LUND UNIVERSITY
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NEKH01 – Bachelor Thesis

Fall 2016

Value Investing on the Nordic Stock Market

Does the *Magic Formula* constitute a viable strategy for outperforming the market?

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Abstract

In this thesis we investigate if following the *magic formula* can yield superior investment returns in relation to the risk taken. The *magic formula* is a term coined by Joel Greenblatt, describing a systematic approach to successful stock investing. The strategy identifies high value companies based on return on capital that are selling at a discount to their intrinsic value based on the company's earnings yield. In order to examine the possible relation between the *magic formula* and superior investment returns, we back-test the formula on the Nordic stock market between 2007 and 2016. We compare the returns of the portfolio with the benchmark OMX Nordic 40. In order to determine if the portfolio has yielded high returns in relation to each unit of risk, we apply the Capital Asset Pricing Model as well as the Fama-French three-factor model. Using the CAPM for the period 2007 to 2016 we arrive at a monthly excess return of 1.27% and an annual excess return of 17.8%. Applying the three-factor model, we yield a monthly and annual excess return of 1.29% and 14.01% respectively. Excess returns are often attributed to having taken on excess risk or merely as the result of chance. The Sharpe ratio for the period 2007 to 2016 was 0.22 for the *magic formula* portfolio compared to 0.027 for the OMX Nordic 40. Testing if the Sharpe ratio of the *magic formula* is different from the Sharpe ratio of the market, it is evident that the results are statistically significant. The years following the financial crisis of 2008 are included in the test period. It is notable that although the *magic formula* portfolio is significantly less diversified than the OMX Nordic 40, it performed better during the setback of 2008 and 2009, and returned to pre-crisis levels more rapidly than the market portfolio.

Key words: Value Investing, Sharpe Ratio, Nordic Stock Market, Magic Formula, CAPM, Fama-French three-factor model

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1. Introduction

The principal theory among academics and institutional investors in recent years has become the theory of efficient markets. Originally explained by Fama (1970), the hypothesis states that the pursuit of excess returns on the financial markets is folly, as asset prices always reflect all available information. Fama (1970) argues that excess returns over a given time period are merely the result of either chance or of taking on excess risk.

This understanding of financial markets has gained criticism from a group within the investing community called value investors. Perhaps the most widely recognized advocate of value investing is Warren Buffett, who on several occasions has questioned the implications of the efficient market hypothesis (Buffett, 1989). Proponents of a value-approach to investing argue, as advocated in Buffett's 1984 article entitled *The Super Investors of Graham-and-Doddsville*, that the probability of several investors, all following the same investment philosophy, consistently outperforming the market, could not be explained by mere chance (Buffett, 1984).

A disciple of the value investing school is hedge fund manager Joel Greenblatt, who through a systematic approach to stock-picking which he calls *magic formula* investing, identifies high value companies based on return on capital that are selling at a discount to their intrinsic value based on the company's earnings yield. Greenblatt has successfully implemented this strategy on the American stock exchange over a significant period of time (Greenblatt, 2006).

We attempt to measure whether having applied Greenblatt's *magic formula* on the Nordic stock exchange from the period 2007 to 2016 would have yielded satisfactory returns in relation to the risk that would have been taken on and if the *magic formula* is likely to produce similar results in the future.

1.1 Purpose

The purpose of this thesis is to investigate the risk-adjusted performance of a portfolio, constructed using Joel Greenblatt's *magic formula* framework, on the Nordic stock market between the years 2007 and 2016 and to determine if the formula constitutes a viable strategy for outperforming the market in the future.

1.2 Results

The results we obtain from back-testing Greenblatt's strategy on the Nordic stock market are quite intriguing. Having applied the *magic formula* on the Nordic stock market from 2007 to 2016 would have yielded a monthly and annual excess return of 1.27% and 17.8% respectively. We conclude that the returns are not merely the result of taking on excess risk. In 83 out of the total 108 months, the volatility as measured by the standard deviation of the portfolio was lower than the market portfolio, represented by the OMX Nordic 40. The average monthly volatility was also lower for the *magic formula* portfolio: 1.1% for the *magic formula* portfolio compared to 1.2% for the OMX Nordic 40. The Sharpe-ratio, expressing the total yield gained per unit of risk taken, is significantly higher for the magic formula: 0.22 as compared to the OMX Nordic 40 which had a Sharpe-ratio of 0.03. We apply the hypothesis test from Jobson and Korkie (1981) to determine if the difference between the Sharpe ratio of the *magic formula* portfolio and the OMX Nordic 40 is statistically significant, we find that that the Sharpe ratio of the *magic formula* is significantly higher than that of the OMX Nordic 40, and not merely the result of chance. In order to determine if the excess return can be explained by having been exposed to a high degree systematic risk, we apply the Capital Asset Pricing Model. Furthermore, we apply the Fama-French three-factor model, which attempts to explain the excess return of the portfolio by adding two more factors to the CAPM, a value factor and a size factor. As for the CAPM and Fama-French three-factor model, we receive positive alpha-values and beta values between 0 and 1. This indicates that the returns are not the result of the *magic formula* strategy taking on excess risk.

As the financial crisis of 2008 is included in the test period, it is clear that, although the *magic formula* portfolio is less diversified than the market portfolio, it performed better during the years of the crisis and recovered much more rapidly than the market portfolio did. Thus, the results of the investigation indicate that applying the *magic formula* on the Nordic stock market will yield returns that are quite satisfactory.

1.3 Outline

In the subsequent section we provide the theoretical framework that the investigation is based on. We introduce the hypothesis of efficient markets and the implications it has on active portfolio management and on the *magic formula* in particular. Further on, we also discuss previous studies of efficient markets and anomalies that contradict the idea of a strongly efficient market. In the theory section we also clarify the models that we apply to determine the risk-adjusted returns such as The Capital Asset Pricing Model, Fama-French three-factor model and the Sharpe Ratio. Following this we discuss the framework behind Joel Greenblatt's *magic formula*. How each company is ranked, how the portfolios are constructed and how portfolio risk is calculated is included in this section. The penultimate chapter, *Data & Method*, is concerned with how we interpret and apply the *magic formula* to the Nordic Market. In this chapter we also explain the compromises that we are forced to make, mainly due to a lack of data. In the last section we analyze and discuss the results of the investigation and provide recommendations for further research.

2. Theory

2.1 The Efficient Market Hypothesis

Fama (1970) proposes the idea of efficient markets. The hypothesis implies that achieving superior returns over a long period is merely the result of luck or a result of the investor taking on excess risk. As markets always reflect all available information, investors cannot exploit information that the wider market does not have access to, as no such information exists. The hypothesis suggests that attempting to manage a portfolio actively is folly, arguing that the only way to achieve higher returns is to take on excess risk.

The efficient market hypothesis differentiates between different levels of efficiency. The least efficient level is weak market efficiency. Weak efficiency suggests that previous movements in the price of a stock do not affect its future movements (Fama, 1970). This implies that any strategy advocating the use of technical analysis to predict the future movements of a stock cannot be used to gain superior returns. Weak market efficiency also suggests that figures in a company's balance sheet, income statement or other fundamentals need not necessarily be reflected in the price of stock. Hence, fundamental analysis can be used to find undervalued and overvalued stocks and thus achieve superior returns.

Semi-strong market efficiency is defined as the market reflecting all publicly available information. Hence, balance sheet figures, cash flow statements and the like cannot be used to find undervalued or overvalued companies, as these figures are already incorporated in the stock price (Fama, 1970). Semi-strong efficiency suggests that the only information that can be exploited in order to achieve superior returns is information that is not readily available to the general public. Insider information, that is, information only available to a certain few within the company, is not reflected in the stock price and could potentially be used to purchase undervalued companies.

The highest form of efficiency is strong market efficiency. The idea of strong market efficiency suggests that all information is reflected in the price of a stock, both public and private. Hence, neither public nor insider information could be exploited to gain excess returns (Fama, 1970). The implications of strong market efficiency are that any form of active portfolio management cannot be carried out successfully over a longer period of time. Thus, investors should revert back to a passive form of investing such as purchasing an index fund.

The efficient market hypothesis has implications on the *magic formula*. Weak market efficiency suggests that the *magic formula* can possibly be used in order to purchase companies with high profitability measures at a bargain price. However, the idea of semi-strong and strong efficiency is contradictory to the idea of applying the *magic formula* successfully. As semi-strong and strong efficiency imply that all publicly available information, including such figures as return on capital, earnings before interest and taxes, and enterprise value are already reflected in the stock price, any attempt at purchasing a company at a bargain price will not yield satisfactory results. Strong and semi-strong efficiency imply that having achieved superior returns over a long period by using Joel Greenblatt's formula is either the result of luck or of the formula taking on excess risk.

2.2 Anomalies

2.2.1 The January Effect

Among market anomalies, one of the most widely studied is the January effect. First observed and described by Wachtel (1942) in *Certain Observations on Seasonal Movements in Stock Prices*, the paper coined the term *January effect*, describing the historically abnormal returns and "bullish tendencies" (Wachtel, 1942, p.185) of stocks during the first month of the year.

Wachtel (1942) examines the returns of stocks in December to January on the Dow Jones Industrial Average from 1927 to 1942 and finds that the index depreciates in only four of the fifteen years. Another study indicating the existence of a January Effect, Rozeff and Kinney (1976) find that the return on the New York Stock Exchange in January from 1904 to 1974 was roughly eight times as high as the average monthly return.

A plausible explanation of the January effect is the willingness to avoid paying excessive amounts in taxes. A stock that has yielded negative returns over a given time period could be sold at the end of the year in order to cancel out capital losses and capital gains, thus minimizing capital gains tax. This large sell-off in the later months of the year has the effect of driving down the prices of stocks. The recovery of stock prices in the early months of the year, following the sell-off in December, offer an explanation to the abnormally high returns historically observed in January.

