graham is often seen as the father of value investing and this theory laid the foundation for investors like Joel Greenblatt and Warren Buffet and the theory suggest that a superior return could be achieved by investing in companies that are undervalued.

2.6 Risk models

2.6.1 CAPM

Capital Asset Pricing Model (CAPM) is an economic model which describes the relationship between systematic risk and expected return for an individual security or portfolio. The model can also be used for pricing a security or portfolio and the model only assumes that there is one risk factor which is the market risk or systematic risk called *Beta*. The Beta of an investment is a measurement of how much risk the investment will add to the portfolio that moves with the market. Different values of the beta imply different levels of correlation with the market. For example, a beta value of one means that the asset is perfectly correlated with the market, negative means that its negatively correlated and a zero means that they are perfectly uncorrelated (Damodaran, 2012). The formula for CAPM is:

$$E(R_i) = R_f + \beta_i \, (E(R_m) - R_f)$$

Where:

$E(R_i)$ = Expected return of asset i

R_f = Risk free rate of interest

β_i = Beta of asset i

$E(R_m)$ = Expected return of the market

According to Fama & French (1996), CAPM has flaws in catching up risk factors that affect asset since the only risk included in the model is the market risk.

2.6.2 Jensen's Alpha

Jensen's Alpha is a measure of risk-adjusted performance based on the CAPM model developed by Michael Jensen (1968). The alpha shows if the return is above or below of what the CAPM predicted. By taking into account several market factors, you will get an alpha that shows the risk-adjusted excess return. This model is relevant as an investor may outperform the market in terms of absolute return, but if the systematic risk involved in the investment is not taken into account, the return can be interpreted incorrectly. The formula for Jensen's alpha (α) is:

$$\alpha = R_i - [R_f + \beta_i \, (E(R_m) - R_f]$$

Where:

R_i = the realized return of the portfolio or investment

R_m = the realized return of the appropriate market index

R_f = the risk-free rate of return for the time period

β_i = the beta of the portfolio of investment with respect to the chosen market index

2.6.3 Fama-French Three-factor model

The Fama-French Three-factor model is an extension of the Capital Asset Pricing Model (CAPM) discussed in section *2.6.1 CAPM*. As mentioned, CAPM describes the relationship between systematic risk and expected return for an individual security or portfolio. However, the three-factor model tries to explain the return by three factors instead of just one as in CAPM. In addition to the systematic risk calculated by CAPM, *value* and *size* are also included as factors in the three-factor model. The excess return from *value* are found by compare the average return from two portfolios with high book-to-market companies with the average return from two portfolios of growth companies and is calculated by taking the average return for high book-to-market companies minus the average return for growth companies, *High Minus Low* (HML). The excess return from *size* are found by comparing the average return of three portfolios with small companies with the average of three portfolios with large companies and is calculated by taking the historical returns from small companies minus the historical returns from large companies; *Small Minus Big* (SMB). The underlying

reason why *value* and *size* are included in the equation is that high book-to-market value companies and small companies tend to yield a higher return than the market as a whole. When SMB and HML are included in the formula, the three-factor model explains about 90% of a diversified portfolio's return compared to CAPM that explains about 70% of a diversified portfolio return (Fama & French, 1993).

The β still defines the market risk according to the equation for CAPM (section *2.6.1 CAPM*) and s_i and h_i measure the asset's exposure to size and value. The three-factor model is calculated by the following equation:

$$E(r_i) = r_f + \beta_i\big(E(r_m) - r_f\big) + s_i SMB + h_i HML$$

Just like CAPM, the model can be used to evaluate how a portfolio has performed and to see if the portfolio yielded a higher return than the model expected. To make a regression with the three-factor model, values for SMB and HML need to be retrieved. To determine whether the return has been higher than the model expected, alpha is added to the equation. If the alpha is positive after the regression has been done and the results are significant, the portfolio's return is higher than what the three-factor model predict. In that case, the portfolio has generated an excess return that is not explained by the three factors in the model. When alpha is included in the equation, it looks like this:

$$E(r_i) - r_f = \alpha + \beta_i\big(E(r_m) - r_f\big) + s_i SMB + h_i HML$$

2.6.4 Sharpe ratio

The Sharpe ratio is an investment tool developed to help investors understand the return of an investment compared to its risk and shows how much a financial asset yields per unit of risk. There are assets which are deemed to be entirely risk-free such as T-bills issued by the Federal Reserve and in Sweden *Statsskuldväxlar* is the equivalent to the federal T-bills. If an investor wants to yield a higher return, then the guaranteed return from the risk-free asset an excess risk has to be taken on. The Sharpe ratio measures how much an investor yields in relation to the risk taken on (Sharpe, 1994). The Sharpe ratio is calculated as follows:

$$sr = \frac{R_p - R_f}{\sigma_p}$$

Where:

$R_p = Return\ of\ portfolio$

$R_f = Risk - free\ rate$

$\sigma_p = Standard\ deviation\ of\ the\ portfolios\ excess\ return$

3. Literature review

3.1 Previous results

Ever since Greenblatt introduced Magic Formula (2006, 2010) different studies have been made to see if excess returns can be achieved compared to the market when using this investment strategy. To evaluate the results in this study we have collected results found by earlier studies on the MF strategy to compare with. The reason is to see if our result is plausible compared with similar studies.

Gustafsson and Sellin (2014) studied MF on the Stockholm Stock Exchange between 2005 and 2015. They concluded that MF yielded an excess return compared to a self-designed index at a significant level of five percent. Håkansson & Kvarnmark (2016) studied MF in the Nordic stock market between 2007 and 2016 compared to OMX nordic 40. They demonstrated an excess return that was significant at a five percent level. Ekquist and Steen (2018) made a study on MF on the European Market between 2007 and 2017. Their conclusion differs somewhat from as they show that 14 out of 18 tested portfolios performed worse than the benchmark index. Greenblatt (2010) made two different tests on MF, one including the 1000 largest companies in US (market capitalization over $ 1 billion) and that portfolio yielded an average annual return of 19.7%. The other portfolio was constructed by ranking the 3500 largest companies (market capitalization over $ 50 million) and that portfolio yielded an average annual return of 23.8%. The results from previous studies are displayed in table 1.

	Published	Time period	Market	Number of companies in the sample	Benchmark index	Result	Significance
Greenblatt	2010	1988-2009	USA	3500	S&P 500	Superior return	Yes
Gustafsson & Selling	2014	2005-2015	Sweden	314	Made by author's	Superior return	Yes
Håkansson & Kvarnmark	2016	2007-20016	Nordic	420	OMX Nordic 40	Superior return	No
Equist & Steen	2018	2007-2017	Europe	3072	S&P 500	Mixed results	Yes/No

Table 1

3.2 Criticism of quantitative investment strategies

Previous studies (discussed in section 3.1 *Previous results*) shows that quantitative investment strategies like MF and Momentum are strategies that can generate higher returns than index. However, quantitative strategies is often addressed by criticism. The most common claims that the critics address and the pitfalls that should be avoided are the following:

1. *Data mining* is when, in retrospective studies, testing and selecting the strategies and combinations of key metrics that one knows has been working the best. This is something that one cannot do at the time of the investment.

