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Magic Formula Investing and The Swedish Stock Market

Can the Magic Formula beat the market?

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Abstract

The purpose of this paper is to contribute to the existing research within the subject of the Magic Formula. The investment strategy will be tested on historical data for companies on the Stockholm stock exchange during the period 2007-04-01 to 2017-03-31. The return will be benchmarked against OMXS30 as an indicator of the market return. In addition to comparisons between the return of the Magic Formula and the market return, risk involved in the investments has also been considered through the use of the Sharpe ratio, CAPM and Fama and French's Three-Factor Model. The Magic Formula portfolio had an average yearly return of 21,25 %, compared to the market return of 5,22 %. Considering the taken risk, the Magic Formula had a Sharpe ratio of 0,769, which was higher than the market 0,146. Furthermore, the CAPM and Three-Factor Model analyses showed a significant excess return of the Magic Formula which could not be explained by risk, company size or value factors.

Key words: Magic Formula, Efficient Market Hypothesis, Fama and French three-factor model, Sharpe ratio, CAPM, Swedish stock market

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1. Introduction

Over the last 50 years, value investing has been getting more recognition as a valid investment strategy. As popularity increases, it has also become a more common subject for research. From the base of value investing, several different strategies have originated and gained a group of followers. Thus, the Magic Formula should not have come as a surprise to anyone with knowledge of the current research within financial economics. However, what did come as a surprise was how Joel Greenblatt decided to share the strategy with the world.

With a goal of sharing his knowledge of investing with his children, Joel Greenblatt decided to write a book about the strategy he used in his work as a hedge fund manager, when choosing which companies to invest in. During the writing process, Greenblatt decided to shift his focus and released the book on the public market, instead of only giving it to his children. In 2006, “The Little Book That Beats the Market” was released and it quickly became popular. The book was easy to read, filled with humour, and explained the strategy in an understandable manner. Three aspects, which all contributed to the gained popularity.

The Magic Formula is a value based investment strategy, which focuses on stocks with high earnings yield and high return on capital. As with all investment strategies, the goal is to beat the market, i.e. achieve a higher return on investment, adjusted for the risk taken in the investments.

“Beating the market” is a controversial subject within financial economics. One of the major theories within this field is the Efficient Market Hypothesis, which states that the market price always “fully reflect” all available information and thus, no investor can outperform the market through stock selection or market timing.

The purpose of this paper is to investigate how the Magic Formula performs on the Swedish stock market, and whether the results support the Efficient Market Hypothesis. The paper evaluates the performance of the investment strategy by backtracking the Swedish stock market and using the Magic Formula to invest during the years of 2007-

2017. The paper also tests if any excess returns from the Magic Formula investments could be explained by having a higher risk than the market average.

The results show that the Magic Formula significantly outperforms the OMXS30 during the 10-year period, without having a higher daily volatility. Over the period, the Magic Formula had an average annual return of 21,25 %, compared to the 5,22 % return that OMXS30 showed. The Sharpe ratio shows that the Magic Formulas risk-adjusted return is greater than the market average, while CAPM and the Fama and French Three-Factor Model indicates that the excess return cannot solely be explained by a higher risk.

This paper is organised as follows. After this introduction, chapter 2 consists of a presentation of existing research regarding the Efficient Market Hypothesis and previous tests of the Magic Formula. This is followed by chapter 3 covering the theoretical basis of the thesis, which consists of the major theoretical base of value investing and the Magic Formula, as well as the theoretical tools and concepts used throughout the analysis. Chapter 4 covers the data that has been used and chapter 5 the method of the analysis. Chapter 6 presents the result and analysis. Finally, chapter 7 concludes this paper.

2. Existing research

This chapter covers some of the existing research regarding the Efficient Market Hypothesis and the Magic Formula, which is based on Greenblatt's book The Little Book That Beats the Market (2006). The focus has been on Scandinavian research due to the chosen purpose of this paper, which focuses on the application of the Magic Formula on the Swedish stock market.

2.1 Testing the Efficient Market Hypothesis

Ever since the Efficient Market Hypothesis was introduced, there has been much research dedicated to testing whether efficient markets are present in the current stock market environment. Naseer and bin Tariq (2015) have compiled current research and tests in a literature review about the Efficient Market Hypothesis.

The weak form Efficient Market Hypothesis has been tested by measuring autocorrelation among returns and examining the impact on stock prices of different trading rules. Most of the research and tests have been consistent with the weak form of the Efficient Market Hypothesis. Although two deviations from randomness were found where, in a given series of price changes, continuation of price changes (i.e. increase after an increase) were more likely than reversals (i.e. a decrease after an increase). The behaviour was justified as an inefficiency due to specialist´s activities on the NYSE trading floor with monopolistic access to information about unexecuted limit orders. This is part of the strong form of the Efficient Market Hypothesis.

Studies on the semi-strong form market hypothesis show that when actual stock split happens, information regarding the stock split is fully reflected in stock prices. Tests showed no significant deviation from the Efficient Market Hypothesis. A test of seasonality showed some calendar anomalies on four of the tested markets, but found no evidence for existing seasonality and investors could not take advantage of seasonality to predict prices, which was consistent with the efficient market model.

Research within the strong form of the Efficient Market Hypothesis is currently the weak spot in the theory. In a study by Jensen (1968), it was empirically proven that despite the

wide range of business and financial contacts that fund managers, specialists, and market insiders had, no group has access to private information and cannot anticipate future returns. (Naseer & Tariq, 2015)

2.2 Testing the Magic Formula

While the Magic Formula has gained some popularity among the population, it has not gained the same recognition within the academic community. However, there have been some previous research in how well the strategy can perform in relation to the stock market.

Davydov, Tikkanen and Äijö (2016) tests the Magic Formula on the Finnish stock market and compares it against the market average and other commonly used value investment strategies. The Magic Formula showed a result which beat the market but was not superior to the other investment strategies in the study. The authors drew the conclusion that the Magic Formula might not be superior in a small market environment, such as the Finnish stock market. However, it does outperform the market with higher returns that are not just a compensation for the higher risk.

Joel Greenblatt (2006) performed a study on the Magic Formula before releasing his book. The study was based on the database “Point in Time”, released by Standard & Poor’s Compustat, which goes back 17 years and provides data which was available to Compustat customers on each date. Thus, no look-ahead or survivorship bias could take place in the study. According to the study, the Magic Formula provided a superior return, with a lower risk than the overall market, both for small- and large-capitalization stocks.

