UNIVERSITEIT VAN TILBURG

Back-testing Magic

An analysis of the Magic Formula strategy

Master Thesis Investment Analysis

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Abstract

This paper performs a back-test of the magic formula strategy first introduced by Joel Greenblatt in 2006 in his book "The little book that beats the market". The magic formula is a method of stock selection where the highest combined scores for Return on Capital and Earnings Yield qualify as the best investment. Greenblatt (2010) provides results from the magic formula strategy that are able to persistently outperform the market from 1988 to 2009. I try and mimic these returns to either validate or reject the claims as made by Greenblatt. To do so a dataset is composed of the NYSE, AMEX and NASDAQ where all stocks are ranked using Earnings Yield and Return on Capital. The results confirm the findings as stated by Greenblatt where both the value-weighted and equally-weighted abnormal returns exhibit strong persistence at high significance. The results remain persistent under alternating investing conditions, like a longer holding period and higher required market capitalization for each stock. Furthermore, a sub sample is tested from the publication of the book in 2006 to 2010. Results during this period are statistically insignificant. Either the publication of the Magic formula has led to its own demise, or the overall downturn in the market temporarily invalidated its use. No decisive conclusion can be made in this respect.

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1. Introduction

Every investor seeks a way to outsmart Mr. Market, the next best investment strategy that earns high abnormal returns. Achieving abnormal return is often dubbed as impossible when we believe the Efficient Market Hypothesis (EMH) to hold true. It is generally believed that security markets are extremely efficient and reflect all available information. As soon as new information arises all market participants quickly incorporate the news into their price, without delay. Thus, predicting future stock prices using past information is a futile endeavor. If all market participants have the same information, all parties would trade on this information making the best obtainable return the same as the market return. In result, the optimal portfolio is one that is completely invested in the Market. The investor is unable to earn above-average returns without accepting above-average risks[1]. This paper discusses the question whether or not it is possible to obtain an abnormal return by looking at publically traded information used in The Magic Formula strategy. Clearly this would violate the EMH and would thus be a market anomaly. Forgoing literature has identified several anomalies, for example persistent higher returns in January and seasonal effects in stock prices. Keim (1998) provides an extensive overview of these different anomalies. One anomaly that has increased its presence in current literature is the persistent outperformance of *value investing strategies*. Value investing is school of thought on investing were the company's fundamental values are pertinent in the decision process to either buy or sell the share. This approach was first advocated by Benjamin Graham and David Dodd in 1928 at the Columbia Business School. The idea behind the approach is simple: "invest in stocks that have low price relative to some measure of their fundamental value". In this context the fundamental value can be book value, market value, intrinsic value etcetera. Even though the idea is simple, there has been a lot of criticism that if the price is low, the possibility that it will drop further is still very likely. Graham himself has several value measures he considers to make sure that besides being cheap the company is still healthy and thus has potential. Graham looks for stocks trading at a discount to their Net Current Asset Value (NCAV). In essence stocks which have a market value lower than their current asset value. In the event of a bankruptcy the investor can still recover his initial investment as the stock is trading

[1] For more information see; Malkiel (2003)

below its' liquidation value. This strategy utilizes the book-to-market anomaly, which is well reported by Fama and French (1992) as a key variable in explaining stock market variance.

Value investing differs from regular investment theory in that it does not believe that the CAPM and beta are good determinants for a share's market price. Modern Portfolio Theory in their eyes is inadequate and should not be used to determine a reliable price or construct a profitable portfolio. Montier (2009) explains that in order for the CAPM to work, it must abide to a set of underlying assumptions which are at odds with reality. Fama and French (2004) show that returns predicted by the CAPM are not in line with the true returns during the period of 1928-2003 They go as far as saying "*we also warn students that despite its seductive simplicity, the CAPM's empirical problems probably invalidate its use"*. Malkiel (2003), a strong proponent of the EMF, admits that some market participants demonstrate less than rational behavior resulting in pricing irregularities and even predictable patterns in stock returns for short periods of time. He goes on by saying that "…whatever patters or irrationalities in the pricing of individual stocks that have been discovered in a search of historical experience are unlikely to persist and will not provide the investor with a method to obtain extraordinary returns."

This thesis will focus on a specific Value investing approach as developed by Joel Greenblatt, who currently is a professor at the Columbia Business School.

Joel Greenblatt achieved annual returns at the hedge fund Gotham Capital of over 50% per year for 10 years from 1985 to 1995 before closing the fund and returning his investors' money. He is known for investing in special situations such as spin-offs, mergers, and divestitures.

In 2006 Joel Greenblatt wrote "The little book that beats the market". In his book he describes how to invest in the market using what he denotes as "the magic formula". The purpose of this paper is to research this method of investing and see if it offers abnormal risk-adjusted returns.

The magic formula as constructed by Greenblatt ranks companies based on two factors: Return On Capital (ROC) and Earnings Yields (EY). As a reciprocal of the P/E ratio it is important to consider research that uses the P/E ratio valuation metric to predict future returns. The difference lies in the use of a combination of value metrics. Greenblatt dubs the approach as a combination of Graham and Buffet, were you not only buy "cheap", but also buy "good". The EY helps to find the "cheap" companies. ROC indicates if the company is "good". The importance of the P/E ratio is researched by Campbell and Shiller (1998). Their research shows that P/E ratios

explained as much as 40 percent of the variance in future returns. They concluded that dividend–price and price-smoothed–earnings ratios have a special significance when compared with many other statistics that might be used to forecast stock prices. The main reason why this strategy needs to be evaluated is that it offers a different approach to the P/E ratio than what was previously done. Also, the magic formula offers exceptional risk-adjusted returns according to Greenblatt. I would like to either confirm or deny these findings and try to find an explanation how this market anomaly is allowed to persist. A main hypothesis is formed to frame the research.

The magic formula outperformed the broad based U.S. Market indices from July of 1985 to June of 2010.

In order to answer this question the paper is constructed as follows. We start with an overview of the literature already written within the field of value strategies in chapter 2. Here we delve in possible explanations for the persistence of a market anomaly and relate this to the valuation metrics used in this paper. The hypotheses that I wish to answer are narrated in chapter 3. The method of research and the data used is addressed in data & methodology in chapter 4. Consequentially the results are redacted in chapter 5. In closing a conclusion is give where the results are summarized in order to answer stated hypotheses. The conclusion is accompanied by closing remarks and recommendations.

2. Literature

This thesis researches the persistence of a market anomaly as documented by Joel Greenblatt. It concerns stocks that trade at a high Earning Yield (EY) and a High Return on Capital (ROC). I begin by elaborating on the magic formula (MF) before discussing the literature concerning market anomalies. Subsequently I describe research that discusses the persistent outperformance of value strategies. In closing possible explanations for the persistence of market anomalies are given where two sides are discussed; the side of rational expectations and the irrational or behavioral explanation.