2. *Look-ahead bias* means that when studies on investment strategies are made, it is based on data that is available now but not at the time of the execution. This means that the data that has been added later can affect the result positively and make the study less credible (Greenblatt, 2010).

3. *Not allowing for transaction costs* are something some tests take into account, but it is not always easy to determine the cost when different investors pay differently. Although, if transaction costs are not taken in to account it is important to discuss since in practice they have an effect on the result.

4. *Not allowing for difficulties in execution.* In theory, investment strategies often look good but can be difficult to implement in reality. This may be due to difficulties in trading the stocks or the price impact that arises when, for example, trading with smaller stocks. That is, smaller stocks give better returns on paper, but because they are more expensive to trade with, you do not really make the profit that your test show.

5. *Choosing a bias sample.* Since there are thousands of stocks that qualify for the portfolio in some tests, the tests are often delimit to a smaller sample. If this selection is made randomly, it has no harmful effect on the study. If, on the other hand, one chooses beneficial stocks, the study adversely affects the results and does not reflect a truthful picture of reality.

6. *Survivorship bias* means that when you go back in time to test a strategy, the data material has been automatically cleared to correct companies that have been delisted or gone bankrupt. This can lead to companies that had actually qualified for the portfolio does not do so. This, in turn, can affect the result in a positive direction and make the study less reliable.

7. *Failure to control for market performance* means that as an investor you must put your results in comparison with the market so that you take into account the current stock market

climate. Since the portfolio tends to move in the same direction as the market, it is important to compare how the strategy that is tested performs in relation to the market. If the strategy that is tested returns 20%, it can be seen as a satisfactory return in itself, but if the market at the same time returns 50%, the strategy has in fact underperformed. In the same way, if the strategy that is tested falls by 20% it can be seen as a poor performance, but if the market has fallen 50% at the same time, the strategy has in fact over-performed the market (Damodaran, 2012).

4. Methodology

4.1 Investigation design

Both Magic Formula (MF) and Magic Formula combined with Momentum (MFM) are strategies that in previous studies (presented in section *3. Previous studies*) have overperformed the market and this study aims to investigate how these strategies have performed on the Swedish market between the years 2004-2018. To answer the study's questions and purpose, data required to calculate the key figures in MF and MFM has been collected to be able to see if the strategies can be helpful to use as saving alternative. Since the study contains large amounts of data, the study is carried out through a quantitative strategy based on data obtained from Thomson Reuters Datastream. Since they have collected data from the company's annual reports, the study is based on secondary data. The advantages of a quantitative approach are that the study is not affected by subjective values, which makes it possible to generalize the results. Since previous studies of Magic Formula and Momentum have used quantitative approaches, the comparability between these studies results and previous studies becomes better (Gustafsson & Sellin, 2014; Håkansson & Kvarnmark, 2016; Ekquist & Steen, 2018; Greenblatt, 2010).

4.2 Study approach

In order to test the performance of MF and MFM in this study, the approach that is best suited are to do a time series study. Since previous studies (presented in section 3.1 *Previous results*) have done the same and we aim to compare with them we found it suitable to do a time series as well. This study is based on the two different investment strategies, MF and MFM, where portfolios are constructed that are re-balanced each year for a period of 15 years. The performance of these portfolios is compared to a market portfolio, which in this study was defined as Stockholm OMX 30 (discussed in section 4.4.1 *Benchmark*). To test how different investment strategies works it is a good alternative to measure its performance in relation to the market (Damodaran, 2012). Greenblatt (2010) used a time series study in his studies and therefore it was advisable to use the same evaluation method as him. Since the study aims to replicate Greenblatt (2010) both regarding the strategy and the approach to evaluate the results, the same criteria regarding selection of companies, calculations and portfolio

composition have been used. Another reason to follow his approach is that a comparison between the results of this study and the results of previous studies should be correct.

4.3 Data collection

In order to be able to answer the research question, data has been collected that is required to calculate the key ratios that MF and MFM consists of and share prices in order to measure how the portfolios have performed. The study was conducted through a quantitative research method, which previous studies on this type of investment strategies also have done (Gustafsson & Sellin, 2014; Håkansson & Kvarnmark, 2016; Ekquist & Steen, 2018; Greenblatt, 2010). We thought it was suitable to use a similar method since we will compare our results with results from previous studies. The study aims to be able to contribute relevant research in the Swedish market where private investors are the target group. In order to get a result that can be considered sufficiently reliable, a period of 15 years has been chosen (2004-2018) so that the study will not be affected by the temporary stock market climate. The reason for the choice of period is because during those years there have been periods of both sharp ups and downs on the stock market.

All data was collected from the financial database Thomson Reuters Datastream. The data used was collected April 27, 2019. First, a list of all the companies available on the Swedish market was collected and it contained 865 companies. To be able to design portfolios that a private investor could replicate, companies listed on the *Spotlight* (in general small companies) were sorted out because they are generally illiquid, and it can be difficult to trade companies there. Another reason to exclude the companies listed on *spotlight* is because they have low market capitalization and in Greenblatts study (2010) companies with a market capitalization under 50 million dollars (defined as "*small companies*") were excluded. This cleanup does not exactly replicate Greenblatt's approach, but largely because companies listed on *Spotlight* generally have a low market capitalization.

Further, MF is not suitable for companies within banking, insurance, real estate and other financial companies, such as investment companies. This is because their accounting differs from companies in other industries and because specific regulations often exist for those sectors and this affects comparability, which is discussed in section 4.4 *portfolio composition*.

After removal of companies that were not relevant to the study, there were a total of 591 companies in our universe.

4.3.1 Selection

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Original selection	865	865	865	865	865	865	865	865	865	865	865	865	865	865	865
Companies included in the ranking	131	136	149	169	194	206	218	228	243	247	256	280	320	375	438

Table 2

Table 2 shows the number of companies that were included in the ranking for each individual year. In order for a company to be included in the rankings, it was required that all data was complete in order for all calculations for MF and MFM to be carried out. Since the study is being tested on the Swedish stock market, a constituent's list was collected for companies listed in Sweden during the selection period. The period analyzed is 29 March 2004 to 29 March 2019. Data collected for calculations of the various parts of Magic Formula were parts from the company's annual reports between 2003- 2018. To be able to calculate the momentum of the stocks and the performance of the strategies the share prices for each stock were collected. To calculate Earnings Yield (EY), the companies' *market capitalization*, *Earning Before Interest and Taxes* (EBIT) and *Net Debt* were collected for all companies included in the study. To calculate ROCE, *working capital*, *cash and property, plant and equipment* was collected for all companies in the study. In order for the calculations to be based on the entire previous year and not the last three quarterly reports, the study starts March 29 for the portfolios and not at the beginning of the years since the annual reports for the previous year have been released by the majority of the companies by then.