2.2.2 Price Earnings Effect

The P/E effect refers to the historical outperformance of stocks with low price-earnings ratios compared to stocks with higher valuations. The price-earnings ratio is a measure of how much a stock is trading for in relation to the earnings of the underlying company. Companies that exhibit low growth potential are usually awarded a low P/E-ratio, while companies with high P/E-ratios and high valuations, trade at a premium due to potential growth in future earnings.

Basu (1977) studies the P/E-effect on the NYSE from 1956 to 1971. Companies are ranked according to P/E-ratio and grouped into five portfolios. The paper finds that the lowest P/E portfolio has an average annualized return of 16.3%, the highest P/E portfolio exhibits an average annual return of 9.34%, and the returns of the three middle portfolios decrease more or less monotonically as P/E ratios increase (Basu, 1977). Furthermore, Basu (1977) finds that the low P/E portfolios do not exhibit higher systematic risk than the high P/E portfolios.

A possible explanation to this anomaly is investor psychology. If investors overestimate future potential growth, too high a premium is paid for the stock. Inversely, underestimating companies with low growth projections can potentially cause the stock of a company to sell at a discount. On aggregate, earnings tend to revert back to the mean. This inevitably causes a portfolio comprised of high P/E companies to underperform a portfolio made up of the stocks of low P/E companies.

2.3 Value Investing

Value investing refers to the act of identifying and purchasing companies that are selling at a bargain to their intrinsic value. Any sensible act of active investing is concerned with purchasing companies that the investor considers undervalued. Hence, all active investing can be described as value investing. However, traditionally value investing has been defined as identifying undervalued companies based on some fundamental measure such as a low price-earnings ratio, high earnings yield or the company selling bellow net current asset value. Historically investing has been grouped into two distinct categories, growth investing and value investing, a rather naive distinction, as growth certainly is a component of a company’s value. However, for the sake of simplicity, purchasing a company that upon analyzing the fundamentals of the business appears to be undervalued is the essence of value investing.

Benjamin Graham of Columbia University is often ascribed as the father of value investing (Graham, 1934). In his seminal work, *Security Analysis*, Benjamin Graham, in collaboration with Professor David Dodd, provides the foundation for what is today called value investing (Graham, 1934). Graham argues that the value of a company and the price of the company's stock are two different things. "Price is what you pay; value is what you get" summarizes Grahams teachings (Buffett, 2009). Graham claims that the discrepancies between price and value are often attributed to "exaggeration, oversimplification or neglect" (Graham, 2009, p.669). Graham (1934) argues that identifying and investing in companies selling below their intrinsic value could achieve superior returns. This idea is not compatible with the efficient market hypothesis, which argues that the market always reflects all available information and that market participants act rationally.

Joel Greenblatt's *magic formula* is rooted in the teachings of Benjamin Graham. The *magic formula* attempts to identify companies that are selling at a bargain price in relation to future earnings potential. While Graham looks to the stability of earnings, dividend history and earnings growth as an indicator of future earnings, Greenblatt focuses on return on invested capital as an indicator of a company's future earnings potential (Greenblatt, 2006). Graham relies heavily on company balance sheets in order to determine the value of a company, with stocks selling below tangible book value or below net current asset value indicating a low valuation (Graham, 2009). Greenblatt substitutes these measures with earnings yield. Although the two investors use different measures to identify possible investments, the reasoning remains the same; identify companies with solid track records that display signs of future earnings potential, and purchase these companies at a bargain to their intrinsic value.

2.4 Theoretical Models

2.4.1 The Capital Asset Pricing Model

The capital asset pricing model is an economic model used for pricing an individual security or portfolio. Using the model on a specific asset one can calculate the specific asset's expected return. The CAPM assumes that there is only one factor of risk, being the market risk factor or systematic risk, usually depicted as Beta, β. The model explains that the higher the beta of an asset, the higher the average return of the asset (Cochrane 1999). The Beta itself is an estimation of how much the asset tends to move with the market. A beta value of one implies that the asset is perfectly correlated with the market, a beta value of negative one indicates that the asset is negatively correlated with the market, and a beta of zero means that the asset is perfectly uncorrelated with the market. The equation is as follows:

$$E(R_i) = R_f + \beta_i\big(E(R_m) - R_f\big) \tag{1}$$

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

The model can also be used to determine if a portfolio's returns exceed the expected return, justified by the specific beta value. For this purpose we rearrange the equation and add the symbol alpha, α, which is the sum of the actual return of the asset and the expected return calculated with the CAPM (Womack, 2003). A positive alpha suggests that the asset yields higher returns than the CAPM predicts. The result is presented below:

$$E(R_i) - R_f = \alpha + \beta_i\big(E(R_m) - R_f\big) \tag{2}$$

2.4.2 Three-Factor Model

The Fama-French three-factor model (Fama & French, 1993) is an expansion of the Capital Asset Pricing Model. Resting on the foundation of the CAPM, the three-factor model takes two more risk factors into account. These factors are the so-called *size factor* and the *value factor.* These factors are often abbreviated as SMB and HML. SMB or Small (market cap) Minus Big is the historical excess return that investors have yielded when investing in small cap stocks compared to big cap companies. HML or High Minus Low is the historical excess return that investors have yielded when investing in value companies compared to growth companies. The HML value is calculated by comparing the average returns of two portfolios comprised of growth stocks and two portfolios comprised of value stocks. Similarly, the SMB value is the difference in average returns between three small market cap portfolios and three big cap portfolios. With these two variables added to the CAPM we find that the degree at which the model explains the return of an asset is increased (Fama & French, 1993). Adding these variables to the CAPM we end up with *Equation 3.* The β remains the market risk coefficient, and the s_i and h_i measure the assets exposure to size and value factors.

$$E(R_i) = R_f + \beta_i\big(E(R_m) - R_f\big) + s_i SMB + h_i HML \tag{3}$$

Furthermore, the model can be rearranged in such a way as to so be used to evaluate the performance of a portfolio, i.e. to determine if the investor yielded abnormal returns due to skill or luck. Running a regression and evaluating the portfolio, one needs to find the values for the SMB and HML factors, readily available from Kenneth French's homepage.[1] To determine if their returns have been in excess, the alpha, α, is added to the model. Please see *Equation 4*. If α is positive after the regression has been carried out and the results are deemed to be statistically significant, the portfolio's returns are greater than the model predicts, i.e. the portfolio has generated excess returns that are

[1] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

not explained by higher exposure to the three factors, but are in fact due to a superior investment strategy.

$$E(R_i) - R_f = \alpha + \beta_i\big(E(R_m) - R_f\big) + s_i SMB + h_i\, HML \tag{4}$$

2.4.3 Sharpe Ratio

The Sharpe ratio or risk-to-volatility measure is a measure of how much a financial asset yields per unit of risk. The risk-averse investor in the United States has the opportunity to purchase T-bills issued by the Federal Reserve of the United States, these financial assets are deemed to be entirely risk-free. The Swedish equivalent is the *statsskuldsväxel* (SSVX). If the investor requires a higher return than that which the risk-free asset guarantees, excess risk has to be taken on. The Sharpe ratio, as proposed by (Sharpe, 1994), measures how much the investor has yielded in relation to the risk taken on. As the Sharpe ratio only requires three figures, the return, the risk-free rate and the volatility or standard deviation, the ratio of different securities is readily comparable. As proposed by Sharpe (1994), the Sharpe ratio is defined as:

$$sr_i = \frac{E\,(R_i) - R_f}{\sigma_i} \tag{5}$$

In order to determine if the difference between the Sharpe ratio of the *magic formula* portfolio and the OMX Nordic 40 is statistically significant, we use the test statistics derived by Jobson and Korkie (1981). Below, we present an outline of the methodology.

$d = E[R_i] - R_f$, Where *d* is the expected differential return (6)

$sr_i = \frac{d}{\sigma_d}$, The expected differential return per unit of risk (ex ante) (7)

Estimating the Sharpe ratio

$\widehat{sr}_i = \frac{m_i}{s_i}$, The expected differential return per unit of risk (ex post) (8)

Where:

$$m_i = \frac{1}{T}\sum_{t=1}^{T} d_{it} \tag{9}$$

$$s_i = \sqrt{\frac{1}{T}\sum_{t=1}^{T}(d_{it} - m_i)^2} \tag{10}$$

The differential return between the portfolio and market at time t:

$$d_{it} = (R_{it} - R_{ft}) \tag{11}$$

Significance Test

Assume that the returns are independently and identically distributed (IID), and use the following significance test:

$H_0: sr_{ij} \equiv sr_i - sr_j = 0$, The difference between the Sharpe ratio of the *magic formula* and of the market is zero.

$H_1: sr_{ij} \equiv sr_i - sr_j \neq 0$, The difference between the Sharpe ratio of the *magic formula* and of the market is not zero.

Apply the transformed difference to calculate a value for $\widehat{sr}_{ij}$:

$$\widehat{sr}_{ij} \equiv \widehat{sr}_i - \widehat{sr}_j = s_j m_i - s_i m_j \tag{12}$$

The variance of the quotient between the Sharpe ratio of the *magic formula* and of the market:

$$\theta = \frac{1}{T}\left[2s_i^2 s_j^2 - 2s_i s_j s_{ij} + \frac{1}{2}m_i^2 s_j^2 + \frac{1}{2}m_j^2 s_i^2 - \frac{m_i m_j}{2s_i s_j}\left[s_{ij}^2 + s_i^2 s_j^2\right]\right] \tag{13}$$

The test statistics used to test the null hypothesis is:

$$z(sr_{ij}) = \frac{\widehat{sr}_{ij}}{\sqrt{\theta}} \sim N(0,1) \tag{14}$$

A two-sided t-test is carried out using the following formula in Excel, with a significance level of 5 percent:

$$P\text{-}value = 2 * (1 - norm.s.dist\left(abs\left(z\left(sr_{ij}\right)\right)\right) \qquad (15)$$

If the calculated p-value is less than 0.05, the null hypothesis is rejected and it is concluded that the difference between the Sharpe ratio of the *magic formula* and the market portfolio is statistically significant.