2.1 The Magic Formula

Greenblatt uses two valuation metrics to construct his portfolio. The used metrics are the Earnings Yield (EY) and Return on Capital (ROC). EY is the reciprocal of the Price/Earnings ratio (P/E) and researched to great extend in foregoing literature. The P/E ratio is considered to be a market anomaly which exhibits that low P/E ratios stocks are generating higher risk-adjusted returns than high P/E ratio stocks. Low P/E stocks are viewed as "cheap" and potentially undervalued. Campbell and Shiller (1998) also concluded that dividend–price and price-smoothed–earnings ratios have a special significance when compared with many other statistics that might be used to forecast stock prices. The P/E ratio shows to have predictive powers, Greenblatt however choses to use an adjusted EY and not just an upside down P/E ratio.

$$Earnings\ Yield = \frac{EBIT}{Enterprise\ Value} \tag{1}$$

The basis of his choice lies in the use of Enterprise Value (EV) instead of just earnings. Greenblatt states that "…Enterprise value takes into account both the price paid for an equity stake in a business as well as the debt financing used by a company to help generate operating earnings". Companies with different tax and debt levels are placed on equal footing allowing for better comparison between Earning Yields. The second value metric that is considered is the Return on Capital.

$$Return\ On\ Capital = \frac{EBIT}{(Net\ Tangible\ Assets)} \quad (2)$$

For reasons of better comparison the EBIT is used once more. No debt or tax levels are taken into consideration. Furthermore Greenblatt prefers to use ROC over Return on Equity or Return on Assets (ROA) so only tangible capital employed is measured. "The idea here was to figure out how much capital is actually needed to conduct the company's business", as stated by Greenblatt.

Both value metrics are used to construct a portfolio of the 30 best companies whom are "cheap" as shown by their EY and "good" as shown by the ROC.

To construct the investor's portfolio Greenblatt has written a step-by-step process. I will provide a summarized version of the steps needed to construct the portfolios for this paper.

1. Screen stocks on the basis of their ROC or ROA (Greenblatt allows use of ROA when the ROC is not obtainable from data).
2. From the list of High ROC(ROA) group, screen for those stocks with the lowest P/E ratio or highest Earnings Yield
3. Eliminate:
    - Utility and financial stocks
    - Foreign companies, ADR's (American Depository Receipts).
4. Buy the 5-7 top ranked companies with 20 % to 33 % of your money which you intend to invest during the first year.
5. Repeat step 4 every two to three months until you hold about 20 to 30 stocks and allocated all your funds.
6. Sell each stock after holding it for one year. For taxable accounts, sell winners a few days earlier than one year and losers a few days later.
7. Continue to process for multiple years.

When following these steps the portfolio ought to exhibit persistent abnormal returns over longer periods of time. The conducted research in this paper deviates slightly from the aforementioned

steps. Namely, the constructed portfolios contain 30 stocks from the start. Greenblatts results are provided below so a comparison can be made.

Table 1:

Magic formula results in % for the period of 1988 to 2009 where AAR = Average Annual Return

Year	Small Stocks (over $50 Million)	Large stocks (over $1 billion)	S&P 500	Year	Small Stocks (over $50 Million)	Large stocks (over $1 billion)	S&P 500
1988	27,1	29,4	16,6	1999	53	14,4	21
1989	44,6	30	31,7	2000	7,9	12,8	-9,1
1990	1,7	-6	-3,1	2001	69,6	38,2	-11,9
1991	70,6	51,5	30,5	2002	-4	-25,3	-21,1
1992	32,4	16,4	7,6	2003	79,9	50,5	28,7
1993	17,2	0,5	10,1	2004	19,3	27,6	10,9
1994	22	15,3	1,3	2005	11,1	28,9	4,9
1995	34	55,9	37,6	2006	28,5	18,1	15,8
1996	17,3	37,4	23	2007	-8,8	7,1	5,5
1997	40,4	41	33,4	2008	-39,3	-38,8	-37
1998	25,5	32,6	28,6	2009	42,9	58,9	26,5
				AAR	**23,8**	**19,7**	**9,5**

Table 1 shows the results as described by Greenblatt in "*the little book that still beats the market*". The magic formula is able to outperform the S&P500 17 times in 22 years for stocks with a minimum market cap of $ 50 million and 16 times in 22 years for large stocks with a minimum value of $ 1 billion. The results are very promising and clearly outperform the S&P 500. During the financial crisis the formula however performs worse than the market. It takes a strong determined investor to hold the MF portfolio during 2007 and 2008 before the relapse in 2009. On average the strategy still proves to yield an average annual return of 23.8 percent relative to a "mere" 9.5 percent average annual return on the S&P 500.

I attempt to replicate these results in order to provide an accurate back-test. Before doing so I describe foregoing literature done into value investing strategies as a market anomaly.

2.2 Market anomaly

In order for markets to be efficient all investors are assumed to be rational profit-maximizers and have access to all available information without cost. According to the Efficient Market Hypothesis (EMH), security prices at any time "fully reflect" all available information. The EMH can be split into three relevant levels of efficiency. Weak form efficiency, semi-strong form efficiency and strong form efficiency. The first incorporates information on past prices. The

second includes information of past prices and all public available information. The third includes all information, including inside information. The theory itself has no empirical testable implications (Fama, 1970). To test the EMH an equilibrium model is needed where the expected return on a security is a function of its risk. The two most often used models are the CAPM and Fama-French three-factor model (1993).

The CAPM as asset pricing model was first discussed by Sharpe (1964), Lintner (1965) and Black (1972) and has since been the standard equilibrium model used by academics and practitioners to calculate average return and risk. The model implies that the expected returns on securities have a positive linear function in relation to the market risk, where market risk is called beta. The beta is calculated by measuring the covariance of the asset with respect to the market to the overall variance of the market. A higher beta indicates a higher volatility with respect to the market and vice versa. The CAPM assumes that volatility is the main risk factor that explains variations in stock prices. Since the birth of the CAPM researchers have attempted and succeeded in invalidating the model (Fama-French 1992, 1993, 1996). Fama and French found that public information, like company size and book to market ratios, are able to predict variations in market returns to a significant degree. Other researchers disapprove of these findings and state that the CAPM's empirical problems may reflect theoretical failings, due to simplified assumptions. The main assumption used is the comparison of the individual security in relation to the "market portfolio". The market portfolio is hard to define and should incorporate all assets not just financial assets. Even if the narrow view is used it only incorporates traded financial assets like a broad US common stock index. It is the model's problems that reflect weaknesses in the theory or in its empirical implementation, the failure of the CAPM in empirical tests implies that most applications of the model are invalid (Fama and French, 2004). Value strategies have shown persistence over longer periods of time and remain unexplained by the CAPM. For markets to be efficient any anomaly is inherently self-destructive. The semi-strong efficient market hypothesis states that indeed any public information present in the market is traded upon and reflected in the stock price. On one side we