Persson and Selander (2009) tests the Magic Formula investment strategy on stocks on the Nordic market for the period 1998 to 2008. The Magic Formula portfolio performed better and had a higher Sharpe ratio than the benchmark MSCI Nordic, but did not have a significant intercept when testing with CAPM and the Fama and French Three-Factor Model. They conclude that the Magic Formula might be better used as a screening tool for potential investments rather than a strategy that should be followed without consideration.

Färdig and Hammarling (2016) tested the Magic Formula investment strategy on the Stockholm stock market during the years 2005 to 2015. Their portfolio test showed that the Magic Formula portfolio performed better than the market and a variety of other portfolios that were based on different investment strategies. The Magic Formula also had the highest Sharpe ratio in the test, but no test was conducted to test the significance of the Magic Formula excess return.

3. Theory

The theory chapter covers the theory behind the Magic Formula and the parameters to consider when using it. Moreover, the chapter covers models to measure risk-adjusted return such as the Sharpe ratio as well as pricing models and investment risks.

3.1 Value Investing

Benjamin Graham and David Dodd first coined the term value investing in the book Security Analysis in 1934. The authors suggest that a value investor looks at the actual value of a company, and not only the price. Hence, a value investor looks for companies that are traded for less than their actual value. As Warren Buffett put it: “Price is what you pay, value is what you get” (Montier, 2009). This contradicts the Efficient Market Hypothesis, which states that the price is a reflection of all available information. Thus, according to the Efficient Market Hypothesis, the price should be equal to the value. Graham and Dodd (2005) suggests that value investing is a three-step progress:

1. Find discrepancies between price and intrinsic value.
2. Evaluate the intrinsic value based on the future earnings power.
3. Earnings power should be evaluated with both a quantitative and qualitative analysis.

Graham and Dodd never suggested that value investing was only a quantitative analysis. They strongly emphasized the qualitative analysis of companies, which complicated the evaluation of future earnings power. During the 1960’s the theory gained traction as the introduction of computer power in the stock market became apparent. However, computers lack the human capabilities to perform qualitative analyses and therefore, a side-track of value investing, based only on quantitative analysis was introduced (Montier, 2009). Graham and Dodd did not initially propose this approach, but the purely statistical approach has remained a part of value investing ever since.

Loughran (1997) argues that the statistical type of value investing cannot be used as an explanatory variable for future returns. In his paper, Loughran ranks stocks based on their book-to-market quota and finds that this measure cannot significantly explain future returns.

3.2 The Magic Formula

The term the Magic Formula was first coined by Joel Greenblatt, a Gotham capital hedge fund manager, in his book The Little Book That Beats the Market. In the book, Greenblatt suggests buying stocks with high earnings yield and high return on capital.

The Magic Formula is an example of a quantitative type of value investing. There is no qualitative analysis involved and the formula does not try to predict future earnings power, it only looks at the past. There are two components to the formula: return on capital and earnings yield. With these two measures, Greenblatt argues that the formula covers both the quality and the value aspects of the company. The purpose of the formula is to sort available companies based on these two factors and thereby purchase above average stocks. By doing this, Greenblatt says that you can outperform the market index, which is the average return on the market. (Greenblatt, 2006)

A high return on capital implies that the company can generate high return on the employed capital, which is good for investors. Ceteris Paribus, a company with higher return on capital will create more value for its shareholders than a company with average or low return on capital. Two of the more common ways of measuring return on capital is either return on assets or return on capital. However, Greenblatt chooses to use the ratio between earnings before interest and tax (EBIT), and invested capital. The reason is mainly that it makes the comparison of companies with different tax rates and different levels of debt easier.

Greenblatt argues that companies with a high return on capital often have some kind of special advantage over their competitors and thus, they are more likely to protect themselves from competitors (Greenblatt, 2006, p. 84). Moreover, a high return on capital often implies that the company have the possibility to invest their profits at a high rate of return, which results in a high rate of earnings growth.

The earnings yield is also based on the earnings before interest and tax, which is divided by the enterprise value. By using the earnings yield instead of price divided by earnings, the ranking measure considers the debt level by including the cost of the debt.

By ranking companies based on return on capital and earnings yield separately, two rankings are obtained. The rankings are then combined by giving the highest ranked company on each ranking the value one, the second company the value two and so forth. The twenty companies with the lowest combined score will be the most attractive ones, according to Greenblatt.

Illiquid and very small companies are excluded from the Magic Formula ranking. If companies are barely tradeable, there will be large fluctuations in the price, which makes them less attractive. Greenblatt suggests that companies with a net worth of less than $50 million should be excluded from the list. In this paper, a lower limit of 500 million SEK has been used. (Greenblatt, 2006, p. 134)

3.2.1 Return on Capital

Return on capital can be calculated in several different ways, for example by calculating return on equity or return on assets. Greenblatt defines return on capital as:

$$Return\ on\ capital = \frac{EBIT}{Invested\ capital}, \text{ where}$$

$$invested\ capital\ =\ net\ working\ capital\ +\ net\ fixed\ assets$$

This definition was chosen because of three reasons. First, EBIT was used because it simplifies the comparison between companies with different tax and debt rates. Secondly, net working capital was used because the companies needs funding for receivables and inventory, but not receivables since they can be considered an interest free loan. Lastly, net fixed assets are included because companies need money to fund their fixed assets. (Greenblatt, 2006, pp. 139-140)

3.2.2 Earnings Yield

Greenblatt defines the earnings yield as:

$$Earnings\ yield\ = \frac{EBIT}{Enterprise\ value}$$

The reason behind using the earnings yield is to understand how much a company earns compared to the value of the company.

3.3 The Efficient Market Hypothesis

The Efficient Market Hypothesis states that in an efficient market, prices “fully reflect” all available information on the market (Fama, 1970). Thus, an investor cannot outperform the market through stock selection or market timing. The only way to achieve a higher return is through luck or investments with higher risk. Fama (1970) suggests three conditions for which a market can be deemed efficient.

i) There are no transaction costs in trading securities.

ii) All available information is available to all market participants at no cost.

iii) All agree on the implications of current information for the current price and distributions of future prices of each security.

However, even though no real market can achieve all three conditions, the conditions are sufficient, but may not be necessary for market efficiency. Markets that fill at least one of the conditions may be efficient even without the other conditions.

The Efficient Market Hypothesis is divided into three parts: weak, semi-strong and strong form. The different forms are divided based on how efficient the market is and thus require different kinds of testing.