2.5 Definitions

A few basic accounting terms are useful to understand in order to fully grasp the reasoning behind the *magic formula* strategy. Greenblatt uses return on capital as a way to quantify the profitability of a company and to gain a readily comparable measure of how efficiently a company is creating shareholder value (Greenblatt, 2006). The second ratio that the formula is concerned with is the earnings yield. The earnings yield simply states the price an investor has to pay for the earnings of a company. Greenblatt (2006) uses the earnings yield to value a specific firm.

2.5.1 EBIT

EBIT or *earnings before interest and taxes* is an accounting term, defined as the total earnings of a company before interest on loans and taxes on earnings have been paid. The reason for using EBIT as opposed to earnings is that different companies operate at different debt and tax levels (Greenblatt, 2006). Comparing different companies operating in different countries and industries, earnings before interest and taxes offers a more comparable measure of reported earnings.

2.5.2 Return on Capital

Return on capital or return on invested capital is a measure of how effectively a company converts capital into earnings and shareholder value. The equation Greenblatt (2006) uses to calculate return on capital is:

$$Return\ on\ Capital\ =\ EBIT\ /\ (Net\ Working\ Capital\ +\ Net\ Fixed\ Assets) \quad (16)$$

2.5.3 Enterprise Value

In order to calculate the earnings yield of each company, the *magic formula* uses enterprise value in the denominator. Enterprise value is used as opposed to total market capitalization (number of shares outstanding multiplied by share price) as enterprise value also takes into account the debt level of the company. Using enterprise value, the level of debt used to generate operating earnings is also taken into account (Greenblatt, 2006).

2.5.4 Earnings Yield

The earnings yield is used as a substitute to the more traditional price-earnings ratio or E/P-ratio (earnings/price) due to the same reasons as return on capital was employed. Greenblatt (2006) defines earnings yield as:

$$Earnings\ Yield\ =\ EBIT\,/\ Enterprise\ value \quad (17)$$

Using EBIT as opposed to reported earnings, one is able to compare companies operating at different tax and debt levels.

2.5.5 Systematic risk

Systematic risk, market risk or un-diversifiable risk is defined as risk that is inherent to the entire market that cannot be mitigated by diversifying ones portfolio. Common examples of systematic risk are such factors as interest rates, currency fluctuations and economic recessions (Bodie, Kane & Marcus, 2014).

3. Magic Formula Theory

3.1 Introduction

Joel Greenblatt, founder and manager of Gotham Capital is most well-known for his *magic formula* for achieving superior investment returns. In his book *The Little Book That Beats the Market*, Greenblatt explains the reasoning behind *magic formula* investing. In brief, Greenblatt's strategy consists of identifying companies that have historically shown tendencies of efficiently employing capital, and purchasing shares in these companies at attractive prices (Greenblatt, 2006).

3.2 The Magic Formula

The *magic formula* does not attempt to value companies based on balance sheet figures or projections of future earnings. The strategy is perhaps best described by Carveth Read in *Logic, Deductive and Inductive*, where the English philosopher states that "It is better to be vaguely right than exactly wrong" (Read, 1898, p.272). The *magic formula* has two components, return on capital and earnings yield, the first being a measure of the quality of the company and the second being a measure for valuing the company. The strategy advocates investing in 20 to 30 companies with high return on capital and high earnings yield. Greenblatt offers no exact explanation as to the number of companies in each portfolio. However, it is argued that between 20 and 30 companies should be sufficient for diversification purposes. A few of these companies may underperform the market, but Greenblatt argues that on average the strategy will identify companies with superior prospects (Greenblatt, 2006).

Companies that have a high return on capital have demonstrated an ability to generate high shareholder value based on the capital employed. Such a company can retain earnings and generate higher returns than a company with a low return on capital. The decision to use return on capital as opposed to more traditional profitably measures such as *return on assets* (earnings/assets) or *return on equity* (earnings/equity) is clarified in (Greenblatt, 2006). Using EBIT in substitute of reported earnings offers a more comparable measure of companies operating at different debt and tax levels. Compared to *return on assets* and *return on equity*, that use total assets or total equity, Greenblatt uses tangible capital employed (Net working capital + net fixed assets), justifying it as a more accurate measure of a company's profitability.

The second component of the *magic formula* is earnings yield. The formula used by Greenblatt to calculate the earnings yield of a company is EBIT divided by enterprise value, enterprise value being the market value of equity plus net interest-bearing debt. The reason for using earnings yield as opposed to more widely used ratios such as the P/E-ratio is that companies have different levels of debt, and in order to compare these companies, the ratios have to be adjusted for different debt levels.

Greenblatt (2006) suggests that investors remove companies whose numbers and figures one cannot be sure are accurate and complete, companies where earnings yield and return on capital are not relevant and companies whose shares are illiquid. In this group of companies, Greenblatt includes financial companies and utilities. For similar reasons, Greenblatt also eliminates companies with a market capitalization of less than 50 million dollars.

3.3 Ranking

The *magic formula* ranks companies based on return on capital and earnings yield. Each company is given a rank based on return on capital, *Rank 1* being awarded to the company with the highest return on capital, *Rank 2* given to the company with the second highest return on capital, continuing to the company with the lowest return. The same procedure is carried out for earnings yield. Each company is given an overall score based on the sum of the two previous rankings. *Company A* having received a Rank of 1 based in return on capital and *Rank 4* based on earnings yield would produce a final score of 5. As previously stated, the strategy advocates investing in between 20 and 30 of the companies with the highest overall score.

3.4 Magic Formula Risk

"In stating this opinion, we define risk, using dictionary terms, as "the possibility of loss or injury." Academics, however, like to define investment "risk" differently, averring that it is the relative volatility of a stock or portfolio of stocks - that is, their volatility as compared to that of a large universe of stocks."

-Berkshire Hathaway Letter to Shareholders 1993 (Buffett, 1994)

In accordance with many other prominent value investors, Joel Greenblatt's understanding of risk diverges from traditional academic measures of risk such as volatility and beta (Greenblatt, 2006). In value investing terms, risk is measured as the risk of permanently losing capital (Buffett, 1994). Consequently, there are two principal risks in using the *magic formula*. One is liquidating the portfolio with negative returns and the other is attributed to the opportunity cost of not using a higher yielding strategy.

The risk of permanently losing capital is to a large degree attributed to the time horizon of the investor. As observed in *The Little Book that Beats the Market*, the *magic formula* underperformed that market for a few individual years from 1988 through 2004 (Greenblatt, 2006). The *magic formula* underperformed the broader market in 5 out of every 12 months. In terms of full-years, Greenblatt's formula underperformed the market in 1 out of 4 years. Over the 17-year period there were periods where the formula underperformed the market for three consecutive years. However, over the 17-year period, the *magic formula* outperformed market averages (Greenblatt, 2006). The impatient investor runs the risk of permanently losing capital if not sticking to the formula for a longer time horizon.

3.5 Prior Research (Magic Formula)

The success of *The Little Book That Beats the Market* and the impressive track record of Gotham Capital have given rise to several academic studies of the *magic formula*. As Greenblatt (2006) dismisses the use of advanced statistics to evaluate the performance of the *magic formula*, a few academics have attempted to do it in his stead, quantifying the performance of the *magic formula* using more traditional models such as the capital asset pricing model and the Fama-French three-factor model.

Persson and Selander (2009) at the Stockholm School of Economics back-test the *magic formula* on the Nordic Stock Market between 1998 and 2008. Persson and Selander find that the *magic formula* yields higher returns than the MSCI Nordic and the S&P 500 for the same period, with a compound annual growth rate of 14.68%, 9.28% and 4.23% respectively. However, when evaluating the performance of the *magic formula* with more rigorous statistical models, such as the CAPM and Fama-French three-factor model, Persson and Selander (2009) find that the results are not significant.

Ye (2013) applies the *magic formula* on the Shanghai Stock Exchange from 2006 to 2011. The study concludes that following the *magic formula* would have outperformed the market on every year except 2006. Notable is that the study includes the financial crisis years of 2008 and 2009. It is found that the *magic formula* outperforms the market during the crisis years as well.

Greenblatt (2006) back tests the performance of the *magic formula* on the American stock exchange over the period 1988 to 2004. As Greenblatt dismisses the use of any advanced statistics to calculate portfolio risk, he simply states the return of the portfolio over the 17-year period. Nevertheless, the returns recorded by Greenblatt are quite impressive. Greenblatt tests the performance of the magic formula on the 1,000 and 3,500 largest companies respectively. The results indicate that the *magic formula* performs better when the 3,500 largest companies are included as opposed to limiting the strategy to the largest 1,000 companies.

4. Data & Method

4.1 Data

The companies included in the study were at some point during the course of the 1^{st} of April 2007 to the 1^{st} of April 2016 listed on the Nordic small cap, mid cap or large cap lists. As only the current constituents are available in Datastream, we consult Bloomberg to find information on historical constituents. A list of the available companies for each period (1^{st} of April – 31^{st} of March of the following year) is created, for a total of nine lists. As the strategy states that financial and utility companies should be excluded, we manually remove each company engaged in these sectors. After removing the unwanted companies, the nine lists consist of between 399 and 434 companies for each period.

The benchmark used to compare the relative performance of the portfolio is the OMX Nordic 40. This index consists of the 40 most traded stocks the Nordic Markets (NASDAQ, 2017). In order to compare the yield of the portfolio, a list of historical prices of the OMX Nordic 40 Index is required. This data is downloaded from Datastream.

All company data is downloaded from Thomson Reuters Datastream. The numbers for enterprise value, EBIT and return on invested capital are downloaded on a yearly basis, as the ranking is only performed once a year. Stock prices are however downloaded on a daily basis, as the calculations of aggregate returns and portfolio volatility require daily values. Furthermore, the stock prices in Datastream have all been adjusted for capital actions such as dividend payments and stock splits.