have firm believers that markets are truly efficient and any market anomaly dissipates over time[2]. On the other side we see that valuation metrics tend to explain variations in stock prices[3] in a persistent manner. The ratio of EY, used in the MF, can be seen as a subset of the well documented market anomaly that is the P/E ratio. Research into the P/E ratio has not provided clear-cut evidence concerning the relationship between stock returns and earnings yield. In the US market Basu (1977) shows that low price earnings ratio (P/E) stocks earn higher risk-adjusted returns that high P/E ratio stocks. High P/E ratio generally indicates strong investor confidence in future earnings. Basu (1977) found the inverse to be true, narrating that perhaps winners tend to be overpriced. Furthermore, the results indicate that the P/E ratio information was not fully reflected in security prices as it should according to the semi-strong form of the efficient market hypothesis. However, transaction costs, search costs and tax effects could hinder the investor from exploiting this "anomaly" and the efficient market hypothesis cannot be rejected completely. Reinganum (1981[a]) build upon this research by addressing the earnings yield in relation to firm size effect. His results indicate the E/P ratio does not appear to be a market anomaly but rather a misspecification of the equilibrium model the CAPM. Further findings show that both E/P ratio and size effect seem to be related to the same set of missing factors from the CAPM. He resumes by saying that when both factors are jointly considered the E/P effect vanishes. Basu (1983) provides contrasting results where the E/P effect dominates size. Jaffe, et al. (1989) in turn finds that both size and E/P ratio is significant for the tested period from 1951 until 1986. The conflicting results do not provide a clear picture of the predictive powers the EY might have as a singular factor or in conjunction with ROC. The EY effect narrated by Reinganum (1981[a]) might exhibit the same effect as the Size factor used by Fama-French (1992), thus providing the MF predictive powers under the same theory. Fama and French (1992) research a larger amount of variables using a cross-section of average returns on the NYSE, AMEX and NASDAQ. They find that beta alone does not suffice to explain average returns. Size (market capitalization) captures differences in average stock returns that are missed by beta. They also find that the factor of book to market is able to explain a considerable degree of variations in average stock returns. It is in 1993 that Fama and French introduce the three-factor

[2] Malkiel (2003) questions the robustness of the proposed research and warns about possible data-mining. In Malkiel (2005) he shows that active managed funds tend to underperform passive index funds in the long term. This evidence suggests that the market portfolio (Passive index fund) incorporates all information and is thus efficient.
[3] Campbell and Shiller (1998a,b), Fama & French (1988, 1992, 1996), DeBondt and Thaler (1995).

model to improve on the CAPM. They add two additional factors alongside the beta to explain variations in stock returns. The factors are Small Minus Big (SMB) and High book to market minus Low book to market (HML). SMB captures the returns of small sized firms and the second captures of high book to market stocks versus low book to market stocks. Fama-French (1993) are able to explain the use of the two additional factors by stating that certain company characteristics carry additional risk. They describe that small firms can suffer longer earnings depression than big firms, which suggests that size is associated with a common risk factor that might explain the negative relation between size and average return. In other words, during a down cycle, large firms are able to rebound more quickly than small firms causing small firms to carry additional risk that remains unexplained by beta. Similarly, they suggest that the HML factor captures the variation of the risk factor that is related to earnings power. Combined the factors incorporate a distress situation in the standard CAPM where firms with low long-term returns have positive SMB and HML slopes and higher future average returns. These stocks have poor past performance and a low book-to-market value, causing them to inherently carry more risk. Conversely, stocks with high long term results tend to have negative slopes on HML and low future returns. In summary, the three-factor model captures that small cap stocks tend to outperform large cap stocks (SML) and value stocks outperform growth stocks (HML). The HML factor addresses the P/E anomaly as found by Basu (1977). The EY as used by Greenblatt can thus be explained by the Fama-French 3-factor model. Early expectations are that the 3-factor model is able to explain the generated returns produced using the Magic Formula strategy, thus invalidating the method as an anomaly. The high Earnings Yield that Greenblatt looks for equates to a low P/E ratio. However, Greenblatt uses an adjusted method to calculate the earnings yield allowing results to easily vary from aforementioned evidence surrounding the P/E ratio and earnings yield. Haugen (2008) states that Greenblatt's indicator for "cheapness" thus the EY is actually a composition of two ratios. He goes on by comparing it as follows. If E is income available for distribution to stockholders, I is interest paid on debt, P is the market value of the stock, and D is the face value of debt, then Greenblatt's EY is equal to (E+I) / (P+D). E/P is the earnings yield, but I/D is the ratio of interest expense to the face value of debt. The size of this ratio is determined by: (a) the credit worthiness of the company, (b) the term of the debt when issued, and (c) the general level of interest rates when the debt was originally issued. Haugen (2008) questions the importance of the I/D ratio in helping to find inexpensive stocks.

The relative importance of the two ratios in the composite is determined by the relative amount of debit in the firm's capital structure. Consider the possible caveat with a company with lots of low-grade debt. The company might be largely overvalued (high P relative to E), but would still rank high in the Magic Formula (Haugen (2008))[4].

2.3 Performance

The contradictions of the CAPM that are summarized above exhibit a relationship. Factors that incorporate stock prices have information about expected returns missed by market betas[5].

Factors like EY and ROC are used to determine the intrinsic value of a company. The intrinsic value is the value of a company based on the perception of its true value including all future dividends and cash flows discounted to the present (Charles, et al., 1999). What the true value of the company is might, or might not, be equal to the market value. It is this discrepancy that generates either high abnormal or sub abnormal returns. It is those discrepancies that value investors look for. In violation of the EMH, simple value heuristics are able to explain variations in stock prices. Applying those value heuristics within a value strategy exhibited outperformance. Early research shows that using the Net Current Asset Value (NCAV) strategy first proposed by Graham and Dodd (1928) allows for persistent outperformance. Oppenheimer (1986) found that, in the period from 1970 to 1983, using the NCAV strategy yielded risk-adjusted returns of 19% in outperformance of the NYSE-AMEX on yearly basis. Outperformance of value strategies is not exclusive to the US market. Chan, Hamao, and Lakonishok (1991) examine the variables earnings yield, size, book to market ratio and cash flow yield on the Japanese market. They find a significant relationship between the variables and the expected returns. Stocks with high valuation ratios generated higher returns than stocks with low valuation ratios. They state however, that it is hardest to disentangle the effect of the earnings yield variable. If the variable is considered in isolation it indeed has a positive and significant impact on returns. If the book-to-market ratio is added, the earnings yield becomes

[4] See Haugen (2008), Comparative Analysis of 2-factor and multi-factor analysis. Available on http://www.quantitativeinvestment.com/GreenblattStudy.aspx

[5] Fama and French, 2004: "A stock's price depends not only on the expected cash flows it will provide, but also on the expected returns that discount expected cash flows back to the present. Thus, in principle the cross-section of prices has information about the cross-section of expected returns. Such ratios are thus prime candidates to expose shortcomings of asset pricing models – in the case of the CAPM, shortcomings of the prediction that market betas suffice to explain expected returns (Ball, 1978)."

insignificantly different from zero. In Europe (France, Germany, the Netherlands and the United Kingdom) Brouwer, et al. (1997) finds outperformance for all four variables investigated. The variables considered are earnings-to-price ratio (earnings yield), cash-flow-to-price ratio, book-to-market ratio and the dividend yield. The variables have high explanatory power in the cross-section of stock returns. For the UK Gregory, et al. (2001) confirms that, consistent with evidence from the US, value stocks indeed generated higher returns in the UK. "*These results are robust to both value-weighting the returns and controlling for size effects*". Similar results for the UK are found by Strong and Xu (1997). Research to date has consistently found outperformance for value stocks and for earnings yield. It is possible that the Magic formula exploits this anomaly resulting in the abnormal returns as mentioned by Greenblatt (2010). No previous research is found that uses the ROC as an anomaly.