4.3.2 Correction in the selection

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Original selection	865	865	865	865	865	865	865	865	865	865	865	865	865	865	865
Correction of selction															
Sector	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109
Companies listed at Spotlight	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145
Other	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Companies included in the ranking	591	591	591	591	591	591	591	591	591	591	591	591	591	591	591
Loss of data	460	455	442	422	397	385	373	363	348	344	335	311	271	216	153
Companies included in the ranking	131	136	149	169	194	206	218	228	243	247	256	280	320	375	438

Table 3

The selection in the study is based on the 2019 stock exchange list and the sector correction was the same for every year that included in the study. Since the selection is based on the stock exchange list for 2019, companies that have gone bankrupt or delisted will not be included in the study. This phenomenon is common in this type of study and is called *Survivorship Bias*, something that is further discussed in section 4.8.1 *potential sources of error*. Since the result in this study is intended to be compared with previous studies and to replicate Greenblatt's (2010) approach in selection, it was of great importance to correct the same way by excluding companies that the formula does not fit for. In Greenblatt's studies (2010) companies with a certain market value were also excluded. Since Greenblatt's tests were made on the US stock market, which is hugely larger than the Swedish, companies with a market capitalization below $ 50 million were sorted out and after that, his study included 3,500 companies. The Swedish stock market contains significantly fewer companies and for this reason we chose to include all companies listed on the Stockholm Stock Exchange and the stock list *First North*. However, companies from *Spotlight* were excluded and also companies within the Banking, insurance, real estate and other financial companies, such as investment companies which is discussed in section 4.4 *portfolio composition*. The exclusion of companies took place when the data was collected for the study, which made that the number of companies (274) excluded from the study was the same throughout the whole study. Of the companies that were excluded, 109 companies were sorted out because of their sector affiliation, 145 due to cleanup from *Spotlight* market and 20 companies due to other reasons. Companies with more than one share class and preference shares were also removed from the sample. This was done because otherwise the results of the various strategies MF and MF plus momentum could be affected if the same company with two classes of shares had qualified for the portfolio. In that case that company had gained more weight in the portfolio and would have had more impact on the portfolio performance. After all the corrections, a total of 591 companies were analyzed in the study (table 3).

4.3.3 Loss of data

In addition to the companies that were excluded from the study according to Greenblatt's (2010) selection method, the study had a loss of companies, which is presented in table 3. The loss was due to the lack of data in Datastream. In the data loss, it is clear that the amount of available data and the number of companies included in the study increased each year the closer to 2018 the study stretched (figure 3). This is because more companies were listed each

year, which means that data for those companies is not available earlier than the year they were listed. The companies that were listed after the study started on 29 March 2004 were thus automatically excluded until they were listed, which is logical because the study intends to test portfolios containing companies that's available to trade in the stock market. Companies that have gone bankrupt during the study period, bough out of the stock market or delisted are not included in the study, since the data from Datastream only included the companies that were listed at the time when the data was downloaded. This created some problems in the study as some companies that could have been included in the portfolios was not included because that data was not available in the study's selection. The disappearance of those companies means that the portfolios that are put together do not replicate a portfolio that would have been traded in real time. The phenomenon is called *Survivorship Bias* which is discussed in 4.8.1 *potential sources of error*. Corrections to this could not be made due to the limitations of the study.

4.4 Portfolio Composition

Magic Formula (Greenblatt, 2006) is a strategy where you create a portfolio containing the 20-30 best-ranked stocks according to the formula and then keeping the portfolio for one year after which a new portfolio composition is done. Since this study intends, among other things, to compare the results obtained with results from previous studies, the composition of the portfolio will replicate Greenblatt's (2006) and consist of 20 stocks. In order to find the companies that the MF portfolio will consist of, the first step is to collect all the stocks that will be included in the ranking (our universe). Greenblatt's (2010) studies use all companies listed in the US that exceed a certain market capitalization. After sorting out the companies that are considered too small to be included in the study, further deletions are carried out by companies where MF does not fit. The companies that are excluded are financial companies such as banks and investment companies. Other companies that are not included in the sample are real estate companies, due to the fact that their balance sheets differ from other industries, which complicates the comparison between the companies included in the study and that they are often subject to regulations linked to the sector they are active in (Greenblatt, 2010). Damodaran (2012) also believes that financial companies and real estate companies are more

difficult to analyze, as these companies often have different regulations and that there are difficulties in defining what is debt and reinvestment in the business.

After the selection is complete and all companies that will be included in the ranking of MF are put together in a list, the parameters required to calculate *Return on Capital Employed* (ROCE) and *Earnings Yield* (EY) are collected. When the calculation is made for our universe of stocks, a ranking is made where the company is awarded "*points*". The companies with the best ROCE get one point, which is the highest ranking and the company with the worst gets the highest score (the highest score varies with the number of companies included in our universe). Similarly, the companies are ranked according to EY. Then the two points from ROCE and EY are added together, after which the company with the lowest (highest) amount of points is ranked first (last).

The top 20 companies with the lowest amount of points are ranked highest and will constitute the portfolio for the coming year. The reason why not only a few companies are bought for the portfolio is because the companies that receive the highest ranking in MF perform well on average, not always, and therefore the portfolio must consist of a number of stocks in order for the portfolio not to have too high company-specific risk (Greenblatt, 2006). The portfolios created in this study will consist of the 20 highest ranked companies and rebalancing will take place annually.

When the portfolio for Magic Formula combined with Momentum (MFM) is created, a ranking will first be made according to MF. Instead of the 20 highest ranked companies, the 40 highest ranked companies will be selected according to their ranking based on MF. Of the 40 companies selected, the 20 companies with the best momentum will qualify for the portfolio. Momentum will be calculated on the stock's price increase over the past six months. This is something that Jagadeesh & Titman (1993) in their study proved to have a positive effect on the return for up to 12 months. Momentum for six months is calculated as follows:

$$Momentum_t^i = \frac{Price_{i,t} - Price_{i,t-6}}{Price_{i,t-6}}$$

Where:

$Momentum_t^i$ = the six month return for the specific stock i at time t

$Price_{i,t}$ = the stock i's price at time t

$Price_{i,t-6}$ = the stock i's price at time t minus 6 months

The portfolio of MFM will be maintained for one year just like the portfolio with only MF.

4.4.1 Benchmark

In order to evaluate the study's results, a benchmark will be used when evaluate the performance of the MF and MFM portfolios that are constructed. For this study the Stockholm OMX 30 has been used. Index data has been collected from Yahoo finance. The reason for the choice of benchmark is because the study is done on the Swedish stock market and then it is reasonable to compare against the index from the same country that is considered to represent the market portfolio. In addition, Greenblatt (2010) uses the S&P 500 as the benchmark index in his study, which is the broad index in the US where he conducted his study. Data for monthly returns have been calculated for OMX 30, which has been compared with the constructed portfolios for the different strategies during the study's measurement period.