Weak form tests only focus on the past prices or returns as the available information that was used by investors to make decisions. Semi-strong tests went further and added

focus to the speed of price adjustments as other types of information became publicly available. Finally, the strong form tests are mainly concerned with whether any investor or groups have recently appeared, which have monopolistic access to information relevant to the formation of prices. (Fama, 1970)

3.4 The Sharpe Ratio

The Sharpe ratio is a risk-adjusted measure used to compare investments or portfolios. By looking at the excess return and the volatility for a stock or portfolio, the risk-adjusted return can be defined. For a high-risk investment, i.e. high volatility, the investor should be compensated with a higher return. The Sharpe ratio is defined as:

$$Sharpe\ Ratio(sr_i) = \frac{Portfolio\ Excess\ Return}{Portfolio\ Volatility} = \frac{E(R_i) - R_f}{\sigma_i}$$

Where the excess return is defined as:

$$Excess\ return = Return\ of\ portfolio - risk\ free\ rate = E(R_i) - R_f$$

In reality, it is hard to find a risk-free investment. However, a state's treasury bills are often considered a risk-free investment. In Sweden, the treasury bills are called Statsskuldväxel. The excess return can be considered as the portfolio return minus the return of treasury bills. (Berk & DeMarzo, 2014)

The portfolio volatility, measured as the standard deviation of the portfolio excess returns, needs to be estimated for the sample and is calculated as:

$$s_i = \sqrt{\frac{1}{T} * \sum_{t=1}^{T} (d_{it} - m_i)^2}$$

Where:

$d_{it} = E(R_{it}) - R_{ft}$ at time t.

$$m_i = \frac{1}{T} \sum_{t=1}^{T} (d_{it} - m_i)^2$$

Resulting in an estimated Sharpe ratio defined as:

$$\widehat{sr_i} = \frac{m_i}{s_i}$$

3.5 Pricing Models

3.5.1 The Capital Asset Pricing Model

The Capital asset pricing model, CAPM, is a model that describes the expected return of an asset or a portfolio, based on the risk. The risk factor, beta (β), is defined as the extent in which the asset follows the market movements. An asset with perfect correlation with the market will have a beta-value of one. Beta-values over one will have larger movements than the market, and values below one will have smaller movements (Cochrane, 1999). The expected return can be calculated as:

$r_a = r_f + \beta_a(r_m - r_f)$, where:

r_f= Risk-free rate

β_a= Beta of the security

r_m= Expected market return

The formula can also be used for regression, if rewritten as:

$r_a - r_f = \alpha + \beta_a(r_m - r_f)$, where:

α= intercept of regression

A positive alpha indicates that the return of the asset is higher than what the CAPM predicts. Through a regression, it is possible to see if the return of an asset is higher than the predicted value of the CAPM.

3.5.2 The Fama and French Three-Factor Model

The Fama and French Three-Factor Model is a development of the CAPM that considers value and size of the assets. According to Fama and French, value

companies and small sized companies outperform the market regularly, and by considering the parameters, a more realistic evaluation can be made, compared to the CAPM. For example, CAPM as an evaluation tool for a portfolio with small sized companies would results in higher estimates than the outcome. The Fama and French Three-Factor Model considers this, and can therefore be used to make predictions that are more accurate. (Fama & French, 1992)

The three-factor formula is defined as:

$$r_a = r_f + \beta_a(r_m - r_f) + S_a * SMB + H_a * HML, \text{ where:}$$

SMB= Small market capitalization minus big

HML= High book to market ratio minus low

S_a= Exposure to size

H_a= Exposure to value factors

SMB and HML are based on historic data by a combination of different portfolios. The current and historic values can be accessed on Kenneth French's web page (2017). The exposure factors, S and H are obtained by regression. As with the CAPM, the Fama and French Three-Factor Model can also be rearranged to measure the performance of a portfolio:

$$r_a - r_f = \alpha + \beta_a(r_m - r_f) + S_a * SMB + H_a * HML$$

Where a positive alpha indicates that the return of the asset is higher than what the Fama and French Three-Factor Model predicts.

3.6 Investment Strategy Risks

There are many strategies and formulas that claims to beat the average market return. However, there are many risks with back testing the strategies based on historical data. The most common risks and faults when testing investment strategies are described below.

Look-ahead bias is when data that was not available during the investment period is being used in a simulation to backtrack the performance of a formula. An example of this is the assumption that financial data becomes available immediately after a financial period. This results in a higher return than could be expected. (Gilles, et al., 2008)

Survivorship bias refers to when only a subset of all available investment possibilities is being considered. This subset only consists of the companies that did not go bankrupt during the chosen period. If this subset is being used to track performance, the result of the strategy may be better than reality. (Rohleder, et al., 2010)

Data mining is the process of creating a formula based on previous data. By back-testing several strategies, one can find a near optimal investment strategy on a certain data set. However, this does not guarantee that the strategy will perform as good in the future. (Greenblatt, 2006, p. 144)

Higher risk often implies higher returns. Using a high-risk formula for investing without risk adjusting the returns can lead to a false perception of high returns. Therefore, a risk evaluation needs to be conducted. One example to compare risk-adjusted returns is the Sharpe ratio. (Lundblad, 2007)

Other risks could include small, illiquid companies with low market turnover. These types of companies are not available to large investors. For high frequency trading formulas or strategies, the transaction cost must be considered too. The returns might not beat the market after the cost of transaction is included. (Greenblatt, 2006, p. 144)

4. Data

Market data is needed to compare the return of the Magic Formula to the market return. Furthermore, to be able to see how the Magic Formula performs over time, data over a period is needed. Greenblatt argues that a period less than three years is too unpredictable to be able to conclude any results of the formula. Therefore, the years analysed in this paper was 2007-2017, which is well above Greenblatt's proposed minimum, and it is also a more recent dataset than the ones analysed in several other studies, such as Rohleder, et al. (2010) and Persson and Selander (2009).

The necessary data was gathered from Thomson Datastream. The data and frequency of each data source used for the paper can be found in Table 1. The trading date was set to the first of April each year, or the closest date previous that the stock market is open. This is mainly because most companies release their yearly financial statements during the first quarter of the year. This ensures up to date data when trading. Moreover, since some data are only updated on a yearly basis in Datastream, there is a risk of look ahead bias occurring. By choosing the first of April as trading date, most firms will have already presented their annual report. Therefore, the risk of look ahead bias decreases. Stocks are sold on the 31st of March the coming year. (Gilles, et al., 2008)

Table 1. Data and frequency

Data	**Frequency**
Price	Daily
EBIT	Yearly
Enterprise value	Yearly
Working capital	Yearly
Total assets	Yearly
Total intangible assets	Yearly
Total current asset	Yearly
Risk free interest	Yearly

Only companies on the Swedish stock exchange, with a market size of 500 million SEK or more, were included in the data collected. According to Greenblatt, the formula does not perform well on certain industries. The reason behind this is that the Magic Formula does not work well due to the structure of their financial statements. Therefore, the following sectors were excluded:

- Banks
- Electricity
- Financial services
- Gas, water, and multitudes
- Oil and gas producers
- Real estate

In addition to the excluded sectors, some additional companies' stocks were excluded due to insufficient data in the Datastream database. This could be a source of error, but since the companies with insufficient data does not follow any obvious pattern, they are considered random occurrences and will therefore not be considered to influence the result.