2.4 Explaining value strategy persistence

Literature[6] has indicated that traditional volatility is insufficient in explaining the expected returns. Interpreting and explaining these results however has been more controversial. Explanations by academics can be divided into two schools of thoughts, a behavioral side and a side that explains the result as a shortcoming in the CAPM as equilibrium model. Proponents of the behavioral theory take a more pragmatic approach by stating that investors do not always act as rational agents when taking decisions under risk (Kahneman and Tversky, 1979). Studies in psychology suggest that individuals tend to use simple heuristics in their decision-making[7]. Lakonishok, et al. (1994) attempt to explain the predictability of returns using investor behavior by stating that "contrarian" investment strategies differ from "naïve" strategies. Examples of "naïve" strategies are, extrapolating past performance too far into the future, assuming a trend in stock prices and overreacting to good or bad news. Lakonishok, et al. (1994) find that investors tend to extrapolate past performance far into the future. So called "glamour" stocks have shown optimal past performance and a thus favored by many investors. "Value" stocks on the other hand did not have optimal past performance and thus tend to be less favored. Lakonishok, et al. (1994) say that "…a likely reason that these value strategies have worked so well relative to the glamour strategies is the fact that actual future growth rates of earnings, cash flow, etc of

[6] See; de Bondt and Thaler (1985, 1987), Lakonishok , et al. (1994), Fama French (1992,1993,1996) Bazu (1977, 1983), Reinganum (1981a, b), Jaffe , et al. (1989) and Campbell and Shiller (1998).
[7] Kahneman and Tversky (1974) and Chen and Lakonishok (2004)

glamour stocks relative to value stocks turned out to be much lower than they were in the past", and "…market participants appear to have consistently overestimated future growth rates of glamour stocks relative to value stocks". De Bondt and Thaler (1985) showed similar results, where the 50 most extreme "losers" outperform the 50 most extreme "winners". Where the losers have low past performance and the winners have high past performance. Over the 5 year test periods losers outperformed winners by an average of 31.9 percent. Both de Bondt and Thaler (1985) and Lakonishok, et al. (1994) provide explanations that are rooted in experimental psychology. The exhibited investor behavior is in line with the representative heuristic first described by Tversky and Kahneman (1974). They find that when making judgments under uncertainty the investor tends to overweight recent data and underweight prior data. It is this consistent mispricing done by investors that yield higher returns for value strategies. La Porta, et al. (1997) build on this earlier research by examining the market reaction around earnings announcement. They find that investors are slow to realize that earnings growth rates for value stocks are higher than is initially expected and conversely so for glamour stocks. La Porta, et al. (1997) explains the results by stating that unsophisticated investors may simply have a preference for investing in "good" companies. Past performance has indicated high levels of profitability and superior management. Investors are willing to buy the stock irrespective of price. Sophisticated investors in turn may prefer well known glamour stocks as they are easier to justify to clients and superiors. From a psychological view the exhibited phenomenon is an overreaction to earnings announcements.

The proponents or the EMH explain persistence of value strategies, like the P/E ratio and the B/M ratio, as a shortcoming in the current CAPM model. They point to the need for a more complicated asset pricing model. Here I address several important improvements to the CAPM. Firstly, CAPM is constrained by unrealistic assumptions. Montier (2009) explains that in order for the CAPM to work, it must abide to a set of underlying assumptions which are at odds with reality. Fama and French (2004) show that returns predicted by the CAPM are not in line with the true returns during the period of 1928-2003 They go as far as saying "*we also warn students that despite its seductive simplicity, the CAPM's empirical problems probably invalidate its use"*. Fama & French (2004) go on by narrating that it is unreasonable to assume that investors care only about the mean and variance distributions for a single period. It is more likely that investors also care about how their portfolio covaries with labor income and future income

opportunities. By focusing on the portfolio return variance, the model misses important dimensions of asset risk that remain unexplained by beta. Several attempts have been made to construct an asset pricing model that explains more anomalies and does a better job at explaining average returns. Merton (1973) expanded on the CAPM by incorporating a different assumption about investor objectives. He called the model the intertemporal capital asset pricing model (ICAPM). Instead of one period wealth maximization, additional factors are allowed to capture the investor consumption. The ICAPM takes a multifactor approach and allows for additional beta (or state) variables. The investor still prefers high expected return and low return variances, but is also concerned with covariances of portfolio returns with the state variables. Fama & French (1993) took an approach more in line with Ross's (1976) Arbitrate pricing Theory (APT). Two additional factors are used alongside the beta. Fama & French (2004) argue that the factors are not state variables but "…reflect unidentified state variables that produce undiversifiable risks (covariances) in returns that are not captured by the market return and are priced separately from market betas." The factors HML and SMB are added in order to capture the book-to-market factor anomaly and size factor anomaly. The size factor anomaly was first discussed by Banz (1981) and Reinganum (1981[b]). Huberman and Kandel (1987) found that there is covariation in *returns on small stocks* that is not captured by the market return. Similarly Chan and Chen (1991) found that there is covariation in returns related to *relative distress* that is not captured by the market return and is compensated in average returns. The model explains covariation in stock returns that is missed by the market return. The three-factor model uses a risk based explanation of the failings of the CAPM. Behavioralists reject the risk based hypothesis and rebut that the captured covariation is present because there is a correlation between the book-to-market factor and investor overreaction (Fama & French, 2004). In defense Fama & French (2004) state that the practical application of the three-factor model does not depend on whether or not the average return premiums are based on rational pricing or irrational investor behavior. The largest shortcoming of the three-factor model was the inability to capture the momentum effect of Jegadeesh and Titman (1993). The momentum effect captures the behavior of rising stock prices to rise further, and falling stock prices to keep falling. Stocks that have done well in the past remain to do so over the coming months, and vice versa. Carhart (1997) improved upon the three-factor model by adding a momentum factor.

The proponents of the CAPM refute any rejection of the equilibrium model by stating that it is impossible to test the CAPM as the true market portfolio at heart of the model is theoretically and empirically elusive (Roll, 1997). To test upon the CAPM academics merely use a proxy for the market portfolio. It remains unclear what assets need to be included or excluded from the market portfolio. The author feels that if this is the case, it is hard to justify the use of the CAPM in practical applications as it uses a market proxy like the CRSP value-weight portfolio of U.S. stocks. In empirical tests it is this market proxy that leads to rejections of the EMH.