In order to calculate portfolio alpha and beta values we use the Fama-French three-factor model. This model requires estimates of SMB and HML values for the entire period of investigation. These values are downloaded from Kenneth French's website.[2]

[2] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

Lastly, in order to determine the risk-adjusted return of the portfolio, the risk-free rate is required. The risk-free rate that we use is the SSVX 1-month rate. The historical monthly rates are downloaded from the Swedish *Riksbank's* website for the period 2007-04-01 to 2016-03-31.

4.2 Method

We follow the *magic formula* as rigorously as the data permits. The market and timeframe we are examining is the Nordic large cap, mid cap and small cap lists (consisting of Sweden, Denmark, Finland and Iceland) from the 1st of April 2007 to the 1st of April 2016. The ranking is performed at the start of each period. The agreed upon start date for each period is April 1st. The reasoning behind ranking on April 1st as opposed to the 1st of January is to ensure that all companies have published their financial statements for the previous fiscal year. A further reason for not purchasing shares on the 1st of January is that the January effect has been previously documented, and we wish to eliminate the possibility of any outside factor affecting the results to the greatest possible degree.

A list of the constituents of each index is readily available in Datastream. However, we are only able to find a list of the current constituents of each index. As we are testing the performance of the *magic formula* from 2007 to 2016, this could present a possible survivorship bias, due to companies filing for bankruptcy and being delisted from the small cap, mid cap and large cap lists. In order to avoid this problem we consult Bloomberg. Bloomberg provides information on historical constituents as well as currently listed companies. A list of available companies is created for each year, from the 1st of April 2007 to the 1st of April 2016, constituting a total of 9 lists.

Greenblatt (2006) eliminates companies that are defined as utility and financial companies. This includes such companies as banks, mutual funds and insurance firms. However, a more strict definition of what constitutes a utility or financial company cannot be found. Companies such as banks and investment companies, and companies whose primary line of business is concerned with providing utilities are obviously excluded from the study. However, companies whose primary line of business is more ambiguous are not readily included or excluded. In order to determine if a company should be defined as a financial or utility company, we consult NASDAQ OMX Nordic. On NASDAQ OMX Nordic's website, each company is defined according to the sector it operates in. We create a total list of historical constituents and manually identify and remove each company that operates in the financial or utility sector.

We rank each company according to two different measures. The first measure is a quality measure and the second is a valuation measure. Greenblatt (2006) uses return on investment as a measure of the quality of a company. The valuation measure used is earnings yield.

As historical balance sheet and income statement figures are not entirely available in Datastream, we use the formula for return on invested capital already incorporated in Datastream. This is done in order to avoid having to exclude listed companies due to a lack of one of the components of the formulas such as net fixed assets or enterprise net working capital. The formula for return on invested capital, as defined by Datastream is found in the appendix under the subheading *Datastream Formulas*. It is in our opinion that the formulas defined by the *magic formula* and Datastream are sufficiently analogous as to use the Datastream formula in its place.

We rank each company accordingly and calculate the sum of the two rankings. An equal weight of the total capital is allocated to each of the 20 highest ranked companies. Prior to ranking the companies, we agreed upon that in the event of company 20 and 21 having the same rank, a portfolio comprised of 21 companies would be created instead of the usual 20, with each company being allocated one twenty-oneth of the total capital. This is a slight departure from the original strategy, as Greenblatt (2006) never explicitly clarifies how to proceed in the event of two companies having the same rank. However, as we perform the ranking, this is not the case for any portfolio. Hence 9 portfolios of 20 stocks each are created. We purchase the companies at the same date (1st April) as we perform the ranking and hold until March 31st of the following year. For certain years, prices are unavailable for the 1st of April and 31st of March. This is the result of the market being closed on that particular date, due to bank holidays or weekends. In order to avoid the human factor entering the study, we purchase and sell shares on the first trading day after the weekend.

As this study is carried out in Sweden, and the study aims to determine if the *magic formula* would have yielded superior returns for the Swedish investor investing in the Nordic region from 2007 to 2016, the possibility of currency fluctuations could potentially alter the results. In order to avoid this, we download all figures in Datastream and Bloomberg in SEK.

To carry out the volatility measurements, one not only needs the list of historical prices but also a list of daily returns. Using the historical prices, the daily returns are calculated using the following formula:

$$R = \frac{P_t - P_{t-1}}{P_{t-1}} \tag{18}$$

Where,

P_t is the closing price on day *t*

P_{t-1} is the closing price the previous day

In order to determine if the return of the portfolio is the result of a superior trading strategy or merely the result of taking on excess risk, the risk of each portfolio is calculated. The standard deviation of each portfolio is calculated. The price history of each of the 20 stocks comprising each of the nine portfolios is downloaded. Using the historical returns of each stock, the volatility of each portfolio is calculated. The volatility is calculated using the built-in function for standard deviation in Microsoft-excel. This is done with each of the nine portfolios as well as the OMX Nordic 40 in order to compare the risk of the *magic formula* portfolio and the risk of the OMX Nordic 40. A second measure of portfolio risk is the portfolio beta. The beta of the portfolio is also calculated using the built-in functions in Excel. The two required values for calculating beta are the covariance between the *magic formula* portfolio and the OMX Nordic 40, and the standard deviation of the OMX Nordic 40. The beta is calculated on a 36-month trailing basis. In other words the beta value on 2015-04-01 is a representation of the how much the portfolio has moved in relation to the market over the course of the previous three years (2012-04-01 to 2015-04-01). Hence, we only calculate beta-values three years into the testing period. This is done in order to measure how much the portfolio fluctuated compared to the wider market.

The Capital Asset Pricing Model and the Fama-French three-factor model is used in order to determine if the yield is a result of taking on excess risk. The excess return of the *magic formula* portfolio is compared to the excess return of the OMX Nordic 40. The built-in Excel regression tool is utilized to carry out the CAPM and Fama-French three-factor model regressions.

First we run a regression using monthly excess returns. Carrying out the regression we estimate an alpha value and a beta value. The same regression is carried out using annual excess returns. Hence we end up with two different alpha values, one representing the monthly excess return and one representing the annual excess return.

A similar regression is carried out using the Fama-French three-factor model. The same procedure is carried out. As three coefficients are estimated, three separate x-columns are used in the regression. Hence, a value for alpha and the coefficients SMB, HML and β are estimated.

The third test we use in order to determine if the portfolio has in fact yielded excess returns per unit of risk is the Sharpe ratio. We calculate the Sharpe ratio by finding the ratio between the excess return of the portfolio and the standard deviation of the portfolio. As for the return of the portfolio, we use the average monthly return for the 108 months recorded. The same procedure is carried out for the risk-free rate. The 1-Month SSVX rate is downloaded from the Swedish *Riksbank's* homepage for each of the 108 months and the average risk-free rate is calculated for the 108 months. The denominator of the fraction is the volatility of the portfolio, which is defined as the standard deviation of the monthly returns of the portfolio. Calculating the Sharpe ratio of the portfolio, we subtract the average risk-free rate from the average monthly return and divide by the standard deviation of the monthly returns. The same procedure is carried for the Sharpe ratio of the OMX Nordic 40 in order to compare the return per unit of risk between the *magic formula* portfolio and the benchmark portfolio.

In order to determine if the difference between the Sharpe ratio of the *magic formula* and the Sharpe ratio of the OMX Nordic 40 is statistically significant we use the test statistics proposed by Jobson and Korkie (1981). We establish a null hypothesis. The null hypothesis states that the difference between the Sharpe ratio of the *magic formula* and of the market is zero. The alternative hypothesis states that the difference between the Sharpe ratio of the magic formula and of the market is not zero. Using the framework derived from Jobson and Korkie's equations (please see p.14), we carry out the test statistics and either accept or discard the null hypothesis.

4.3 Problems

The greatest drawback to back-testing the *magic formula* is the lack of historical figures in Datastream and Bloomberg. In order to carry out a ranking of a company the enterprise value, return on capital, EBIT and price of the stock is needed for the period. If one of these figures is absent, a sufficient ranking cannot be carried out. When ranking the companies for each period, a few companies are discarded due to a lack of sufficient figures.

A further issue, where we are required to deviate from following Greenblatt's strategy is the presence of two negative values when calculating the earnings yield. In order to calculate the earnings yield, the EBIT is divided by enterprise value. In a few instances, the EBIT and enterprise value are negative, resulting in a positive and often unreasonably high earnings yield. We remove companies that exhibit these characteristics from the ranking due to the fact that they do not live up to the implied criteria.