5. Method

To invest according to the Magic Formula, Greenblatt suggest the following steps:

1. Exclude companies that are not on the large or midcap on each stock exchange.
2. Exclude utility and financial stocks.
3. Calculate earnings yield ($\frac{EBIT}{Enterprise\ value}$).
4. Calculate return on capital ($\frac{EBIT}{Invested\ capital}$).
5. Rank companies high to low based on earnings yield and return on capital.
6. At a set date, invest in 20 companies.
7. Sell after one year and repeat the process.

The necessary market and company data was obtained from Datastream. The data was manually filtered by removing companies with lost or insufficient data, to create a complete dataset. Datastream offers the possibility to filter the unwanted sectors, so the list of companies obtained only included the suggested companies. Moreover, the price obtained from Datastream was adjusted, so effects due to dividends and splits have been accounted for.

The return of OMXS30 was used to compare the return of the Magic Formula portfolio with a reference point. OMXS30 includes the 30 most traded stocks on the Swedish stock market. The daily value of the index during the period could be obtained from Datastream.

The period was set from the 1st of April 2007 until the 31st of March 2017. All the 20 stocks were purchased on the 1st of April and sold on the 31st of March the following year, chosen by ranking them according to Greenblatt's formula. To measure the return regarding the risk taken, the Sharpe ratio, CAPM and the Fama and French Three-Factor Model were used. All data from Datastream were imported to Excel and divided up on a yearly basis. Yearly returns for the portfolio and OMXS30, along with standard

deviations were calculated. The company portfolio for each year according to the Magic Formula can be seen in the appendix.

To compare the Magic Formula to the market return, regressions based on CAPM and the Fama and French Three-Factor Model were made in STATA. Moreover, the Sharpe ratio was calculated in Excel.

6. Result and Analysis

This chapter covers the measured returns for the Magic Formula and OMXS30 between 2007 and 2017. It also covers the volatility and the risk-adjusted return for the portfolio. In the end of the chapter, the Magic Formula and the Efficient Market Hypothesis are analysed.

6.1 Returns

The portfolio based on the Magic Formula has followed the overall movement of OMXS30. However, the Magic Formula portfolio has consistently outperformed the market, as seen in Figure 1. Despite the Magic Formula portfolio outperforming the market, it was still heavily affected by the financial crisis, with negative returns during 2007 and 2008. Nevertheless, the portfolio managed to do a recovery during 2009 and have since maintained a strong increase in value, higher than OMXS30, as seen in Figure 2.

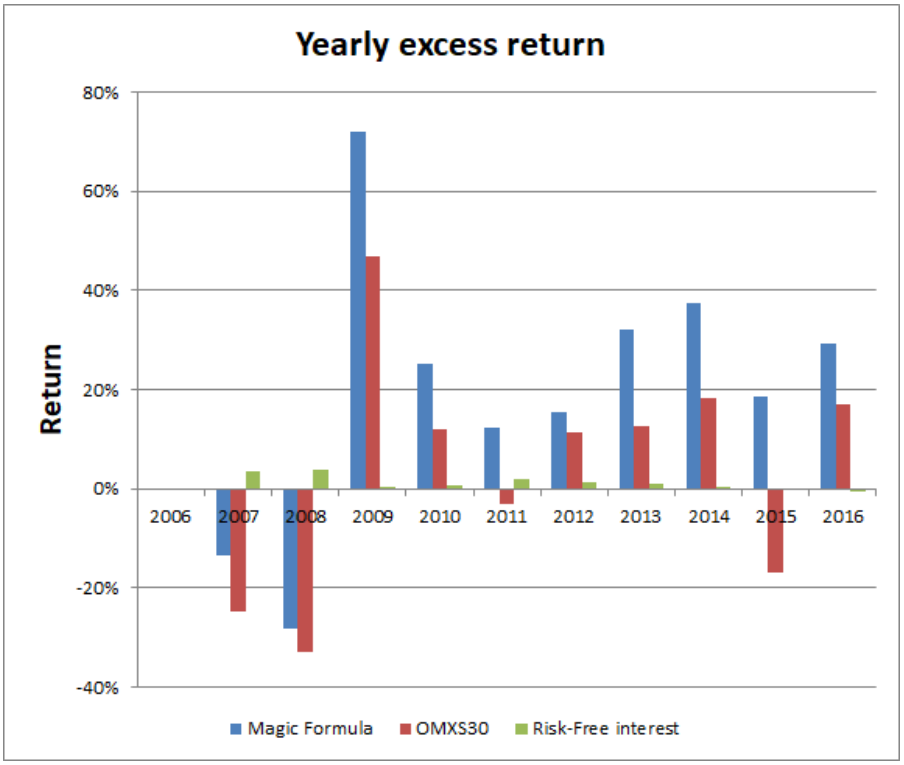

Figure 1: Yearly excess return of the Magic Formula portfolio, OMXS30 and the risk-free interest rate.

Comparing the two portfolios, the Magic Formula portfolio outperformed the market portfolio during the period 2007-2017, as seen in Table 2. The Magic Formula portfolio provided a 382,0 % excess return, meaning each invested SEK returned an additional 3,82 SEK after the ten-year period. The market portfolio, OMXS30, on the other hand provided a 15,8 % excess return, providing an additional 0,158 SEK for each invested SEK.

The Magic Formula portfolio has followed the overall movement of the stock market. The two biggest differences in the time period 2007-2017 was 2009 and 2015. However, the success during these years cannot be contributed to a single stock in any of the cases. During 2009, there was a high overall growth with the top five stocks in the portfolio at least doubling in value during the holding period. In 2015, the Magic Formula managed to pick good stocks with only the bottom seven stocks having negative returns for the period.