One of the latest developments in asset pricing is the alternative three factor model by Chen, Novy-Marx and Zhang (2010). The model differs from the Fama-French model by proposing an investment factor, and a return on asset (ROA) factor to explain the cross-section of expected stock returns. The complete model consists of: (a) the market excess return, (b) the difference between the return of a portfolio of low-investment stocks and the return of a portfolio of high-investment stocks and (c) the difference between the return of a portfolio of stocks with high return on assets and the return of a portfolio of stocks with a low return on assets[8]. The model proclaims to explain more anomalies than the Fama-French three-factor model. Indirectly the model makes a case for the use of Greenblatt's magic formula. Greenblatt states that he allows the use of ROA (instead of ROC) to infer what "profitable" companies are. I expect using the Magic formula in conjunction with the Alternate three-factor model to adjust for risk, provides results that differ from those found by Greenblatt himself. However due to ongoing debate about the validity of the results as posted by Chen, Novy-Marx and Zhang (2010) I was unable to acquire the needed ROA- and Investment factor to apply the alternative three-factor model

Which school of thought has the correct interpretation remains an ongoing debate. Wu and Zhang (2010) test upon many different accounting-based anomalies and see if these are either driven by risk or mispricing (behavioral aspects). Their results, albeit with serious caveats, shows that there is evidence that mispricing, not risk, is the main driving force of capital markets anomalies. In this paper a wide range of asset pricing models are used to test upon the MF. Consequently, I can either confirm or deny the presence of a market anomaly within the used MF.

[8] See: Chen, Novy-Marx, Zhang (2010)

3. Hypothesis

This paper will examine the performance of a value investing strategy called the magic formula investment (MF). Are the results provided by Greenblatt in his book "The little book that still beats the market" accurate or merely based on luck? Even though the intuition behind the Magic formula sounds promising, buy good companies cheap; is it able to outsmart Mr. Market?

I form several hypotheses to provide an in-depth back-test of the methodology used by Greenblatt. Due to marginal information provided Greenblatt about his methodology and the way his dataset is constructed, several inconsistencies might evolve. The difference should not affect the conclusion whether or not the MF strategy works or not. I begin analyzing the descriptive statistics to answer the following hypothesis;

- ***Hypothesis 1A****: The magic formula outperformed the broad based U.S. Market indices from July of 1985 to June of 2010.*

- ***Hypothesis 1B****: The magic formula outperformed the broad based U.S. Market indices from July of 1985 to June 2010 even with a minimum market value of 1 billion dollars and with a holding period of one, three and five years.*

The results are provided and discussed as the strategy progresses over time. The initial prognosis is, in line with Greenblatt, that the raw returns will prove to be higher than the Market, in this case the combined NYSE, AMEX and NASDAQ indices. Results will be accompanied by the standard deviation to assess if the higher return also incorporates a higher risk. For reasons of comparison the Sharpe ratio and the Average Annual Return (AAR) is calculated. Further statistical tests are needed to determine if the MF strategy can be denoted as an anomaly left unexplained by several Asset Pricing Models.

- ***Hypothesis 2A****: Traditional Asset Pricing Models are able to explain the returns generated by the magic formula portfolios from July of 1985 to June of 2010.*

- ***Hypothesis 2B****: Traditional Asset Pricing Models are able to explain the returns generated by the magic formula portfolios from July of 1985 to June of 2010 even with a minimum market value of 1 billion dollars and with a holding period of one, three and five years.*

3.1 Additional hypotheses:

In addendum, I have several other hypotheses that stray from the main hypothesis. I will narrate on them in this section, yet the results are found in the appendices.

Magic after publication

"The little book that beats the market" reached bookstores in 2006 and quickly became a bestseller. As stated by Malkiel (2003) "I am skeptical that any of the "predictable patterns" that have been documented in the literature were ever sufficiently robust so as to have created profitable investment opportunities, and after they have been discovered and publicized, they will certainly not allow investors to earn excess returns." Does the MF suffer the same faith. I test a subsample from 2006 to 2010 to see if the strategy exhibits statistically significant abnormal returns. Before composing the results I keep in mind the period in which the sample lies, namely the Financial Crisis and consequently the overall economic downturn. If the MF strategy exhibits abnormal returns, its remains persistent during both large-scale economic downturn and after publications. This also means that if insignificant returns are discovered no direct conclusion can be made as to its' specific cause.

The hypothesis is described as follows:

- ***Hypothesis 3A****: The magic formula outperformed the broad based U.S. Market indices from July of 2006 to December of 2010 after publication of the Magic formula strategy.*

- ***Hypothesis 3B****: Traditional Asset Pricing Models are able to explain the returns generated by the magic formula portfolios from July of 2006 to December of 2010 after publication of the Magic formula strategy.*

Inversed magic

The research is extended to look at the inverse of the magic formula. Greenblatt claims that "..the magic formula appears to be very powerful. It not only seems to work for the top-ranked stocks, but its ranking seems to have meaning throughout the total universe of stocks "and "…over the long term the formula appears to work in order with group 1 beating group 10 by a wide margin". Greenblatt does however advise against a long-short strategy where the top ranked stocks are bought and the bottom ranked stocks are sold. He narrates that "It [the magic formula]

doesn't always work. Sometimes the top-ranked stocks go down at the same time the bottom-ranked stocks are going up.[9]" I want to research these claims by forming the inverse of the top-ranked MF portfolio. The 30 lowest ranked stocks are used to form a portfolio.

- ***Hypothesis 4A****: The inverse magic formula underperformed the broad based U.S. Market indices and the top magic formula from July of 1985 to June of 2010.*

Similar with the top-ranked MF portfolios, I want to test if current Asset Pricing Models are able to explain the returns generated by the bottom-ranked MF portfolios.

- ***Hypothesis 4B****: Traditional Asset Pricing Models are able to explain the returns generated by the inverse magic formula portfolios from July of 1985 to June of 2010.*

Patterns in the returns

Using group deciles and the inverse MF portfolios I want to see if a clear pattern can be exhibited behind the MF approach. Do the worst portfolios also perform the worst? I attempt to replicate a table composed by Greenblatt, where he grouped his stock universe in 10 deciles. Within his table a pattern clearly exists from group 1 performing the best in raw returns and group 10 performing the worst.

- ***Hypothesis 5:*** *Magic formula portfolios when grouped in 10 deciles from best ranked to worst ranked exhibit a clear pattern in returns from high returns to low returns from July of 1985 to June of 2010.*

[9] The quotes are from "The little book that still beats the market" (2010) pp. 158 & 159. The quotes concern a table where group 1 holds the top ranked stocks and group 10 the bottom ranked stocks.

4. Data & Methodology

This section offers a description of the used dataset and how it is constructed, the method in which the portfolios are constructed and how the returns are analyzed.