4.5 Evaluation of results

To calculate how the various investment strategies have performed, data retrieved from Thomson Reuters Datastream has been used as a basis for calculations in Microsoft Excel. To evaluate how the strategies have performed, different measures have been used that describe the portfolio's return and risk and the relationship between them. Calculations for return, risk and the risk-adjusted return for the portfolios through Sharpe Ratio and Jensens Alfa has been done. Statistical tests will also be carried out in the data analysis program SPSS to ensure significance in the results.

4.5.1 Return

The purpose of this study is to test whether it is possible to obtain an excess return by using the different investment strategies MF and MFM. Therefore, the return for each portfolio has been calculated as this is the main reason why an investment strategy is used. Dividends are

not included in the return and therefore only the return obtained through price developments is calculated. The return was calculated annually and cumulatively in order to be able to measure the annual and the total return during the measurement period for the portfolios and benchmark index. In order to describe the performance of the strategies in a descriptive manner, a fictitious investment is also made in the different strategies and for the benchmark index in order to provide an even clearer picture of the return. The cumulative return shows the total profitability during the whole test period and thus shows the compounded interest effect achieved during longer investment horizons. The advantage of not only having the total return during the entire study period is to be able to compare the return annually in order to be able to analyzes differences during specific periods. To calculate annual returns, the following formula was used:

$$r_t = (P_t - P_{t-1})/P_{t-1}$$

Where

$r_t = portfolio\ return\ at\ time\ t$

$P_t = stock\ price\ at\ time\ t$

$P_{t-1} = price\ at\ initial\ investment$

To calculate the cumulative return this formula was used:

$$r_t = P_0 \times (1 + r_1) \times (1 + r_2) \dots (1 + r_n)$$

Where:

$r_1 = return\ period\ one$

$r_2 = return\ period\ two$

$r_n = return\ period\ n$

4.5.2 Risk

In order to not present a misleading result, the different portfolios risk has also been calculated. According to EMH it is possible to generate a higher return by taking a higher risk

(Fama, 1970). One common way to calculate risk in a portfolio is to calculate the standard deviation. It describes how much the observations (monthly returns in this study) on average deviate from their mean value. Simple expressed, the standard deviation describes how large the fluctuations have been in the portfolio and the greater the fluctuations, the higher the standard deviation and risk the portfolio has had (Damodaran, 2012). The standard deviation has been calculated using the Microsoft Excel function "STDEV.S". Since monthly data has been used in the calculations, the standard deviation calculated is multiplied with the root of 12 to obtain the annual standard deviation. The formula used is:

$$\sigma p = \sqrt{\frac{\sum_{t=1}^{N}\left(r_t - \bar{r}_p\right)^2}{n-1}}$$

Where:

$r_t = Portfolio\ return\ at\ time\ t$

$\bar{r}_p = Portfolio\ mean\ return$

$n = number\ of\ observations$

4.5.3 Risk-adjusted excess return

In order to calculate the risk-adjusted excess return for MF, MFM and the markets risk-adjusted return, the risk-free interest rate has been subtracted from the return. According to Damodaran (2012), a risk-free interest rate may not be exposed to default or reinvestment risk and therefore the interest rate on the Swedish three-month Treasury bill was chosen as a risk-free interest rate in the calculations. In order to obtain the expected return, a regression was carried out in SPSS to calculate CAPM and Jensens Alpha to obtain what is not explained by CAPM (Bodie, Kane, Marcus, 2018). In addition to CAPM and Jensen's alpha, a beta value was also calculated, which measure how sensitive the portfolios are to the movements on the benchmark index OMX 30. To calculate a beta value, Microsoft's Excel function "SLOPE" was used, where the monthly returns of the portfolios are set against the market's monthly return. When comparing the market's risk-adjusted return and the portfolio's risk-adjusted return Jensen's alpha could be calculated, which is defined as the difference between the

portfolios' expected return (which was calculated by CAPM regression) and the actual returns of the portfolios. Jensen's alpha is calculated as follows:

$$\alpha = R_i - [R_f + \beta_i \, (E(R_m) - R_f]$$

Where:

R_i = the realized return of the portfolio or investment

R_m = the realized return of the appropriate market index

R_f = the risk-free rate of return for the time period

β_i = the beta of the portfolio of investment with respect to the chosen market index

The value of Jensen's Alpha that is calculated by using SPSS will also be tested for statistically significance at a five percent level and the p-value will also be collected.

When testing the alpha for the MF portfolio for statistically significance the null hypothesis (H_0) is defined as "*the alpha of the MF portfolio is equal to zero*" and the alternative hypothesis (H_1) is defined as "*the alpha of the MF portfolio is not equal to zero*".

When testing the alpha for the MFM portfolio for statistically significance the null hypothesis (H_0) is defined as "*the alpha of the MFM portfolio is equal to zero*" and the alternative hypothesis (H_1) is defined as "*the alpha of the MFM portfolio is not equal to zero*".

4.6 Potential sources of error

4.6.1 Survivorship Bias

When collecting data, Thomson Reuters Datastream has been used as a database. The database only uses the current stock lists which leads to companies that were delisted from the stock exchange for various reasons during the study period (2004-2018) were not included. The reasons why companies may be delisted could be bankruptcy, acquisitions from the stock exchange, change of stock list or bundling with another company. The phenomenon is called

Survivorship Bias (Bodie, Kane & Marcus, 2018) and can influence the results of the study when companies that would have been included in the sample were excluded due to missing data. The different reasons for possible delisting do not lead to a result in the same direction as a bankruptcy, for example, would adversely affect a company's return while a possible acquisition from the stock exchange would have a positive effect on the return of the portfolio. Even though we know about the problem, we have chosen to overlook it since we did not have the resources to retrieve the data that would have been required.

4.6.2 Transaction costs, taxes & dividends

In the study, no account has been taken to costs attributable to the transactions that take place when the portfolios are constructed. The reason why we chose to exclude these costs is because it is difficult to generalize these costs because it is based on what type of account form that is invested from, which bank that is used and the amount of money that are invested. On the other hand, it is a factor necessary to discuss since in practice it would have a negative impact on the return for the majority of investors as it is usually a cost compatible with the purchase of shares. The tax rate is also something that has not been calculated in the study, which largely depends on which kind of account form that is used. Despite the problem of excluding transaction costs and taxes, we ignore them in the study as it is difficult calculate a number in general and because the study should not be affected by subjective assessments.