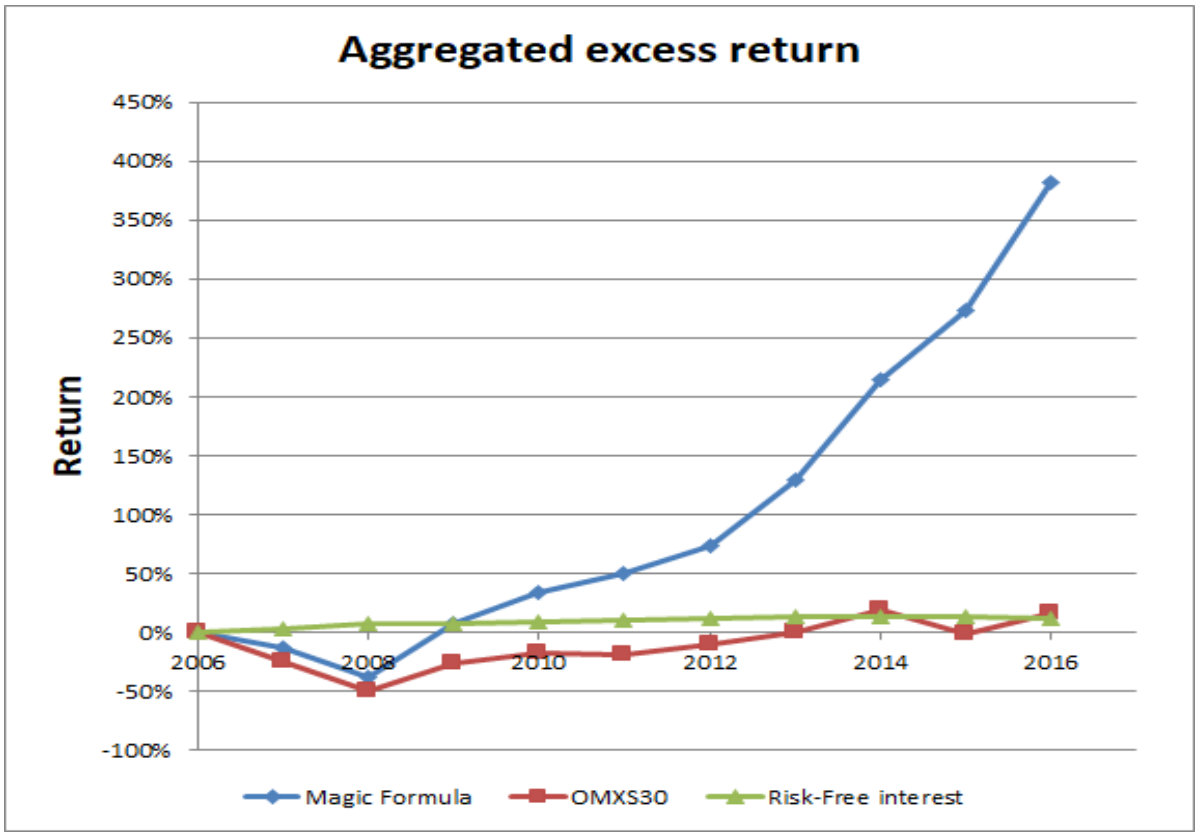

Figure 2: Aggregated excess return of the Magic Formula portfolio, OMXS30 and the risk-free interest rate.

Table 2. Returns for the Magic Formula and OMXS30.

Year	The Magic Formula	OMXS30
2007	-10,22%	-21,43%
2008	-24,26%	-28,91%
2009	72,50%	47,28%
2010	25,79%	12,52%
2011	14,07%	-1,46%
2012	16,91%	12,70%
2013	32,90%	13,69%
2014	37,91%	18,71%
2015	18,22%	-17,32%
2016	28,69%	16,45%

	The Magic Formula	OMXS30
Average	21,25%	5,22%
Min	-24,26%	-28,91%
Max	72,50%	47,28%
Period return	548,71%	133,57%
Standard Deviation	1,06%	1,38%

6.2 Volatility

A high return, as seen in 6.1, does not directly imply that the Magic Formula is a better investment strategy than following the index. The higher return could be a result of taking on a higher risk than the market. With volatility as a risk measurement, and comparing the volatility and returns of OMXS30 and the Magic Formula portfolio, a risk-adjusted return can be calculated. This comparison is done through the Sharpe-measure and presented in 6.3. The daily volatility has been plotted for each year in Figure 3. For 9 out of 10 years, the Magic Formula had a lower volatility than the OMXS30 index. Moreover, when considering the volatility of the daily returns, the Magic Formula had a daily volatility of 1,06 %, while OMXS30 had a daily volatility of 1,38 %. This indicates that the Magic Formula portfolio's higher return cannot be explained by a higher volatility than OMXS30.

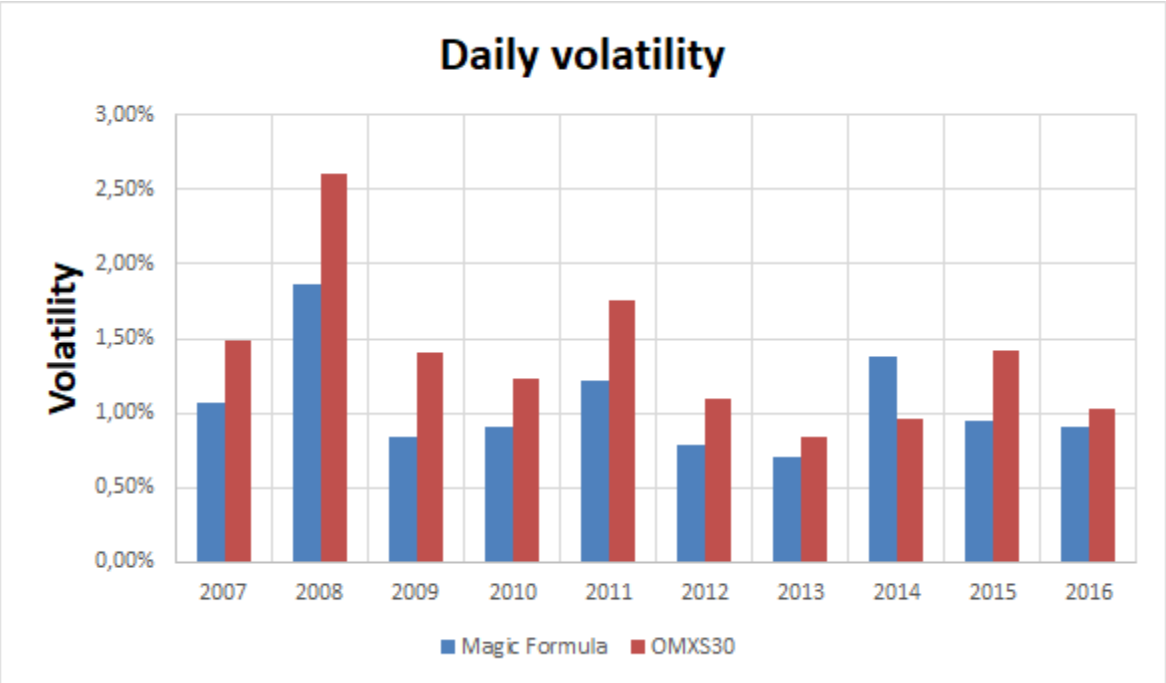

Figure 3. Annual volatility of the Magic Formula and OMX30.