4.1 Data

Two sources are used to construct ranking portfolios and measure their performance over time. COMPUSTAT provides the accounting variables needed to calculate the Return on Capital (ROC) and the Earnings Yield (EY). The COMPUSTAT data has annual intervals. Different from quarterly data, annual data is unrestated making I ideal for back-testing[10]. The monthly data on stock returns, stock prices and number of shares outstanding are obtained from the Center for Research on Equity Prices (CRSP). The sample includes all stocks on the NYSE, NASDAQ and AMEX. Financial firms (SIC codes between 6000 and 6999) are excluded from the sample as they lack the fundamentals needed to calculate their ROC or EY (Greenblatt, 2010). Financial firms can exhibit high leverage. The high leverage could indicate distress for industrial firms but have a different meaning for financials making them difficult to compare (Fama French, 1992). Furthermore, non-operating establishments (SIC code 9995) are excluded for similar reasons. I also exclude firms that do not have the data required to calculate the EY or ROC for July of *t* or December of *t-1*. The study does take into account companies that have become delisted due to mergers, bankruptcy etc. In doing so I avoid a possible survivorship bias in the data (Banz and Breen (1986)) Furthermore, CRSP delisting returns are added to the monthly returns when applicable. The sample includes domestic US firms with ordinary common equity, thus excluding ADR's and REITS. Data is linked using the COMPUSTAT CRSP Merged database and combined by their respective unique identifiers from COMPUSTAT (GVKEY) and CRSP (PERMNO, CUSIP) to obtain the most accurate merge. The sample ranges from 1985 until 2010. By starting in the year 1985 the sample will be less contaminated by a significant look-ahead bias due to COMPUSTAT's major expansion in 1978 when data was added retroactively for a large quantity of firms (Lakonishok, et al., 1994).

The measurement of persistence of Magic formula strategy is tested using several factor models alongside the CAPM. The used models are Fama and French's three factor model with and

[10] (Vora & Palacios, WRDS April 2010)

without the momentum factor added by Carhart (1997). I also use Cremers, et al. (2010) benchmark factor model to see if any generated alpha is due to the used market benchmark. Finally we add the liquidity factors by Pastor and Stambaugh (2003). The data needed to perform tests using the Fama-French three factor model are the factors High Minus Low, Small Minus Big, the Market Returns and the Risk Free Rate. The market returns calculated by Fama-French are from the NYSE, NASDAQ and AMEX thus allowing for an optimal match between the data and benchmark. The risk free rate is the 1-month Treasury bill from Ibbotson and Associates, Inc. Furthermore, the factors used by the Cremers, et al. (2010) factor model and the Liquidity Factor used by Pastor and Stambaugh (2003) were found using CRSP[11]. The factors are described within the methodology.

4.2 Portfolio formation:

The construction of the portfolios is dependent on ROC and the EY. To calculate the earnings yield we follow the example of Greenblatt (2010) by using an adjusted measure for both. The accounting variables are calculated from annual data on COMPUSTAT. Greenblatt (2010) provides a general overview MF formula. The precise application of the formula is debated by many. The formula as used here is in line with Larkin (2009) adjusted with information obtained from interviews with Greenblatt, which provided a more in-depth explanation. After comparing several methods of calculation the author strongly believes the one used below is the most representative.

Return on capital is calculated as:

$$Return\ On\ Capital = \frac{EBIT}{(Net\ Fixed\ Assets + Net\ Working\ Capital)} \tag{3}$$

The Net Fixed Assets is equal to Property, Plant and Equipment after depreciation (PPENT). Net Working Capital is calculated as:

$$Net\ Working\ Capital = Max\{0; Current\ Assets - Excess\ Cash - Interest\ bearing\ debt\} \tag{4}$$

[11] Available on the Wharton Research Data Services (wrds-web.wharton.openn.edu/wrds)

Where Excess cash is;

$$Excess\ Cash = Total\ cash - Max\{0; Total\ Cash + Current\ Liabilities - Current\ Assets\}. \quad (5)$$

Where interest bearing debt is;

$$Interest\ Bearing\ Debt = Curret\ liabilities - Debt\ in\ Current\ Liabilities. \quad (6)$$

The earnings yield is calculated as:

$$Earnings\ Yield = \frac{EBIT}{Enterprise\ Value} \quad (7)$$

Where Enterprise Value (EV) is;

$$EV = Max\{1; Marketvalue\ (Price * shares\ outstanding) + Preferred\ shares + Long\ term\ debt + debt\ in\ Current\ Assets - Excess\ Cash \quad (8)$$

To construct the portfolios the ROC and EY must be ranked in the same fashion as stipulated by Greenblatt. Each company in the data sample is ranked in descending order for both EY and ROC. The ranks for both accounting variables are added to give each company a combined score. The 30 companies that score the highest are included in the portfolio as of July of *t*. In this construct we differ from the approach used by Greenblatt whom recommends starting with 9 companies and retaining a large portion of cash. The position in the stock market is expanded each month to construct the full portfolio of roughly 30 stocks. As I do not only want to test the performance of the strategy in itself, but also want to examine the possible anomaly that the strategy provides, I immediately start with 30 stocks at the formation of the portfolio. Portfolios are formed in July of each year *t* from the year 1985 until 2010. In 2010 the data ranges until June. The formation in July is used in attempt to mitigate the effects of earning announcements or surprises. By using the COMPUSTAT Research Insight database the data potentially suffers from "look ahead bias" (Banz and Breen (1986)). Accounting data is potentially corrected for financial restatements and allows a discrepancy of what was really known by the investor at that point in time, and the data provided by COMPUSTAT. Greenblatt had the advantage of using the COMPUSTAT Point-in-time database, which was inaccessible for the research within this paper. To prevent "look-ahead bias" other measures are taken. The constructed portfolios are ranked

using trailing 12 month data, ensuring that the accounting information is publically available before the returns are recorded. The firms within the sample are obligated to have accounting data available on July of *t* or December of *t-1* or they are excluded from the dataset. Observations with an EY higher than 50% or a ROC higher than 300% are excluded from the sample to prevent outliers. The cut-off points are chosen arbitrarily and a based on observations made in the data. Higher values tend to take flight from "normalcy". The extreme values suggest some condition in the company's history or accounting that might make its numbers not properly comparable with the rest of the population. Testing the data with and without the outliers offered only small differences in annual returns, but offered unrealistic values for ROC or EY. Another prerequisite of the magic formula strategy is that a company must have market value of $50 million or higher. Greenblatt states that "with companies of that size, individual investors should be able to buy a reasonable number of shares without pushing prices higher" (Greenblatt (2010) p.63). The portfolios are adjusted accordingly. The portfolios are formed and rebalanced annually, every 3 or every 5 years, depending on the holding period. The returns are compounded annually as raw (R_{it}) returns and both value-weighted and equally weighted from July of year *t* to June of year *t + 1*, *t+3* or *t+5*.