Another factor that was not taken into account in the study is *dividends*, which had affected the result of the study. In the OMX30, banks and other companies that in general pay high dividends are included (Avanza, n.d.). The MF and MFM portfolios consist of both small and large companies which may lead to that the portfolios in our study in general pay a lower dividend than the companies in OMX30. This could lead to that the comparison between the MF and MFM portfolios with OMX30 might be in our favor and make the return seem better than it is compared to the OMX30.

The main reason for these selections is because we intend to replicate Grenblatts (2010) approach, since in his study he did not take into account transaction costs, taxes or dividends. Since we also intend to compare the results in this study with results from previous studies of the strategies, these parameters were excluded as they were excluded in the studies we compare with (Gustafsson & Sellin, 2014; Håkansson & Kvarnmark, 2016; Ekquist & Steen,

2018; Greenblatt, 2010). In both OMX30 and the strategies, the returns is measured through the price developments which makes the return from the strategies and the benchmark comparable.

4.6.3 Potential problems with the Benchmark

In the study, OMX30 is used as the benchmark index to be able to see if we could yield a superior return than the market. The OMX30 is an index of the thirty most traded shares on the Stockholm exchange (Avanza, n.d.). The problem with this benchmark could be that banks (that in general is a big part of OMX30), real estate companies or other companies are included in the index. This could make the comparison a bit skewed since our study won't include neither of them since those kind of companies does not fit for the metrics in Magic Formula. This is discussed in section 4.4 *portfolio composition.* Dividend payed out might also be higher for companies included in OMX30 since banks in general pay out high dividends (Avanza, 2018). Since the dividend are excluded from our study, the results from OMX30 might seem "weaker" than it is, since dividends play a major part for the return of OMX30 (appendix, graph 1) and make the comparison unfair. Another factor that should be mentioned is that OMX30 is not equally weighted, which the strategies in the study are, and that could affect the comparison between the strategies and the benchmark (NASDAQ, n.d.).

5. Empirical Results and Analysis

5.1 Absolute returns

Strategy	Average annual return	Average of 10 worst monthly returns	Average of 10 best monthly returns	Cumulative return 2004-2018
Magic Formula	18,19%	-12,48%	14,66%	565%
Magic Formula plus Momentum	19,48%	-11,10%	10,16%	743%
OMX 30	6,95%	-11,19%	9,15%	225%

Table 4

Table 4 shows the annual average return for the different strategies Magic Formula (MF), Magic Formula combined with Momentum (MFM) and the benchmark index OMX 30. The table shows that the two strategies MF and MFM have had a higher return than the benchmark OMX30. Magic Formula has delivered an average annual return of 18.19% during the measurement period, MFM has yielded a return of 19.48% and the benchmark index OMX 30 has yielded an annual average return of 6.95%. The cumulative return between 2004- 2018 was 565% for Magic Formula, 743% for MFM, while the OMX30 had a total return of 225%. Table 4 shows the average return on the worst and best 10 months for each strategy. Magic Formula is the strategy that had the worst and best months during the measurement period, which indicates higher volatility in that strategy. Figure 4 shows how much an investment of SEK 1000 at the start of the study 2004-03-29 that was retained until the end of the study 2019-03-29 had grown for the three different strategies. If a private investor would have saved their money in one of the strategies it is a big difference in the outcome. 1000 SEK invested in a MF portfolio would have grown to 5659 SEK during the period of the study, while SEK 1000 invested in the MFM portfolio would have grown to SEK 7427 in the same period and SEK 1000 invested an index fund following the OMX 30 would have grown to SEK 2246 (figure 3).

In 2017 MF went up about 66% which was a strong excess return compared to the OMX30, which decreased by 0.2% in the same year. One big reason for the return for MF that year was that one company, *Enorama Pharma*, hade an increase in stock price from SEK 9 to SEK 112, which resulted in a return of 1150%. Without the return from *Enorama Pharma*, the strategy MF had yielded an annual average return during the whole study period of 14,34% instead of 18,19%, a difference of almost 4% attributed to one company's return.

One of the most interesting year to analyze is during the financial crisis in 2008. Between the period 2008-03-29 to 2009-03-29, MF gave a negative return of 41.6%, MFM yielded a negative return of 39.4% while the OMX30 yielded a negative return of 36%. Thus, it is hard to interpret any major differences in absolute return during the year. But at a closer look at the return the following year, i.e. the period 2009-03-29 to 2010-03-29, there is a big difference in return between the different strategies. OMX 30 went up 51.4%, MF went up 94.3% and MFM 53.7%. One possible explanation for the large excess return in the MF portfolio during that year may be that investors see more value in the type of companies that qualifies for the portfolio, i.e. companies with high Return on Employed Capital (ROCE) and high Earnings Yield (EY). According to Greenblatt (2010), the companies that qualify for the MF portfolio are companies that are trading at a low value (EY) with high quality (ROCE) and an assumption may be that people want to buy that type of company to a greater extent after a period of major downturns as they can be seen as a safer investment on average.
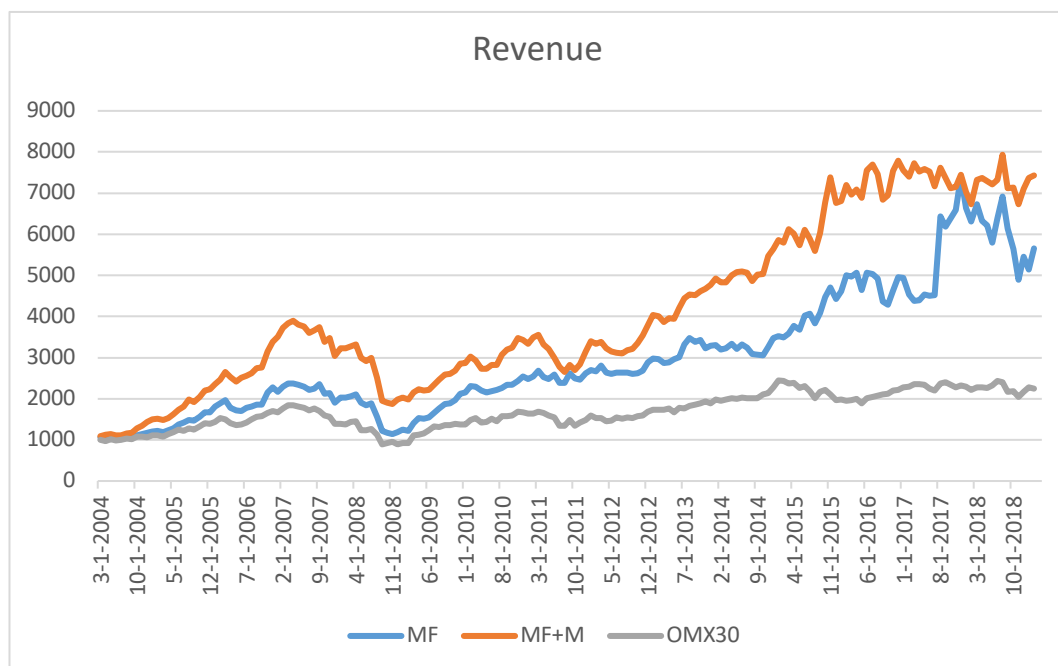