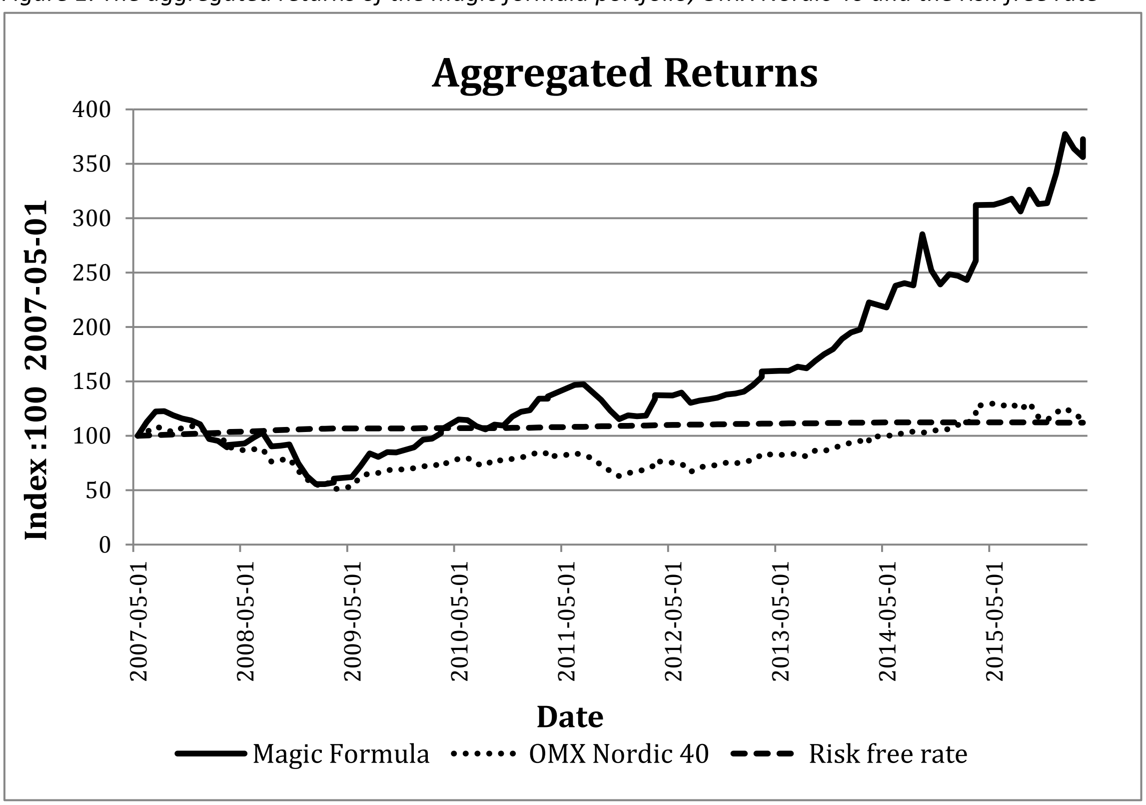
A limitation of calculating the beta and alpha values of the portfolio using the Fama-French three-factor model is that there are no values for SMB and HML for the Nordic region alone. Consequently, values for the greater European market are downloaded from French's website. An assumption we make by using the European figures is that the Nordic and European markets exhibit the same characteristics. This need not necessarily be the case, as the Nordic market only constitutes a fraction of the entire market. In the absence of more specific data for the Nordic region, we settle for the European figures.

5. Results & Analysis

5.1 Absolute Returns

In *Figure 1* the returns for the *magic formula* portfolio and the OMX Nordic 40 are displayed. As is evident, the total return of the *magic formula* portfolio is vastly superior to the returns of the benchmark portfolio. As exhibited, both portfolios suffered major contractions during the financial crisis of 2008 and 2009. However, the *magic formula* portfolio recovered rapidly and returned to pre-crisis levels after roughly one year. The benchmark portfolio, tracking the OMX Nordic 40 recovered much more slowly, hence yielding a significantly lower total return. Investing 100 SEK in the *magic formula* portfolio at the beginning of the period would have appreciated to 397.9 SEK (a total return of 297.9%). This can be compared to the benchmark portfolio with which 100 SEK invested would have appreciated to a value of 113.4 SEK (a total return of 13.4%).

Figure 1: The aggregated returns of the magic formula portfolio, OMX Nordic 40 and the risk-free rate



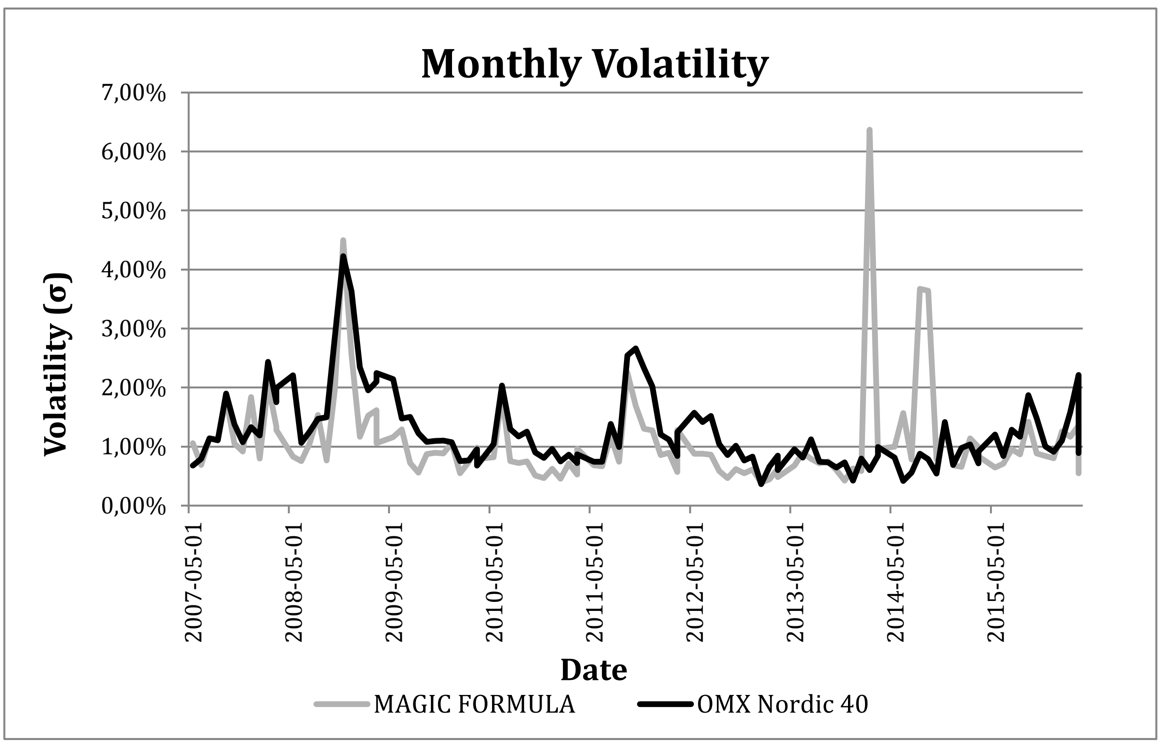
The returns of the *magic formula* portfolio differ from the benchmark portfolio and the risk-free asset on a monthly and yearly basis. The cumulative annual growth rate (CAGR) of the *magic formula* portfolio is 16.6% compared to 1.4% for the OMX Nordic 40. The highest measured monthly return for the *magic formula* portfolio is 19.7% compared to 18.0% for the benchmark. Interestingly, the lowest monthly return is lower than the benchmark portfolio, being -18.9% and -14.5% for the *magic formula* and benchmark portfolio respectively. As for what appears to be a dent in the otherwise rather smooth curve showing the aggregate return of the *magic formula* portfolio, taking place between 2014-05-01 and 2015-05-01, this is largely the result of Aalborg Boldspilklubb appreciating from 0.55 SEK to 1.69 SEK in the month of July of 2014, and dropping back to 0.57 SEK in the subsequent month. As displayed in *Figure 1*, the impact of one stock on a portfolio comprised of only 20 companies can be quite substantial.

It is in times of recession that the merits of an investment strategy are put to the test. The *magic formula* fared much better than the market as a whole during the crisis years of 2008 and 2009. 100 SEK invested using the *magic formula* would have contracted to 55.4 SEK during December of 2008. This can be compared to the lowest point of the OMX Nordic 40 that took place in February of 2009, when the 100 SEK invested at the start of the period depreciated to a value of 50.8 SEK. The low points of both portfolios are quite similar but the subsequent recoveries are dramatically different. The *magic formula* portfolio returns to a value 100 SEK in February of 2010, compared to the OMX Nordic 40 that returns to a value of 100 SEK in March of 2014.

5.2 Volatility

Achieving superior returns need not be the result of a superior investment strategy, but could simply be the result on taking on excess risk. Hence, merely looking at the total return would give a skewed picture of the results of a portfolio. In order to determine whether the superior returns are indeed the result of a superior strategy, the volatility of the portfolio is measured. We calculate the volatility of the portfolio by taking the standard deviation of the daily returns of the portfolio on a monthly basis. Hence, we end up with 108 values for monthly volatility, representing the fluctuations of the return of the portfolio. As is displayed in *Figure 2*, the volatility of the *magic formula* portfolio was lower for much of the period. The volatility of the *magic formula* portfolio is lower than the benchmark portfolio in 83 out of the 108 months measured. The average monthly volatility is also lower, 1.1% and 1.2% for the *magic formula* and OMX Nordic 40 respectively. This is an indication that excess risk may not have been taken on. At three points in time, February, August and September of 2014, the volatility of the *magic formula* portfolio is significantly higher than that of the benchmark portfolio. This is however largely the result of a major appreciation in one of the stocks included in the *magic formula* portfolio.