4.3 Methodology

The constructed portfolios are researched using an Ordinary Least Squares (OLS) regression.

$$y_t = \alpha_i + \beta x_t + \varepsilon_t. \tag{9}$$

Where the dependent variable y_t will be the observed returns from the Magic formula and the independent variable βx_t is used to explain these variations. The β is the slope that best fits the relationship between the dependent and the independent variables. The residual ε_t measures the distance from the slope to the observed value of y_t . The monthly returns of the portfolios are tested against the Capital Asset Pricing model (Cochrane, 1999), the Fama-French three factor model (Fama & French, 1993), the Carhart 4-factor model (Carhart, 1997), Cremers, et al. (2010) alternative factor model and the Pastor and Stambaugh (2003) liquidity factor model. I use a wide range of different Asset Pricing Models to research if the Magic Formula Strategy exhibits abnormal returns.

The first model used is the CAPM to see if the traditional asset pricing model is sufficient enough to explain the monthly returns generated by the Magic formula strategy. The expected return of portfolio *i* is tested using the following time series regression,

$$R_{it} - R_{ft} = \alpha_i + b_i\,(R_{mt} - R_{ft}) + \varepsilon_{it}. \quad (10)$$

On the left hand side, R_{ft} is the monthly risk free rate and R_{it} is the monthly portfolio returns.
The right hand side α_i is alpha and b_i is the sensitivity of the excess portfolio returns relative to market returns. ε_{it} is the error term.
The Fama-French (1992) three factor model has a similar construct but adds two additional factors that explain more return variation than market risk alone. The expected return on portfolio *i* is tested using the following time series regression,

$$R_{it} - R_{ft} = \alpha_i + b_i\,(R_{mt} - R_{ft}) + s_{it}(SMB) + h_{it}(HML) + \epsilon_{it}. \quad (11)$$

The additional factor of Small minus Big (SMB) attempts to explain variations in returns by company size, and the High minus Low (HML) does so by the differences in Book-to-market values. Carhart (1997) adds another factor that allows for momentum in stock price. Momentum states that stock prices that have done well in the past will continue to do so. The phenomenon was introduced by Chan, et al. (1996). Carhart (1997) constructed the following four factor asset pricing model that includes the momentum effect (MOM),

$$R_{it} - R_f = \alpha_{it} + b_{it}\,(R_{mt} - R_{ft}) + s_{it}(SMB) + h_{it}(HML) + m_{it}(MOM) + \epsilon_{it}. \quad (12)$$

Cremers, et al. (2010) constructed an alternative factor model that attempts to eliminate the used benchmark from generating alpha. The authors found that the Fama-French and Carhart models suffer from biases. The models attempt to put disproportionate weight to value stocks, especially within large stocks, which in turn induces a positive correlation in the SMB and HML betas of cap-weighted portfolios. The authors go on by providing evidence that passive benchmarks like the S&P500 ought to exhibit zero alphas; yet using the Cahart four factor models provides positive alphas of up to 0.82%. To overcome the positive alphas generated due to the used benchmark Cremers, et al. (2010) constructed the following alternative factor model,

$$R_{it} - R_f = \alpha_{it} + b_{it}(R_{mt} - R_{ft}) + s_{it}(RMS5) + h_{it}(R2RM) + i_{it}(S5VS5g) + j_{it}(RMVRMG) + k_{it}(r2vr2g) + l_{it}(MOM) + \epsilon_{it}. \quad (13)$$

RMS5 is the mid minus large cap factor, R2RM is the small versus large cap factor, S2VS5g is the large cap value minus growth factor, RMVRMG is the midcap value minus midcap growth factor, r2vr2g is the mid versus large cap factor and MOM is the momentum factor.

The final factor model included is Pastor and Stambaugh's (2003) liquidity factor model. The authors investigated whether marketwide liquidity is a state variable important for asset pricing. They find that stocks that are more sensitive to liquidity tend to have substantially higher expected returns. To capture the state of liquidity Pastor and Stambaugh (2003) constructed factors alongside Fama-French 3 factor model in an attempt to explain more variation in excess stock returns.

The factor model is constructed as follows,

$$R_{it} - R_f = \alpha_{it} + b_{it}\,(R_{mt} - R_{ft}) + s_{it}(SMB) + h_{it}(HML) + l_{it}(LIQ\_V) + \epsilon_{it}. \quad (14)$$

The LIQ_V is the value weighted traded liquidity factor based on the 10-1 portfolio from a sort on historical % liquidity betas. By comparing the most well-known factor models to date, more concise conclusion can be drawn about the excess returns using the Magic formula.

5. Empirical Results

After forming the portfolios, as described in the Data section, results are generated to answer the stated hypothesis. Table 2 shows both the value weighted and equally weighted returns using annual rebalancing. My results differ from Greenblatt somewhat, which was expected due to several difference between the portfolio construction narrated by Greenblatt and the method I used.

5.1 Magic formula portfolio

Table 2:
Descriptive statistics of the top ranked portfolio formed on the 30 highest ROC & EY stocks[a]

Statistics	Value Weighted	Equally Weighted	Market average - Value weighted	Market average - Equally weighted	S&P 500
mean	0.0185	0.0181	0.0092	0.0111	0.0072
median	0.0215	0.0209	0.0150	0.0164	0.0114
sd	0.0771	0.0640	0.0465	0.0559	0.0455
min	-0.3073	-0.3209	-0.2254	-0.2722	-0.2176
max	0.2670	0.1785	0.1285	0.2250	0.1318
Sharpe	**0.1961**	**0.2294**	**0.1246**	**0.1374**	**0.0834**
T-test	4.2070	4.9480	3.4660	3.4760	2.7750

[a]The portfolios are constructed as follows. Each year *t* from 1985 to 2010 portfolios are formed by ranking the highest ROC & EY stocks measures in July of *t*. Portfolios are annually rebalanced using the highest 30 stocks as indicated by their combined ROC & EY score. Additionally all stocks are required to have a minimum market capitalization of 50 million in May of year *t*. Both equally weighted and value weighted returns are calculated. Equally weighted return is measures by dividing the return of each stock with the total stocks in the portfolio, in this case, thirty. Value-weighted return is measures by calculating the lagged market capitalization of June and adjusted monthly by cumulatively multiplying the June market value times one month trailing return (excluding dividends), similar to Fama-French (1993). This procedure is repeated every July of year *t*. Market average return, both value weighted and equally weighted, are returns on the NYSE, AMEX & NASDAQ combined for the same period as the magic formula portfolios. The Sharpe ratio is calculated using a one month US treasury bill for the risk free rate. The mean risk free rate is equal to 0.34 percent. Finally, a student's t-test is added.