Figure 3

Even if the strategies yielded a superior return in our findings using the two investment strategies the results might not show an entirely true picture. In this study we choose to exclude dividends and transaction costs, which might have had an impact on the results. For an example, graph 1 (appendix) shows how much more OMX30 would yield if dividends would have been included during the period of our study. If the dividend had been included when calculating the return of the strategies and OMX30, the difference might have been smaller between the strategies and OMX30. Our portfolios would also yield a higher return if dividends had been included, but perhaps not as much as OMX30 since the index often contains companies that pay high dividends (Avanza, 2018). The same might happen if we had included the transaction costs. Since we rebalance our portfolios more frequently a higher fee would be paid compared to buying an index fund. Taking the dividends and transaction cost in account, the result might have turned out differently. The loss of data could also make the return from MF and MFM portfolios look better than it would have been in practice since some companies that may had been included was left out because of missing data (discussed in section 4.6.1, *Survivorship Bias*).

5.2 Standard deviation – volatility

As we could see in section 6.1 *Absolute returns,* both MF and MFM yielded a higher average annual return than the benchmark index OMX30. The higher return could be explained to the fact that the strategy actually performs better but it could also be the result of taking on excess risk compared to the benchmark. Therefore, just by looking at the absolute return could give a skewed picture of the performance of the strategies tested in this study. One way to analyze and determine whether the excess return of the MF and MFM portfolios is a result of a superior strategies, the volatility on a yearly basis was measured. The yearly volatility is calculated by taking the standard deviation of the MF and MFM portfolios and compare it with the standard deviation of OMX30 to see the fluctuations of the different portfolios.
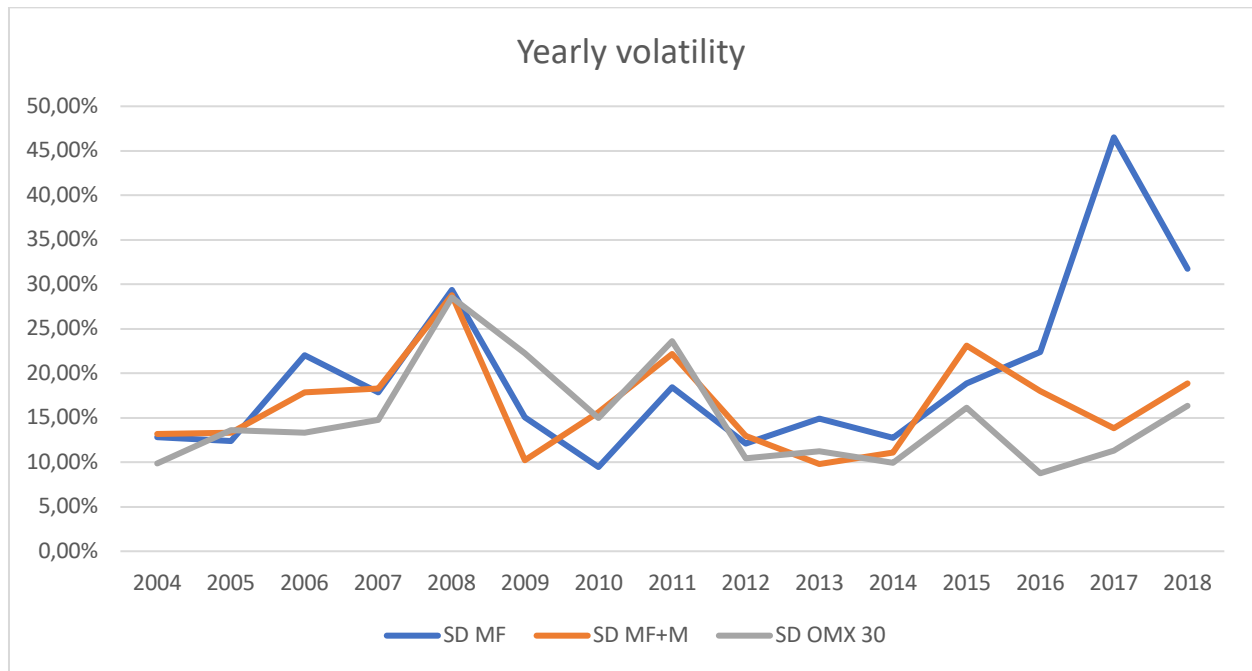
Figure 4

Figure 4 shows that the standard deviation of OMX30 is lower compared to the MF and MFM portfolios. One possible explanation may be that the firm-specific risk increases in the MF and MFM portfolios, as the portfolios contain a lower amount of companies than the benchmark index OMX30. Another reason could be that companies that qualify for the MF and MFM portfolios may be companies with lower market capitalization and they may presumably have lower volume trading which can increase volatility. Another reason may be that companies that qualify for the MF and MFM portfolios due to low valuation (high EY) may be companies in a negative profit trend. As a high EY may be due to the market expecting lower profits in the future which could lead to downturns if the market is correct in that assumption, or gains if the market is wrong. Companies with high ROCE can also qualify for the portfolios and this indicates that these companies have higher quality than the average, which may lead to the market trading up these companies, giving an excess return.

Comparing the two strategies MF and MFM with each other it is shown that the MF portfolio have a higher standard deviation than the MFM portfolio. This would suggest that MFM could be a less risky investment strategy between the two. The higher standard deviation in the MF portfolio largely depends on the huge upswing in the standard deviation in 2017 which depends on the major appreciation of one stock in the MF portfolio. *Enorama Pharma* was purchased to the MF portfolio in 2017-04-29 at 9 SEK and the price increased to 112

SEK in 2018-0329 when the stock was sold. This explain the higher degree of standard deviation in the MF portfolio compared to the MFM portfolio.

5.3 Sharpe Ratio

Sharpe Ratio (SR) is a measure of the risk-adjusted return that shows the return minus the risk-free rate in relation to the risk described as standard deviation, or volatility. As mentioned in the previous section 6.1 *Absolute returns* and 6.2 *Volatility*, the two strategies MF and MFM have yielded a higher return than the benchmark index OMX30. The strategies have also had a higher risk. To find out whether the risk-adjusted return has been better for the MF and MFM strategies than its benchmark index OMX30, the SR has been calculated and is shown in table 5.

Strategy	Average annual return	Standard deviation	Average Risk Free rate	Sharpe Ratio
Magic Formula	18,19%	22,37%	1,10%	0,76
Magic Formula plus Momentum	19,48%	18,01%	1,10%	1,02
OMX 30	6,95%	16,56%	1,10%	0,35

Table 5

Although MF and MFM have had higher volatility than the OMX30, the return has been much higher which generated a higher SR for both of the strategies compared with its benchmark. MFM yielded a higher return at a lower risk, giving it a higher SR than MF. The results indicates that it might have been better to use MF or MFM as investment strategy for a private investors long-term savings compared to save in an index fund following the OMX30 (table 5).