Another aspect to consider is how the Magic Formula performs during the financial crisis. During the year 2008, when the financial crisis had its greatest impact, the volatility of the Magic Formula was slightly lower than the OMXS30, 1,87 % compared to 2,61 %. This implies that the Magic Formula might have had a slightly lower risk during the crisis. However, there are not enough data points to statistically tell a significant difference, but it is in line with the lower average volatility. 2014 was the only year during the 10-year time span that the Magic Formula showed a higher volatility than OMXS30. There is no certain explanation to this, OMXS30 had one of its lowest volatility that year while the Magic Formula showed a slightly above average volatility.

6.3 The Sharpe Ratio

As presented in 6.1 and 6.2, the Magic Formula portfolio and OMXS30 are not equally volatile and have provided different returns. The problem when comparing the returns of the two portfolios is that they might have acquired different amount of risk, which could explain why the Magic Formula portfolio outperformed OMXS30. The Sharpe-ratio provides a risk-adjusted excess return for the two portfolios, which can be used to make a fair comparison of their performances.

The Magic Formula has a Sharpe-ratio of 0,769 compared to the value for OMXS30 that is 0,146. Thus, when adjusting for the risk taken, the Magic Formula portfolio still provided a higher excess return compared to OMXS30. This indicates that the higher return from the Magic Formula portfolio is not only dependent on a higher risk.

6.4 The Capital Asset Pricing Model

The CAPM analysis consists of a linear regression performed in Stata. The regression is performed with the risk-adjusted return from the Magic Formula portfolio as dependable variable and the risk-adjusted return from the market portfolio, OMXS30, as the explanatory variable.

Analysing the Magic Formula with the Capital Asset Pricing Model will conclude if the excess return is due to a higher systematic risk. An alpha value that is significantly greater than zero indicates that the Magic Formula gives a higher return than what the model predicts, i.e. the portfolio does not give a higher return only due to higher systematic risk. As can be seen in the formula below, an alpha value greater than zero indicates a higher return than the CAPM would predict.

$$r_a - r_f = \alpha + \beta_a(r_m - r_f)$$

Table 3 shows that the alpha value is 0,157 while the P-value is lower than 0,05, indicating that the annual excess return cannot be explained solely by high systematic risk. This concludes that the return on the Magic Formula model is higher than what could be expected, based on the risk of the assets. Since the investment has a higher risk premium than the risk acquired, the investment will perform better than what the capital asset pricing model suggests.

Table 3. Capital Asset Pricing Model annual regression results.

	CAPM			
	Coefficient	Standard Error	t-stat	P-value
Alpha	0,1566	0,0313	5,01	0,001
Market	1,090	0,1366	7,99	0,000

6.5 The Fama and French Three-Factor Model

The Fama and French Three-Factor Model consists of a linear regression performed in Stata. The regression is performed with the risk-adjusted return from the Magic Formula portfolio as dependable variable. The risk-adjusted return from the market portfolio, and the value- and size factors, HML and SMB, are considered the explanatory variables.

The Fama and French Three-Factor Model proposed by Fama and French (1992) expands the CAPM to also consider the value and size of the assets. Thus, the Fama and French Three-Factor Model can be used to determine if any excess return can be explained by the higher systematic risk, more value or smaller stocks. As can be seen in the formula below, an alpha value greater than zero indicates a higher return than the Fama and French Three-Factor Model would predict.

$$r_a - r_f = \alpha + \beta_a(r_m - r_f) + S_a * SMB + H_a * HML$$

The regression gave an alpha-value of 15,4 % with 0,005 as the corresponding p-value. This indicates that there are other factors than higher systematic risk, more value or smaller stocks, i.e. something that is not part of the Fama and French Three-Factor Model, which affects the excess return of the Magic Formula portfolio.

There are also additional conclusions that can be drawn from the regression of the Fama and French Three-Factor Model. Just like the CAPM analysis indicates, the beta value is positive and statistically significant with a value of 1,27 and a p-value of 0,002. Thus, the model indicates that the Magic Formula portfolio achieves a higher return partly based on taking a higher systematic risk in the investment, even though the higher risk cannot explain all the excess return. However, the other parts of the Fama and French Three-Factor Model, the exposure to value factors and the exposure to size, have not provided a statistically significant explanation to the higher excess return. As shown in Table 4, both factors specific to the Fama and French Three-Factor Model have a low value and are not significant. Thus, the excess return cannot be explained by an increased exposure to small size companies or value factors.

Table 4. Fama and French Three-Factor Model annual regression results.

	Fama & French's Three-Factor Model			
	Coefficient	Standard Error	t-stat	P-value
Alpha	0,1536	0,0346	4,39	0,005
Market	1,2677	0,0059	5,03	0,002
SMB	-0,000019	0,0041	0,00	0,998
HML	-0,00326	0,0350	-0,80	0,455

6.6 The Efficient Market Hypothesis

The Efficient Market Hypothesis suggests that an investor cannot outperform the market through stock selection or market timing. The only way to beat the market is to take on more risk. The three forms of the Efficient Market Hypothesis have different implications on the Magic Formula.

The weak form, also called the random walk theory does not discourage the idea of the Magic Formula. The weak form states that due to randomness in stock prices, it is not possible to look at past stock prices to predict future prices by finding patterns. Moreover, past earnings and growth cannot be used to predict future earnings and growth. However, by doing a fundamental analysis and research of companies' financial statement it is possible, albeit not easy, to beat the market. Since the Magic Formula is a kind of fundamental analysis, an excess return from the Magic Formula could be possible according to the weak form of the Efficient Market Hypothesis.

The second part of the Efficient Market Hypothesis, the semi-strong form, suggests that all public information, including earnings, return on capital etc., are included in the price. Therefore, it is not possible over perform the market average by neither fundamental nor technical analyses. This implies that the Magic Formula should not work, according to the semi-strong form of the Efficient Market Hypothesis.