Figure 2: The monthly volatility of the magic formula portfolio and OMX Nordic 40

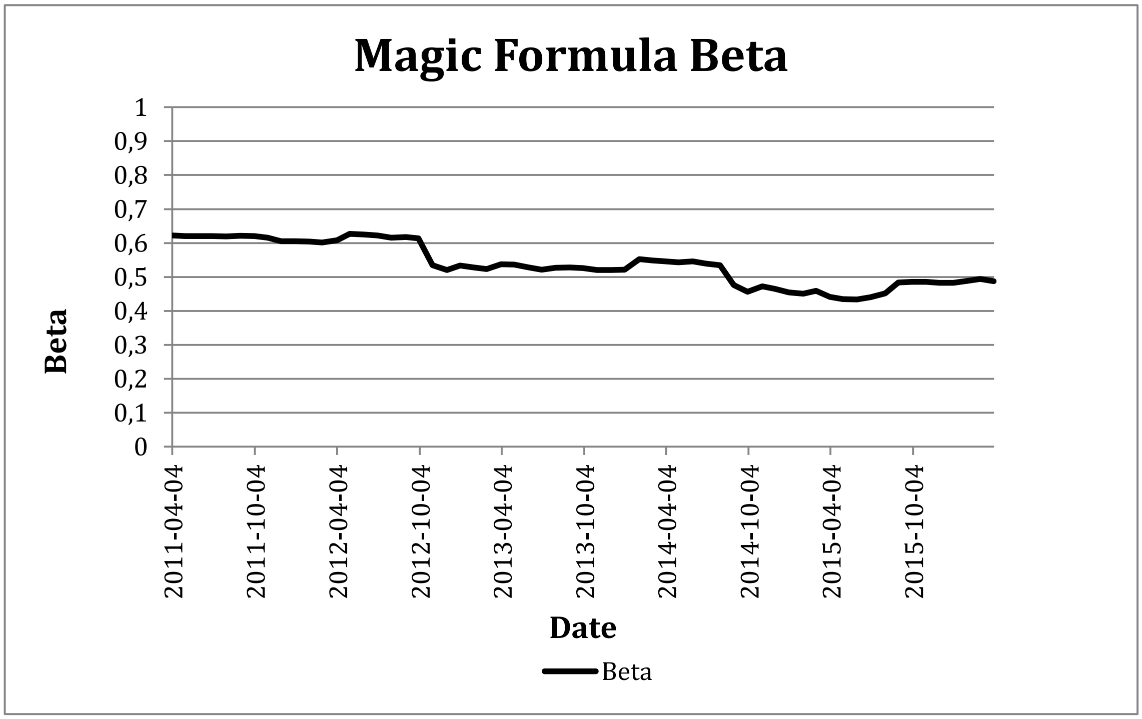


In the case of February of 2014, Nordic Shipbuilding appreciated from a value of 0.85 SEK to 2.4 SEK. In September of the same year, Aalborg Boldspilklub went from a value of 1.69 SEK at the start of the month to 0.57 SEK at the end of the month. In the case of Aalborg Boldspilklub it is notable that over the course of the entire holding period, the stock price only depreciated 7.5%. However, in the individual month of September the price of the stock fell substantially, resulting in high volatility. *Figure 2* shows that in the case of a portfolio comprised of only 20 companies, a sudden change in price of a single stock can have a large impact on the entire portfolio.

Furthermore, it is in the interest of the investigation to determine the degree to which the financial crisis of 2008 and 2009 affected the volatility of the *magic formula* portfolio. During the financial crisis of 2008 and 2009, which we for the sake of simplicity define as the period 2008-09-01 to 2009-09-01, the volatility of the *magic formula* portfolio was lower in all but one month out of the total twelve months. During the month of November of 2008, the volatility of both portfolios increased significantly, with standard deviations of 4.50% and 4.22% for the *magic formula* portfolio and OMX Nordic 40 portfolio respectively. This indicates that the magic formula does not necessarily constitute a greater risk than the market as a whole during times of financial crises.

In addition to standard deviation, the beta of the portfolio is also measured. Beta, being a measure of how much an asset is exposed to market risk, indicating how much a portfolio fluctuates in relation to the market, is used in order to determine if the *magic formula* portfolio is indeed riskier than the benchmark portfolio. We calculate the portfolio beta on a 36-month trailing basis. Hence, the beta of our portfolio is only available three years into the testing period. The beta of the portfolio is significantly lower than 1.0 for the entire period, with 0.43 and 0.62 being the lowest and highest betas recorded (*Figure 3*, p.35). The *magic formula* portfolio exhibits an average beta for the entire period of 0.54, indicating that the portfolio fluctuates less than the benchmark portfolio. The high beta at the start of the period (2011-04-04) is likely attributed to the distress years of 2008 and 2009, as these years are included in the 36-month trailing beta for April 2011 and are characterized by high volatility. Subsequently, the portfolio beta decreases and appears to stabilize at around a value of 0.5.

Figure 3: The 36-month trailing beta of the magic formula portfolio



5.3 Capital Asset Pricing Model

We use the Capital Asset Pricing Model to determine if the excess return of the *magic formula* portfolio can be explained by having been exposed to a high degree of systematic risk.

Table 1: Capital Asset Pricing Model Regression Results (Monthly)

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	1.27%	0.004	2.745	0.007
Excess Market	0.860	0.093	9.252	0.000

As displayed in *Table 1*, we find that the intercept or the alpha of the portfolio on a monthly basis is positive (1.27%). Furthermore, the p-value is very low (0.007), indicating that the alpha value of the portfolio is statistically significant and that the *magic formula* performed better than the CAPM predicts.

Table 2: Capital Asset Pricing Model Regression Results (Annual)

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	17.80%	0.045	3.971	0.005
Excess Market	1.253	0.177	7.069	0.000

A similar regression is carried out in order to determine the alpha value on an annual basis. As displayed in *Table 2*, the intercept or alpha is 17.80% with a low p-value of 0.005, indicating that the magic formula performed better than the CAPM predicts. Thus, we discard the idea that the Capital Asset Pricing Model completely explains the return of the *magic formula*.

5.4 Three-Factor Model

The Fama-French three-factor model is used to determine if the excess return can be explained by being exposed to more systematic risk, or having a greater exposure to value and small cap stocks.

Table 3: Fama-French three-factor model Regression Results (Monthly)

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	1.29%	0.004	2.798	0.006
Excess Market	0.801	0.098	8.130	0.000
SMB	0.003	0.002	1.657	0.101
HML	0.001	0.002	0.710	0.480

As in the case of the Capital Asset Pricing Model, when carrying out the regression for the Fama-French three-factor model on a monthly basis, we receive a positive alpha of 1.29%, and the p-value of 0.006, indicating that the results are statistically significant.

Table 4: Fama-French three-factor model Regression Results (Annual)

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	14.0%	0.030	4.626	0.006
Excess Market	1.024	0.142	7.200	0.001
SMB	0.014	0.004	3.526	0.017
HML	-0.003	0.004	-0.869	0.425

Furthermore, the Fama-French three-factor model is carried out with annual figures. As displayed in *Table 4*, the alpha value is 14.0% with a p-value of 0.006. Hence, we are led to the conclusion that the Fama-French three-factor model does not fully explain the superior returns of the *magic formula* portfolio.

5.5 Sharpe Ratio

The Sharpe ratio is a measure of return in relation to risk. A high Sharpe ratio indicates a high level of return in relation to the amount of risk taken on. The Sharpe ratio of the *magic formula* portfolio is 0.22 compared to a Sharpe ratio of 0.03 for the OMX Nordic 40. The high Sharpe ratio is largely attributed to the high returns of the *magic formula* portfolio compared to those of the OMX Nordic 40. Testing if the difference between the Sharpe ratio of the magic formula and the OMX Nordic 40 is statistically significant, we define the null hypothesis as "The difference between the Sharpe ratio of the *magic formula* and of the market is zero" and define the H_1 as "The difference between the Sharpe ratio of the *magic formula* and of the market is not zero". Executing the Jobson and Korkie (1981) procedure and carrying out a two-sided t-test we receive a p-value of 0.018. The p-value of the test is lower than 0.05, which is the customary level of significance, indicating that the results are statistically significant. We therefore reject the null hypothesis and conclude that the difference between the Sharpe ratio of the magic formula and of the market is not zero. Hence, the high Sharpe ratio of the *magic formula* portfolio cannot be attributed to luck or chance.

6. Conclusions

In the section on the theory regarding efficient markets, we discuss the incompatibility of efficient markets and the use of an active management strategy such as the *magic formula*. According to the efficient market hypothesis, any excess return that a strategy such as the *magic formula* yields is the result of chance or of taking on excess risk. The purpose of this thesis is to investigate the risk-adjusted performance of a portfolio, constructed using Joel Greenblatt's *magic formula* framework, on the Nordic stock market between the years 2007 and 2016 and to determine if the formula constitutes a viable strategy for outperforming the market in the future.

The results we collect are not entirely similar to the results collected by previous studies of the *magic formula*. Persson and Selander (2009) test the performance of the *magic formula* on the Nordic Stock Market from 1998 to 2008, and document a compound annual growth rate of 14.68% compared to the 16.6% CAGR that we record. Compared to our investigation that concludes that neither the CAPM nor the Fama-French three-factor model can explain the returns of the *magic formula* for the period recorded, Persson and Selander (2009) find that the CAPM and Fama-French three-factor model do in fact explain the abnormal returns. Ye (2013) tests the performance of the *magic formula* on the Shanghai Stock Exchange during the crisis years of 2008 and 2009 and, as in our investigation, concludes that the *magic formula* fared better than the wider market during the years of distress.

As for the efficient market hypothesis, the performance of the *magic formula* suggests that the market may not be entirely efficient. The formula appears to exploit figures belonging to the income statement and balance sheet, indicating that the market perhaps should be characterized as weakly efficient.

As far as returns are concerned, the *magic formula* has been vastly superior to the market portfolio, represented by OMX Nordic 40. 100 SEK invested using the *magic* *formula* in April of 2007, would have appreciated to a value of 397.9 SEK in April of 2016, compared to 113.4 SEK if allocated to the market portfolio. The seemingly high returns of the *magic formula* could possibly be explained by the *magic formula* taking on excess risk or simply be the result of chance.

Studying the results of the volatility of the *magic formula* portfolio, it appears that the volatility is not greater than the market portfolio. In 83 out of the total 108 months, the *magic formula* shows a lower volatility than the market portfolio. Glancing at the average monthly volatility of the two portfolios, one finds a variance of 1.1% and 1.2% for the *magic formula* and market portfolio respectively. Thus, it appears that a portfolio constructed by using the *magic formula* strategy need not necessarily take on more risk than investing in the market portfolio.

In order to determine if the excess return is significant in relation to the risk taken on, we use the Fama-French three-factor model, the capital asset pricing model and the Sharpe ratio. Using the capital asset pricing model as well as the three-factor model, we calculate portfolio alpha values of 1.27% and 1.29% respectively on a monthly basis. These values are affirmed when testing for statistical significance. This indicates that the returns of the *magic formula* are higher even when taking into account how much risk each portfolio takes. As for the Sharpe ratio, the return per unit of risk is significantly higher for the *magic formula* than the OMX Nordic 40, resulting in 0.217 and 0.027 respectively. Using a two-sided t-test, we determine that the difference between the high Sharpe ratio of the *magic formula* and the Sharpe ratio of the market portfolio is statistically significant. This leads us to the conclusion that the high returns of the *magic formula* are not merely the result of taking on excess risk or of chance, but that the formula does manage to exploit stock market inefficiencies and can be used as a viable strategy for outperforming the market in the future.