As discussed in section 5.1 *Absolute returns*, dividends and transaction cost were not included in the study which may have affected the return and the difference in the *Sharpe ratio* might have been smaller between the strategies and OMX30 than the study shows.

5.4 Capital asset pricing model

The Capital Asset Pricing Model (CAPM) have been used in our thesis to determine if the excess return on the Magic Formula (MF) and Magic Formula Momentum (MFM) portfolios can be explained by having been exposed to a higher degree of systematic risk (Damodaran, 2018).

5.4.1 CAPM – MF

The outputs are acquired from a linear regression using monthly return on Magic Formula and OMX30 (180 observations) in SPSS is given in table 6.

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
	(Constant)	,710	,390		1,821	,070	-,059	1,479
	OMX30	,808	,081	,598	9,949	,000	,648	,968

. Dependent Variable: MF

Table 6

As displayed in table 6 we found a constant (or the alpha) of the MF portfolio to be positive with a value of 0,710 and with a p-value of 0,07. The null hypothesis (H_0) is defined as "*the alpha of the MF portfolio is equal to zero*" and the alternative hypothesis (H_1) is defined as "*the alpha of the MF portfolio is not equal to zero*". Since we can't reject the null hypothesis at a significance level of 5%, we can't prove statistically that the alpha value of the MF portfolio is significant.

The positive alpha suggests that the Magic formula have produced 0,71 % higher monthly return than what the CAPM expected. Therefore, it is safe to say that CAPM does not explain the return yielded by the MF portfolio. The alpha value obtained in the regression shows how much of the monthly return that is not explained by CAPM and the return that is not explained by CAPM could be attributed to the MF strategy.

5.4.2 CAPM – MFM

The outputs are acquired from a linear regression using monthly return on MFM and OMX30 (180 observations) in SPSS is given in table 7.

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	,830	,282		2,946	,004	,274	1,386
	OMX30	,755	,059	,694	12,872	,000	,640	,871

a. Dependent Variable: MF+Momentum

Table 7

In an identical regression as in part 6.4.1 we found that the constant (alpha) of the MFM portfolio to be positive with a value of 0,830 and with a p-value 0,004. The null hypothesis (H_0) is defined as "*the alpha of the MFM portfolio is equal to zero*" and the alternative hypothesis (H_1) is defined as "*the alpha of the MFM portfolio is not equal to zero*". Since we can reject the null hypothesis at a significance level of 5%, we can prove statistically that the alpha value of the MF portfolio is statistically significant and therefore conclude that the MFM portfolio performs better than CAPM predicts.

The positive alpha suggests that the MFM have produced 0,830 % higher monthly return than what the CAPM expected. Therefore, it is safe to say that CAPM does not explain the return yielded by the MFM portfolio. The Alpha value obtained in the regression shows how much of the monthly return that is not explained by CAPM and the return that is not explained by CAPM could be attributed to the MFM strategy.

5.5 Further analysis of the results

Both *size* and *Book-to-market ratio* are factors that's has been able to yield a higher return without taking higher risk according to what CAPM explains (Bodie et al. 2011). In Fama French three-factor model, *size* and *value* are added as explanatory variables to a portfolio's expected return which is discussed in section 2.6.3 *Fama French Three Factor Model*. In our thesis, we measured the risk in the strategies through *Sharpe Ratio* and *CAPM*. Our results show that the strategies MF and MFM had a higher Sharpe Ratio than the market (OMX30) and that our return is not explained by the systematic risk (CAPM) since we got a positive alpha value for both of the strategies. However, we cannot ensure that the excess return is due to superior strategies, since the result could be explained by the fact that the strategies find small companies or companies with high book-to-market value, which previous research has shown to be factors that affect the return positively (Fama & French, 1993).

Earning Yield (EY) is a measure of how the company is valued, just like book-to-market value, and is one of the parameters of Magic Formula. In addition, it may be that small firms in general have a higher Return on Capital Employed (ROCE) than large firms. The two metrics in Magic Formula (EY and ROCE) could generate the formula to choose small

companies with a low valuation. That kind of companies has on average performed significantly better than the market (Bodie et al. 2011). Therefore it could be those factors that explains the return, rather than Magic Formula and Magic Formula combined with Momentum itself.

5.6 Results compared to previous studies

Like mentioned before we wanted to compare the results from our study with the results from other studies. The studies we found interesting to compare with was done by Gustafsson & Sellin (2014), Håkansson & Kvarnmark (2016), Ekquist & Steen, (2018) Greenblatt, (2010) since they examine *Magic Formula* (MF) in a similar way as we do. The results of the different studies are displayed in figure 8. Gustafsson & Sellin (2014), Håkansson & Kvarnmark (2016) came to the conclusion that MF yielded superior returns compared to index just like the results of this study. Ekquist & Steen (2018) did not conclude a superior return which could be explained by the large amount of markets they did their study on. Both Greenblatt (2010) and Gustafsson & Sellin (2014) found their results to be statistically significant while Håkansson & Kvarnmark (2016) did not. We, just like Ekquist & Steen, (2018), found mixed statistically significant result in our study.

	Published	Time period	Market	Number of companies in the sample	Benchmark index	Result	Significance
Greenblatt	2010	1988-2009	USA	3500	S&P 500	Superior return	Yes
Gustafsson & Selling	2014	2005-2015	Sweden	314	Made by author's	Superior return	Yes
Håkansson & Kvarnmark	2016	2007-20016	Nordic	420	OMX Nordic 40	Superior return	No
Equist & Steen	2018	2007-2017	Europe	3072	S&P 500	Mixed results	Yes/No
Verngren & Sjöbeck	2019	2004-2018	Sweden	591	OMX 30	Superior returns	Yes/No

Figure 8

6. Conclusion

The purpose of this thesis was to find out if the different investment strategies *Magic Formula* (MF) and *Magic Formula combined with Momentum* (MFM) performed better than their benchmark index OMX30 on a risk-adjusted basis. The result may give inspiration to private investors to use these strategies for a better long-term saving. The research questions answered in the study are *"How has Magic Formula performed historically compared to the benchmark index OMX30?"*. To further investigate whether Magic Formula could be made more efficient, the strategy was tested in a combination with momentum and therefore the study's other research question was *"How does the momentum affect the risk-adjusted return on Magic formula"*.

In line with previous studies done at Magic Formula by Gustafsson & Sellin (2014), Håkansson & Kvarnmark (2016), Ekquist & Steen (2018) and Greenblatt (2006, 2010), our result shows that MF gives a better return than the benchmark index OMX30 and that MFM yields an even better return. During the study's measurement period between 2004- 2018, MF portfolio gave an annual average return of 18.19%, MFM portfolio an annual average return of 22.37% and the benchmark index OMX 30 gave an annual average return of 6.95%.