The strong form of the Efficient Market Hypothesis includes, in addition to the semi strong form, that it is not possible to beat the market even with insider information. In the same way as for the semi-strong form, the Magic Formula should not work according to the strong form of the Efficient Market Hypothesis.

The excess return of the Magic Formula in this paper is contradictory to the semi-strong and strong parts of the Efficient Market Hypothesis. According to the Efficient Market Hypothesis, the excess return is either due to luck or due to excessive risk taking. The longer the period, the less chance of continuous luck there is. However, the results might be consistent with the weak form.

Based on the information used to choose the Magic Formula portfolio, the analysis in this paper can be considered a semi-strong form test of the Efficient Market Hypothesis. The excess return of the Magic Formula portfolio is inconsistent with the Efficient Market Hypothesis, indicating that the Stockholm stock exchange might not have been an efficient market during the period 2007-2017. However, it is important to consider the weaknesses of this test, further described in 6.8. The test is based on data obtained from Thomson Datastream, where incomplete data sets have been removed from the test. Thus, there are companies that have not been considered in the analysis and could have affected the results.

Another important point is that this is only one test and should not by itself be considered a proof for or against the Efficient Market Hypothesis. Many tests are required to make a significant conclusion on the subject and this could be a contribution as one test.

6.7 Comparison with Existing Research

6.7.1 The Finnish stock Market 1991-2013

The result from testing the Magic Formula on the Swedish stock market has many similarities with the results from the test on the Finnish stock market by Davydov, Tikkanen and Äijö (2016). The Magic Formula portfolios achieved an annual mean return of 19,26 % and 21,25 % on the Finnish and the Swedish stock market respectively. Both were a statistically significant increase from the market returns of 13,63 % and 5,22 %. Thus, the Magic Formula beat the market in both cases. An interesting part of the test on the Finnish market is that the Magic Formula was tested and compared to other value-based investing strategies. The results indicated that at a

small market, such as the Finnish stock market, the Magic Formula was not superior to other strategies.

6.7.2 The Nordic Stock Market 1998-2008

In the analysis by Persson and Selander (2009), a monthly average return of 1,32 % was achieved, which equals an annual return of 17,04 %. The achieved returns were higher than the ones from the market portfolio. However, CAPM and the Fama and French Three-Factor Model did not give a significant excess return. Based on these analyses, Persson and Selander concluded that the Magic Formula did not beat the market during the observed period, which differs from the results found in this paper. Rather than applying blind trust in the Magic Formula, Persson and Selander recommends using the Magic Formula as a first screening process to find potential investment opportunities. This is a recommendation that could be applied to most subjects in life; it is important to form an opinion and try to understand why a strategy or a person recommends a certain option before choosing to trust the advice.

It is difficult to compare why the Magic Formula did not achieve as good result in the analysis by Persson and Selander (2009), as it did in this paper. There are several differences between the analyses. The largest difference is obviously the different period and stock market. Nevertheless, there are also smaller differences, such as Persson and Selander adjusting the portfolio return for transaction costs. Perhaps the market crashes in 2001-2002 and 2007 were too tough for the Magic Formula to handle and thus lead to the non-significant difference from the market return.

6.7.3 The Swedish Stock Market 2005-2015

Considering that the analysis by Färdig and Hammarling (2016) is based on the same market during a highly overlapping period, the results should be similar. Färdig and Hammarling got an average annual return of 19,37 %, which is slightly lower than the one achieved in this paper. The difference may have many different reasons, but the most prominent one is the consideration of Swedish taxation and brokerage costs by Färdig and Hammarling, which has not been considered in this paper. Thus, the return presented by Färdig and Hammarling is the net return, while the result of this paper

presents the gross return. Färdig and Hammarling concludes that the Magic Formula beats the market.

6.7.4 Overall Comparison

When Greenblatt performed his 17-year study between 1988-2004, the average yearly return was 30,8 %, compared to the S&P 500 return of 12,4 % for the same period (Greenblatt, 2006). The main theme in all the papers is that, over time, the Magic Formula outperforms, or at least performs as well as the market. However, during individual years or shorter time spans, the Magic Formula sometimes performs worse than the market. Moreover, the Magic Formula does not seem to be market dependent, since it works as well on US stock market and stock market in the Nordics.

The result in this paper is in line with both Greenblatt's research and other papers that have looked at the stock markets in the Nordic region. This shows that the Magic Formula outperform the market return at several different markets and during multiple time spans. By being tested in several papers, during different time spans and markets with results that outperform the market over time, the indication is that it is unlikely that the Magic Formula builds on data mining. If data mining would be the case, it is not probable that the Magic Formula would perform well in all the papers mentioned above. The results of this paper strengthen the perception that no data mining has been involved in the creation of the Magic Formula.

This paper is one of the first that tests the Magic Formula on a time span that is entirely after 2006, which was the year The Little Book That Beats the Market by Greenblatt was released. There are two interesting aspects of this. Firstly, it was impossible for Greenblatt to account for this period of time when he designed the Magic Formula, i.e. if the excess return of the Magic Formula depended on data mining, the results in this paper could have been negatively affected. Secondly, during the chosen time span of this paper, the Magic Formula was common knowledge. This could affect the returns due to several investors trying to invest using the Magic Formula.

6.8 Risks

This paper has relied on historical financial data from the database Thomson Datastream. Once the necessary data was imported in Excel, there were missing data on several companies. These were excluded from the analysis since a proper analysis could not be performed. There could be many reasons why there is a lack of data for some companies, for example it could be because of an IPO during the year, bankruptcy or simply because Thomson Datastream were not able to access the data. Depending on the reason, this could affect the result. The risk of excluding bankrupt companies has been reduced by not removing bankrupt companies for which the necessary data could be accessed.

Moreover, if data that did not affect the trading decision were missing, i.e. data on other days than the trading days, the company was not excluded from the list. Companies that were excluded due to lack of data were only excluded for the year with insufficient data, and not excluded from the whole 10-year period.

Another source of error is the exclusion of utility and finance companies. This might skew the results. However, since it is stated in the Magic Formula that these kinds of companies should be removed it is a risk that has to be accepted in order to evaluate the performance of the Magic Formula.

7. Conclusion

This paper has studied if the Magic Formula could outperform the Swedish stock index OMXS30 during the period 2007-2017. The results show that it is possible to get a significantly higher return on investment with the Magic Formula compared to OMXS30, on the Swedish stock market. The excess return cannot completely be explained by a higher risk, according to the CAPM and the Fama and French Three-Factor Model.