7. Further Research

Modern portfolio theory is largely absent from the *magic formula*, perhaps to its advantage. A suggestion for further research would be to incorporate modern portfolio theory to Greenblatt's strategy. One such suggestion would be to research the effect of assigning a greater weight to either the return on capital component or the earnings yield component of the formula. As opposed to giving the same weight to both the quality and valuation component, perhaps an optimum weight for each measure could be identified.

Following Greenblatt's strategy, each stock in the *magic formula* portfolio is assigned the same weight. In other words, a portfolio consisting of 20 companies would allocate 5 percent of the total capital to each stock, irrespective of ranking. It would perhaps be in the interest of future researchers to investigate if a greater proportion of the total capital should be allocated to the companies with higher rankings. An optimum weight corresponding to the overall ranking could perhaps be calculated.

8. References

Basu, S (1977), “Investment performance of common stocks in relation to their price earnings ratios: A test of market efficiency”, *Journal of Finance,* Vol. 32, pp.663-682.

Bodie, Z., Kane, A. & Marcus, A.J., (2014), “Investments”, 10th edn, Berkshire, McGraw-Hill.

Buffett, W (1984-05-17), “The Superinvestors of Graham-and-Doddsville”, Columbia Business School, Available Online:https://www8.gsb.columbia.edu/articles/columbia-business/superinvestors [Accessed 12 December 2016]

Buffett, W (1989-02-28), “Berkshire Hathaway Shareholder Letters 1988”, Available Online: http://berkshirehathaway.com/letters/1988.html [Accessed 19 December 2016]

Buffett, W (1994-03-01), “Berkshire Hathaway Shareholder Letters 1993”, Available Online: http://berkshirehathaway.com/letters/1993.html [Accessed 19 December 2016]

Buffett, W (2009-02-27), “Berkshire Hathaway Shareholder Letters 2008”, Available Online: http://www.berkshirehathaway.com/letters/2008ltr.pdf [Accessed 19 December 2016]

Cochrane, J. H. (1999), "New Facts in Finance”, *Economic Perspectives Federal Reserve Bank of Chicago,* Issue Q III, pp.36-58.

Fama, E (1970), “Efficient Capital Markets: A Review of Theory and Empirical Work”, *Journal of Finance,* Vol. 25, pp.383–417.

Fama, E & French, K.R. (1993), “Common Risk Factors in the Returns on Stocks and Bonds”, *Journal of Financial Economics,* Vol. 33, pp.3–56.

Graham, B & Dodd, D (1934), “Security Analysis”, 1st edn, New York, McGraw-Hill.

Graham, B & Dodd, D (2009), “Security Analysis”, 6th edn, New York, McGraw-Hill, pp.669.

Greenblatt, J (2006), “The Little Book That Beats the Market”, Hoboken, John Wiley & Sons Inc.

Jobson, J. D. & Korkie, B. M. (1981), “Performance Hypothesis Testing with the Sharpe and Treynor Measures”, *The Journal of Finance,* Vol. 36, pp.889-908.

NASDAQ (2017), ”OMX Nordic 40” Available Online: https://indexes.nasdaqomx.com/Index/Overview/OMXN40 [Accessed 2 January 2017]

Persson, V & Selander, N (2009), “Back testing “The Magic Formula” in the Nordic region”, Master Thesis, Stockholm School of Economics, Available Online: http://arc.hhs.se/download.aspx?MediumId=769 [Accessed 15 November 2016]

Read, C (1898), “Logic, Deductive and Inductive”, Ballantyne, Hanson and Co, pp.272.

Rozeff, M. S. & Kinney, W (1976), “Capital market seasonality: The case of stock returns”, *Journal of Financial Economics,* Vol. 3, pp.379-402.

Sharpe, W. F. (1994), “The Sharpe Ratio”, *Journal of Portfolio Management,* Vol. 21, pp.49–58.

Wachtel, S. B. (1942), “Certain observations on seasonal movements in stock prices”, *Journal of Business,* Vol. 15, pp.184-193.

Womack, K. L. & Zhang, Y (2003), “Understanding Risk and Return, the CAPM, and the Fama-French Three-Factor Model”, Tuck Case No. 03-111.

Ye, Y (2013), “Application of the Stock Selection Criteria of Three Value Investors, Benjamin Graham, Peter Lynch, and Joel Greenblatt: A Case of Shanghai Stock Exchange from 2006 to 2011”, *International Journal of Scientific and Research Publications,* Vol. 3 Issue 8.

9. Appendix

9.1 Databases

Bloomberg Terminal

Kenneth French "*Data Library*" Available Online:
http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html [Accessed 15 December 2016]

NASDAQ OMX Nordic
http://www.nasdaqomxnordic.com/ [Accessed 28 November 2016]

The Swedish Riksbank's database of Market rates, Available Online:
http://www.riksbank.se/sv/Rantor-och-valutakurser/Sok-rantor-och-valutakurser/
[Accessed 7 December 2016]

Thomson Reuters Datastream

9.2 Portfolios

2007-03-30 – 2008-03-31

BE GROUP AB
BEIJER ALMA AB
BERGS TIMBER AB
BOLIDEN AB
DAMPSKIBS NORDEN AS
JEEVES INFORMATION
KABE HUSVAGNAR AB
KNOWIT AB
KONECRANES ABP
NCC AB
NORDIC ALUMINIUM OYJ
RAUTARUUKKI CORP
RAUTE OYJ
RORVIK TIMBER AB
SCHOUW & CO A/S
SOFTRONIC AB
SPAENCOM A/S
TICKET TRAVEL GROUP

TORM PLC
UNIFLEX AB

2008-04-01 – 2009-03-31

ACANDO AB
BE GROUP AB
BIOTAGE AB
DAMPSKIBS NORDEN AS
HIQ INTERNATIONAL AB
HOJGAARD HOLDING A/S
JEEVES INFORMATION
KNOWIT AB
KONECRANES ABP
MARTELA OYJ
MODERN TIMES GRP
OUTOTEC OYJ
POOLIA AB
POYRY OYJ
PREVAS AB
REJLERS PUBL AB
SOFTRONIC AB
SWECO AB
TEKLA OYJ
UNIFLEX AB

2009-04-01 – 2010-03-31

ABB LTD
ADDTECH AB
ASTRAZENECA PLC
AXFOOD AB
DORO AB
EXEL COMPOSITES OYJ
FLSMIDTH & CO A/S
H. LUNDBECK A/S
HOJGAARD HOLDING A/S
MILLICOM INTERNATIO
NETONNET AB
ORC GROUP
ORION OYJ
PROACT IT GROUP AB
Q-MED AB

SKANSKA AB
SOFTRONIC AB
UNITED INTERNATIONAL
U-SEA BULK SHIP
WARTSILA OYJ

2010-04-01 – 2011-03-31

AF AB
ASTRAZENECA PLC
ATLANTIC PETROLEUM
AVAILO PUBL AB
AVEGA GROUP AB
BETSSON AB
DORO AB
DOVRE GROUP
GN STORE NORD A/S
H. LUNDBECK A/S
KABE HUSVAGNAR AB
KARJALAN KIRJAPAINO
LUNDIN PETROLEUM AB
MILLICOM INTERNATIO
NORDIC ALUMINIUM OYJ
ODD MOLLY INTERNA
ORION OYJ
SANTA FE GROUP A/S
TELE2 AB
UNIFLEX AB

2011-04-01 – 2012-03-30

ASPOCOMP GROUP OYJ
ASTRAZENECA PLC
AVAILO PUBL AB
AVEGA GROUP AB
BILIA AB
CBRAIN A/S
COMPTEL OYJ
DORO AB
EWORK GROUP AB
HALDEX AB
HOLMEN AB
JEEVES INFORMATION

MALMBERGS ELEKTRISKA
MICRO SYSTEMATION AB
NORTH MEDIA AS
ORION OYJ
PANDORA
PROFFICE AB
SAAB AB
UNIFLEX AB

2012-03-30 – 2013-03-29

ASTRAZENECA PLC
BIOGAIA AB
DEDICARE AB
ENEA AB
ENQUEST PLC
EWORK GROUP AB
FISKARS OYJ
GLUNZ & JENSEN HOL
HAGAR HF
KABE HUSVAGNAR AB
KOEBENHAVNS
LAGERCRANTZ GROUP AB
METSA BOARD OYJ
MODERN TIMES GRP
ROBLON AS
SAGA FURS OYJ
SECTRA AB
SEMCON AB
UNITED INTERNATIONAL
VENUE RETAIL GROUP

2013-04-01 – 2014-03-31

ALLTELE ALLMANNA SVE
AVEGA GROUP AB
DEDICARE AB
DOVRE GROUP
ELECTRA GRUPPEN AB
ENEA AB
ENQUEST PLC
F-SECURE OYJ
HAGAR HF

ICA GRUPPEN AB
ICELANDAIR GROUP
LAGERCRANTZ GROUP AB
MALMBERGS ELEKTRISKA
NOLATO AB
NORDIC SHIP
NOVOTEK AB
ORION OYJ
SWEDISH MATCH AB
UNITED INTERNATIONAL
VBG GROUP AB

2014-04-01 – 2015-03-31

AALBORG BOLDSPILKLUB
AVEGA GROUP AB
COLUMBUS A/S
DEDICARE AB
FISKARS OYJ
HAGAR HF
LUCARA DIAMOND
MEDIVIR AB
MILLICOM INTERNATIO
MULTIQ INTL AB
MYCRONIC AB
NOLATO AB
NORDIC MINES AB
NOVOTEK AB
PONSSE OYJ
QPR SOFTWARE OYJ
ROTTNEROS AB
RTX TELECOM A/S
SCANDINAVIAN BRAKE
TETHYS

2015-04-01 – 2016-03-31

AVEGA GROUP AB
BILIA AB
COLUMBUS A/S
CONCENTRIC AB
DEDICARE AB
HAGAR HF

ICELANDAIR GROUP
KONE CORPORATION
LUCARA DIAMOND
NOKIA CORP
NOLATO AB
NOVOTEK AB
PONSSE OYJ
POOLIA AB
RAUTE OYJ
RNB RETAIL
ROTTNEROS AB
TRAINERS HOUSE
UNIFLEX AB
YLEISELEKTRONIIKKA

9.3 Removed Companies

Companies removed due to being classified as utilities or financials or due to a lack of data.