In the theory section 4.1 *Efficient Market Hypothesis* an explanation of the theory and different levels of market efficiency are described. According to the theory, it is possible to generate a higher return if a higher risk is taken. In order to not only examine the result in the form of absolute returns, the risk that the different portfolios have taken during the measurement period was measured to find the performance on a risk-adjusted basis.

During the measurement period, the MF portfolio had a standard deviation of 22.37%, the MFM portfolio a standard deviation of 18.01% and the benchmark OMX30 had a standard deviation of 16.56%. Although the two investment strategies took a higher risk measured as standard deviation, the return has been higher in terms of the return per unit of risk. To clearly see the ratio between the return and the risk, the *Sharpe Ratio* was computed for each portfolio. The ratio measures how much extra return a portfolio generated than the risk-free interest rate in relation to the risk (standard deviation) it has taken. The *Sharpe Ratio* for the

MF portfolio was 0.76, for the MFM portfolio it was 1.02 and for the OMX30 0.35. Thus, MF and MFM have performed better than the OMX30 according to their Sharpe ratio.

The result that shows that the strategies MF and MFM had a higher Sharpe ratio than OMX30 goes against some parts of the theory that the market is effective according to the EMH. However, Damodaran (2012) believes that the market is not always efficient and that it can be utilized through different investment strategies. The result could also be explained by the fact that the strategies find small companies or companies with high book-to-market value, which previous research has shown to be factors that affect the return positively (Fama & French, 1993).

Since MF and MFM generated a higher Sharpe ratio than their benchmark, the study's results could point to the fact that the market is not always efficient and that it has been utilized in the strategies examined in this study.

To further measure the performance of the strategies a regression of the CAPM model were done and the alpha value for the different portfolios was generated. The alpha value of the monthly return for the MF portfolio was 0.710 and for the MFM portfolio the alpha value was 0.830. The results show how much monthly return the strategies yielded that wasn't predicted by the CAPM. The alpha values indicate, as with the Sharpe Ratio, that the returns for MF and MFM are higher for the strategies when the market risk in the strategies have been taken into consideration. When testing for statistical significance, it was not found that the alpha value for the MF portfolio was different from zero and we cannot statistically prove that alpha is different from zero. For the MFM portfolio, however, it was found in the statistical significance test that the alpha value was different from zero.

It can be concluded that the two strategies Magic Formula and Magic Formula combined with momentum have given a higher return than the benchmark index OMX30 between 2004 and 2018. Furthermore, it is stated that the extra return generated by the different strategies is not due to higher risk, since the calculations carried out to measure the risk-adjusted return show that the risk-adjusted return is higher in the strategies compared with the benchmark index OMX30. However, the result was not significant for the MF strategy and we can't statistically prove that the alpha-value for that strategy is different from zero.

Since Magic Formula and Magic Formula combined with Momentum seems to find stocks that are currently not properly priced by the market, the strategies could according to our finding be used to outperform the market in long-term savings.

The purpose of the paper was to find out if the investment strategies Magic Formula and Magic Formula combined with momentum can provide a better risk-adjusted return than their benchmark index, which they did. We wish that the result that was found in this study will give inspiration to private investors in order to achieve a higher return in their savings and a more satisfactory pension in the future.

> *"The best time to plant a tree was 20 years ago. The second best time is now"*
> *-Chinese proverb*

7. Further research

In order to further improve the research on Magic Formula and to make the investment strategy even more effective in the future we have found some interesting views that can be applied in future studies. We propose for future studies of the strategy, that the companies that qualify for the portfolios could be given different weights based on their ranking as it could generate higher returns. In our study, we combined Magic Formula with momentum and found that it contributed to higher returns than Magic Formula generated by itself. Therefore, it would be interesting to combine Magic Formula with other investment strategies to see if it can yield a higher return than Magic Formula does for itself. It would also be interesting to see if a more frequent balancing of the portfolio could generate a better result. In a study like that, momentum could be included to see if the effect in shorter periods than one year would give a higher return. Finally, it would be interesting to analyze the two key figures included in the Magic Formula separately to see if it is one of the key figures that explains the return that is generated through the use of the strategy to a greater extent.

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Appendix

	Magic Formula			Magic Formula combined with momentum			OMX30			Riskfree rate
	Retun	Standard deviation	Sharp ratio yearly	Return	Standard deviation	Sharpe ratio yearly	Return	Standard deviation	Sharpe ratio yearly	
2004	23,28%	12,79%	1,65	58,95%	13,15%	4,32	11,37%	9,88%	0,94	2,11%
2005	55,92%	12,40%	4,37	60,11%	13,30%	4,39	33,08%	13,61%	2,31	1,7%
2006	18,20%	21,99%	0,72	59,34%	17,89%	3,19	14,49%	13,33%	0,91	2,3%
2007	-13,68%	17,85%	-0,97	-15,61%	18,31%	-1,05	-23,08%	14,77%	-1,80	3,6%
2008	-41,60%	29,38%	-1,55	-39,43%	28,77%	-1,51	-36,00%	28,52%	-1,40	3,9%
2009	94,33%	15,08%	6,23	53,68%	10,23%	5,21	51,38%	22,22%	2,30	0,4%
2010	12,35%	9,46%	1,25	15,84%	15,64%	0,98	10,72%	14,99%	0,68	0,5%
2011	13,55%	18,45%	0,64	-8,80%	22,15%	-0,47	-3,99%	23,62%	-0,24	1,7%
2012	11,89%	12,09%	0,88	19,48%	12,99%	1,40	13,23%	10,47%	1,14	1,3%
2013	2,50%	14,92%	0,11	19,15%	9,80%	1,86	12,05%	11,21%	0,99	0,9%
2014	3,55%	12,76%	0,25	13,38%	11,06%	1,17	23,21%	9,93%	2,30	0,4%
2015	51,53%	18,87%	2,75	22,83%	23,10%	1,00	-20,99%	16,11%	-1,29	-0,3%
2016	-15,33%	22,42%	-0,65	20,83%	17,98%	1,20	16,57%	8,76%	1,97	-0,7%
2017	65,69%	46,51%	1,43	-8,18%	13,84%	-0,54	-0,21%	11,30%	0,04	-0,7%
2018	-9,37%	31,73%	-0,27	20,65%	18,84%	1,13	2,42%	16,32%	0,19	-0,7%
Average Return	18,19%			19,48%			6,95%			1,10%
Standard deviation		22,37%			18,01%			16,56%		
Sharpe ratio	0,76			1,02			0,35			
Beta	0,808			0,755						
Jensens Alpha	0,124			0,140						
Biggest draw down	-12,48%			-11,1%			-11,19%			
	14,66%			10,16%			9,15%			

Table 1

https://blogg.nordnet.se/aktier-utdelning/

Graph 1