Does this mean that it is possible to disregard the Efficient Market Hypothesis? Probably not entirely. This paper is based on a limited timeframe, which includes a market crash and the excess results could in part depend on luck. However, as mentioned earlier, several other papers have also shown an excess return with the Magic Formula. Moreover, the excess return cannot fully be explained by the risk taken, according to the Fama and French Three-Factor Model test. One paper showed that the Magic Formula did not create a significant excess return, but no study has shown that the Magic Formula performs worse than the market average.

The implication of this paper, since the Magic Formula significantly outperforms the market, is that the Efficient Market Hypothesis is not valid on a semi-strong level on the Swedish stock market. However, the data in this paper covers only 10 years of the Swedish stock market. To be able to disregard the Efficient Market Hypothesis, a much larger data set would be needed. Moreover, the result in this paper cannot be used to test the Efficient Market Hypothesis on a weak or strong level.

The Efficient Market Hypothesis says that all information is available to all investors at the same time. Many analysts follow larger companies, such as those in OMXS30, closely. Therefore, information spreads to the public fast. A future research topic could be to look at how the Magic Formula performs on the smaller multilateral trading facilities, such as Aktietorget and First North. Since the companies traded on these platforms are smaller, fewer analysts cover them and therefore the Efficient Market Hypothesis might not hold.

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10. Appendix

2007-04-01 - 2008-03-31
ADDNODE B
ARENA PERSONAL
BE GROUP
BETTING PROM.SWEDEN
BTS GROUP
CONNECTA
ENACO
INTELLECTA B
JEEVES INFO.SYSTEMS
KAKEL MAX
KNOW IT
MODUL 1 DATA
NETJOBS GROUP
PROACT IT GROUP
PROFFICE B
SERVAGE B
SJR IN SCANDINAVIA B
SOFTRONIC B
UNIFLEX B
VLT B

2008-04-01 - 2009-03-31
3L SYSTEM
ACANDO B
ADDNODE B
CONNECTA
DIADROM HOLDING
HIQ INTERNATIONAL
JEEVES INFO.SYSTEMS
MICRO SYSTEMATION B
MODERN TIMES GP.MTG B
MOMENT GROUP
NORDIC LEISURE
ODD MOLLY INTL.
POOLIA B
PREVAS B
PROFFICE B
SJR IN SCANDINAVIA B
SOFTRONIC B
SWECO B
TICKET TRAVEL
UNIFLEX B

2009-04-01 - 2010-03-31
3L SYSTEM
ADDTECH B
AF B
AURIANT MINING
AXFOOD
BTS GROUP
DORO
DUNI
INSPLANET
INTELLECTA B
KNOW IT
MOMENT GROUP
ORC GROUP
PROACT IT GROUP
PROFFICE B
Q-MED
SECURITAS B
TRICORONA
WESC
VITEC SOFTWARE GROUP B

2010-04-01 - 2011-03-31
AF B
AVAILO
AVEGA GROUP B
AXFOOD
BETSSON B
CAPERIO HOLDING
CISION
CONNECTA
ENTRACTION HOLDING B
HOUSE OF FRIENDS
INSPLANET
KAKEL MAX
KNOW IT
READSOFT B
SECURITAS B
SJR IN SCANDINAVIA
TELE2 B
UNIFLEX B
WISE GROUP
VITEC SOFTWARE GROUP B

2011-04-01 - 2012-03-31
ADDNODE B
AVAILO
AVEGA GROUP B
CAPERIO HOLDING
CHERRY B
HEDSON TECHS.INTL.
HOUSE OF FRIENDS
INSPLANET
JEEVES INFO.SYSTEMS
KNOW IT
NETJOBS GROUP
PREVAS B
PROFFICE B
READSOFT B
SCANDBOOK HOLDING
SEMCON
SIGMA B
SJR IN SCANDINAVIA B
VENUE RETAIL GROUP B
VITEC SOFTWARE GROUP B

2012-04-01 - 2013-03-31
ADDNODE B
ADDTECH B
BIOGAIA B
CAPERIO HOLDING
CONNECTA
DEDICARE
DIADROM HOLDING
ENEA
HIFAB GROUP
INSPLANET
KNOW IT
LAGERCRANTZ GROUP B
MODERN TIMES GP.MTG B
MQ HOLDING
NETJOBS GROUP
NORDIC LEISURE
SEMCON
VENUE RETAIL GROUP B
WISE GROUP
VITEC SOFTWARE GROUP B

2013-04-01 - 2014-03-31
ADDNODE B
ADDTECH B
AF B
AVEGA GROUP B
CYBERCOM GROUP EUROPÉ
DEDICARE
ELANDERS B
HOUSE OF FRIENDS
ICA GRUPPEN
LAGERCRANTZ GROUP B
MERTIVA A
MIDSONA B
NOLATO B
NORDIC LEISURE
NOVOTEK B
ONIVA ONLINE GROUP EU.
PROFFICE B
SEMCON
SJR IN SCANDINAVIA B
UNLTD. TRAVEL GROUP

2014-04-01 - 2015-03-31
ADDNODE B
ALLENEX
ALLGON B
AVEGA GROUP B
BYGGMAX GROUP
CYBERCOM GROUP EUROPÉ
DEDICARE
KINDRED GROUP SDR
LAGERCRANTZ GROUP B
MEDIVIR B
MOD.EKONOMI.SVER.HLDG
MOMENT GROUP
MQ HOLDING
MULTIQ INTERNATIONAL
NORDIC MINES
NOVOTEK B
PROFFICE B
SEMCON
TAGMASTER
UNLTD. TRAVEL GROUP

2015-04-01 - 2016-03-31	2016-04-01 - 2017-03-31
ACANDO B	ACANDO B
AF B	AURIANT MINING
ALFA LAVAL	AVEGA GROUP B
ALLGON B	BETSSON B
AVEGA GROUP B	BONG
BYGGMAX GROUP	CAPERIO HOLDING
CONCENTRIC	ENEA
DEDICARE	FEELGOOD SVENSKA
ELANDERS B	FINGERPRINT CARDS B
LAGERCRANTZ GROUP B	HUMANA
MEKONOMEN	INWIDO
MOMENT GROUP	KNOW IT
MQ HOLDING	MQ HOLDING
NOVOTEK B	MYCRONIC
POOLIA B	NOBIA
SJR IN SCANDINAVIA B	PROACT IT GROUP
SOFTRONIC B	SJR IN SCANDINAVIA B
UNIFLEX B	SWEDISH MATCH
UNLTD.TRAVEL GROUP	UNLTD.TRAVEL GROUP
WISE GROUP	WISE GROUP