A/S GRONLANDSBANKEN
A/S MONS BANK
ADMIRAL CAPITAL A/S
AKTIA BANK PLC
ALANDSBANKEN ABP
ALM. BRAND A/S
ARISE AB
ASIAKASTIETO
ATRIUM LJUNGBERG AB
AVANZA BANK
BANKNORDIK P/F
BESQAB AB (PUBL)
BLUE VISION
BONAVA AB
BURE EQUITY AB
CAPMAN OYJ
CASTELLUM AB
CATENA AB
CITYCON OYJ
COLLECTOR AB
COREM PROPERTY
DANSKE A
DANSKE BANK A/S
DIOS FASTIGHETER
DJURSLANDS BANK A/S
DONG ENERGY A/S
EAST CAPITAL
EIK FASTE
EQ OYJ
ETRION CORP
EVLI PANKKI OYJ
F E BORDING A/S
FABEGE AB
FASTIGHETS AB BALDER
FASTPARTNER AB
FORTUM OYJ
FYNSKE BANK
GERMAN HIGH STREET P

GREENTECH ENGERY
HEBA FASTIGHETS AB
HEMFOSA FASTIGHETER
HUFVUDSTADEN AB
HVIDBJERG BANK A/S
INDUSTRIVARDEN AB
INTRUM JUSTITIA AB
INVEST LUXOR AS
INVESTMENT AB LATOUR
INVESTOR AB
INVESTORS HOUSE OYJ
JEUDAN A/S
JM AB
JUTLANDER BANK
JYSKE BANK A/S
KINNEVIK
KLOVERN AB
KREDITBANKEN AS
KUNGSLEDEN AB
L E LUNDBERGFORET
LAN & SPAR BANK A/S
MELKER SCHORLING AB
MIDWAY HOLDING AB
NEWCAP HOLDING A/S
NGS NEXT GENERATION
NORDAX GROUP
NORDEA BANK
NORDFYNS BANK A/S
NORDICOM A/S
NORDJYSKE BANK AS
NORDNET SECURITIES
NP3 FASTIGHETER AB
ORAVA ASUNTORAH
ORESUND INVESTMENT
OSCAR PROPERTIES
OSTJYDSK BANK A/S
PANDOX AB
PANOSTAJA OYJ
PLATZER FASTIGHETER
PRIME OFFICE
RATOS AB
REGINN HF
REITIR FASTEIGNA

RESURS HOLDING AB
RINGKJ. LANDBOBANK
SAGAX AB
SALLING BANK A/S
SAMPO OYJ
SIEVI CAPITAL OYJ
SJOVA-ALMENNAR
SKANDINAVISKA ENSK
SKJERN BANK A/S
SPAR NORD BANK
SPAREKASSEN
SPONDA OYJ
STRATEGIC INV
STRAX
SV. HANDELSBANKEN AB
SWEDBANK AB
SYDBANK A/S
TAALERI OYJ
TECHNOPOLIS OYJ
TF BANK
TK DEVELOPMENT A/S
TOPDANMARK A/S
TOTALBANKEN A/S
TRACTION AB
TRYG A/S
WALLENSTAM AB
VESTJYSK BANK A/S
VICTORIA PARK I
VICTORIA PROPERTIES
VIS INSURANCE LTD
VOSTOK NEW

9.4 Performance (Monthly returns)

Period	Date	Magic Formula Portfolio	OMX Nordic 40
1	2007-05-01	12,42%	3,54%
2	2007-06-01	8,82%	4,83%
3	2007-07-02	0,30%	-2,27%
4	2007-08-01	-3,16%	-2,63%
5	2007-09-03	-2,56%	3,88%
6	2007-10-01	-1,48%	1,52%
7	2007-11-01	-3,19%	-2,63%
8	2007-12-03	-12,09%	-2,88%
9	2008-01-01	-1,90%	-1,83%
10	2008-02-01	-6,17%	-8,40%
11	2008-03-03	2,12%	-2,95%
12	2008-03-31	1,74%	-3,99%
13	2008-05-01	5,65%	1,44%
14	2008-06-02	4,76%	0,30%
15	2008-07-01	-12,19%	-13,43%
16	2008-08-01	0,62%	1,91%
17	2008-09-01	1,37%	2,21%
18	2008-10-01	-18,89%	-14,48%
19	2008-11-03	-15,75%	-11,66%
20	2008-12-01	-11,92%	-9,54%
21	2009-01-01	0,33%	7,57%
22	2009-02-02	2,74%	-9,03%
23	2009-03-02	5,90%	-4,02%
24	2009-03-31	2,34%	4,52%
25	2009-05-01	16,65%	18,05%
26	2009-06-01	16,19%	4,58%
27	2009-07-01	-3,98%	0,36%
28	2009-08-03	5,38%	3,76%
29	2009-09-01	-0,41%	1,46%
30	2009-10-01	2,96%	-0,66%
31	2009-11-02	2,63%	2,05%
32	2009-12-01	7,76%	2,68%
33	2010-01-01	1,11%	-0,31%
34	2010-02-01	5,22%	3,58%
35	2010-03-01	2,98%	-1,74%
36	2010-03-31	8,97%	7,44%
37	2010-05-03	-0,57%	1,38%
38	2010-06-01	-4,87%	-7,23%
39	2010-07-01	-2,57%	-1,92%
40	2010-08-02	4,01%	7,98%

41	2010-09-01	-0,69%	-2,25%
42	2010-10-01	7,47%	2,84%
43	2010-11-01	3,65%	1,66%
44	2010-12-01	1,33%	2,28%
45	2011-01-03	8,63%	4,26%
46	2011-02-01	-0,03%	-2,15%
47	2011-03-01	1,54%	-3,05%
48	2011-03-31	5,16%	1,79%
49	2011-05-02	2,48%	2,00%
50	2011-06-01	0,35%	-2,46%
51	2011-07-01	-4,72%	-3,07%
52	2011-08-01	-5,39%	-8,37%
53	2011-09-01	-7,28%	-7,08%
54	2011-10-03	-6,28%	-6,87%
55	2011-11-01	3,03%	4,11%
56	2011-12-01	-0,77%	2,80%
57	2012-01-02	0,40%	1,90%
58	2012-02-01	12,92%	6,28%
59	2012-03-01	2,65%	5,06%
60	2012-03-30	-0,12%	-1,93%
61	2012-05-01	1,88%	-1,23%
62	2012-06-01	-6,68%	-10,11%
63	2012-07-02	1,43%	5,77%
64	2012-08-01	1,03%	2,51%
65	2012-09-03	1,14%	0,76%
66	2012-10-01	2,08%	2,86%
67	2012-11-01	0,69%	-0,86%
68	2012-12-03	1,16%	2,88%
69	2013-01-01	4,36%	0,55%
70	2013-02-01	5,19%	7,71%
71	2013-03-01	3,13%	0,20%
72	2013-03-29	0,44%	-1,01%
73	2013-05-01	0,04%	0,93%
74	2013-06-03	2,28%	0,41%
75	2013-07-01	-0,89%	-2,97%
76	2013-08-01	4,17%	6,83%
77	2013-09-02	3,65%	-0,68%
78	2013-10-01	2,80%	3,67%
79	2013-11-01	5,14%	2,20%
80	2013-12-02	3,20%	3,09%
81	2014-01-01	1,34%	1,52%
82	2014-02-03	12,56%	-2,07%
83	2014-03-03	0,01%	5,54%

84	2014-03-31	-2,02%	1,83%
85	2014-05-01	9,10%	-0,11%
86	2014-06-02	1,05%	3,21%
87	2014-07-01	-0,89%	0,61%
88	2014-08-01	19,73%	-1,22%
89	2014-09-01	-11,67%	1,92%
90	2014-10-01	-5,17%	0,55%
91	2014-11-03	4,02%	0,96%
92	2014-12-01	-0,68%	3,47%
93	2015-01-01	-1,54%	0,99%
94	2015-02-02	7,36%	7,34%
95	2015-03-02	19,54%	6,82%
96	2015-03-31	0,15%	1,93%
97	2015-05-01	0,74%	-1,69%
98	2015-06-01	1,01%	1,67%
99	2015-07-01	-3,71%	-4,47%
100	2015-08-03	6,54%	5,41%
101	2015-09-01	-4,07%	-9,86%
102	2015-10-01	0,25%	-2,82%
103	2015-11-02	8,64%	6,25%
104	2015-12-01	10,75%	3,17%
105	2016-01-01	-3,58%	-3,82%
106	2016-02-01	-2,14%	-4,97%
107	2016-03-01	4,63%	1,44%
108	2016-03-31	6,82%	-2,35%

9.5 Datastream formulas

Return on Invested Capital *= (Net Income – Bottom Line + ((Interest Expense on Debt - Interest Capitalized) * (1-Tax Rate))) / Average of Last Year's and Current Year's (Total Capital + Short Term Debt & Current Portion of Long Term Debt) * 100*

Enterprise Value *= Market Capitalization at fiscal yearend date + Preferred Stock + Minority Interest + Total Debt minus Cash*