Both value weighted and equally weighted returns exhibit higher returns than the broad US market, but at a higher standard deviation. This is expected in line with the CAPM, where a higher return ought to incorporate a higher risk. For the purpose of comparison the Sharpe (1994) ratio is calculated using the following formula:

$$S_i = \frac{\overline{r}_i - \overline{r}_f}{\sigma_i} \tag{15}$$

First indications show that the Magic formula strategy could have potential. The higher Sharpe ratio relative to the market confirms that the strategy yields higher returns for the level of risk taken. Table 3 is constructed similar to Greenblatt and provides the returns on annual basis relative to the market.

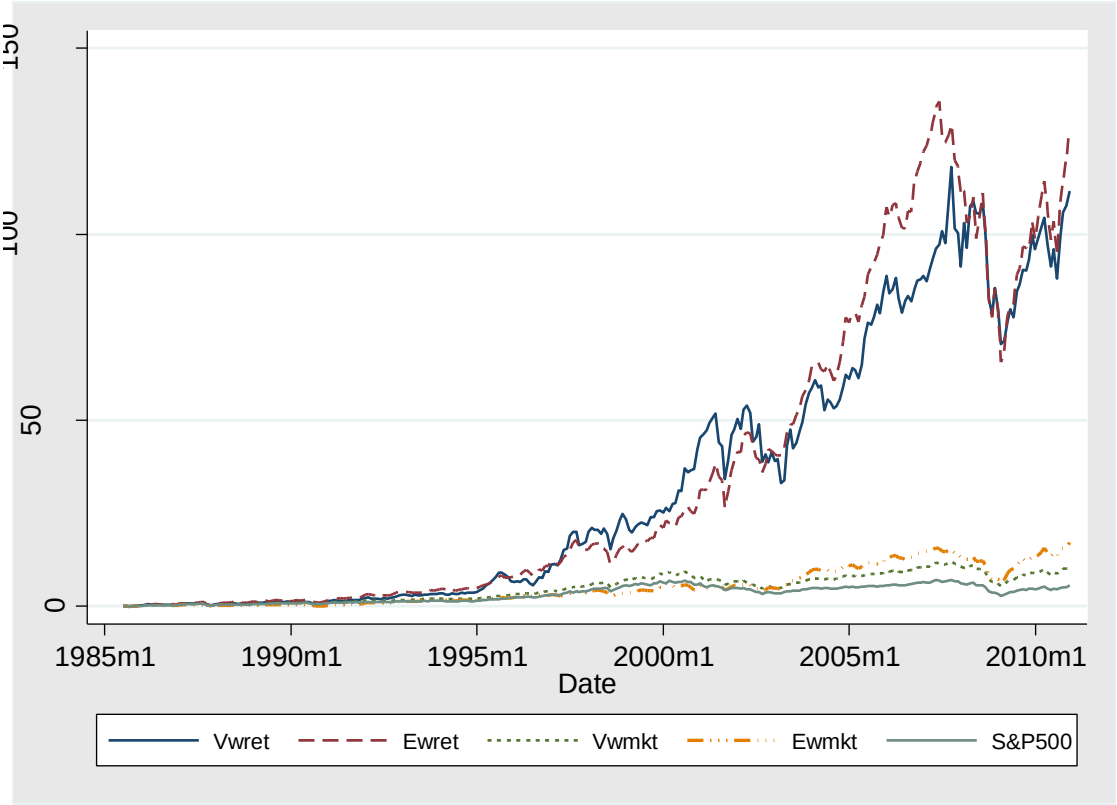
Table 3:
Raw returns in % of the top ranked portfolio formed on the 30 highest ROC & EY stocks[a]

	Magic Formula			Market average		
year	Value weighted	Equally weighted	Greenblatt results	Value weighted	Equally weighted	S&P 500
1985	49.67	55.95		34.31	30.25	30.75
1986	16.65	19.80		19.52	9.52	21.19
1987	6.22	12.66		-6.25	-9.56	-10.03
1988	6.53	12.92	27.10	18.78	9.26	16.26
1989	7.56	12.74	44.60	12.64	-0.46	12.59
1990	6.41	10.24	1.70	6.90	5.99	3.67
1991	27.24	25.32	70.60	13.95	23.62	9.96
1992	39.52	25.70	32.40	16.19	29.58	10.39
1993	6.12	13.09	17.20	0.81	6.02	-1.39
1994	84.81	44.86	22.00	24.23	18.34	22.62
1995	-8.21	31.21	34.00	25.68	30.74	23.11
1996	129.65	47.06	17.30	28.75	9.85	31.99
1997	32.26	12.58	40.40	28.08	16.20	28.10
1998	7.10	8.86	25.50	18.81	6.42	21.07
1999	37.06	38.34	53.00	11.05	24.18	5.97
2000	63.90	57.89	7.90	-16.04	-1.35	-15.82
2001	-14.20	12.05	69.60	-16.73	-2.39	-19.16
2002	6.97	13.07	-4.00	2.35	19.43	-1.55
2003	16.59	32.33	79.90	21.67	41.75	17.07
2004	29.09	27.51	19.30	8.94	12.07	4.43
2005	9.66	22.01	11.10	11.23	15.44	6.62
2006	22.87	33.14	28.50	21.31	18.98	18.36
2007	8.53	-26.90	-8.80	-10.89	-20.40	-14.86
2008	-26.32	-17.65	-39.30	-26.91	-15.44	-28.18
2009	17.39	20.90	42.90	16.58	29.73	12.12
AAR	**23.32**	**21.83**	**23.80**	**10.60**	**12.31**	**8.21**

[a]The portfolios are constructed as stated in Table 2 from July of 1985 to June of 2010. The stated returns are raw returns and are cumulatively compounded from monthly to annual returns. The returns have not been adjusted with the risk-free rate. In this construct I mimic Table 1 as provided by Greenblatt. Market average return, both value weighted and equally weighted, are returns on the NYSE, AMEX & NASDAQ combined for the same period as the magic formula portfolios.

The results confirm earlier observations. The magic formula strategy outperforms the S&P500 19 year out of 25 years when value weighted and 20 out of 25 years when equally weighted. Moreover, this confirms the returns posted by Greenblatt in his book "*The little book that still beats the market*". The raw returns calculated do differ from Greenblatt's as can be seen in table 3. These inconsistencies where expected due to differences in the database used and the method in which portfolios are formed. No conclusion can be drawn, but observations can be made. The value-weighted approach tends to outperform the equally weighted approach, but with more erratic returns. For example, the return from July of 1994 to June of 1995 is equal to 84.81 percent, which almost doubles the initial investment. Furthermore, July of 1996 to June 1997 exhibits a return as high as 129%, while the year before has a negative return of -8.21 percent. The observation that the value weighted portfolios tend to be riskier than the equally weighted portfolios is confirmed by the Sharpe ratio and standard deviation in Table 2. Equally weighted returns exhibit a higher Sharpe ratio, meaning, that a higher return is achieved for the risk taken. Furthermore, aside from 2007 and 2008, the raw returns for the equally weighted portfolio subsequently positive. The investor will be less prone to exit the strategy if return, even if lower than the market, is positive. I resume by graphically depicting cumulative raw returns over the sample period with annual rebalancing.

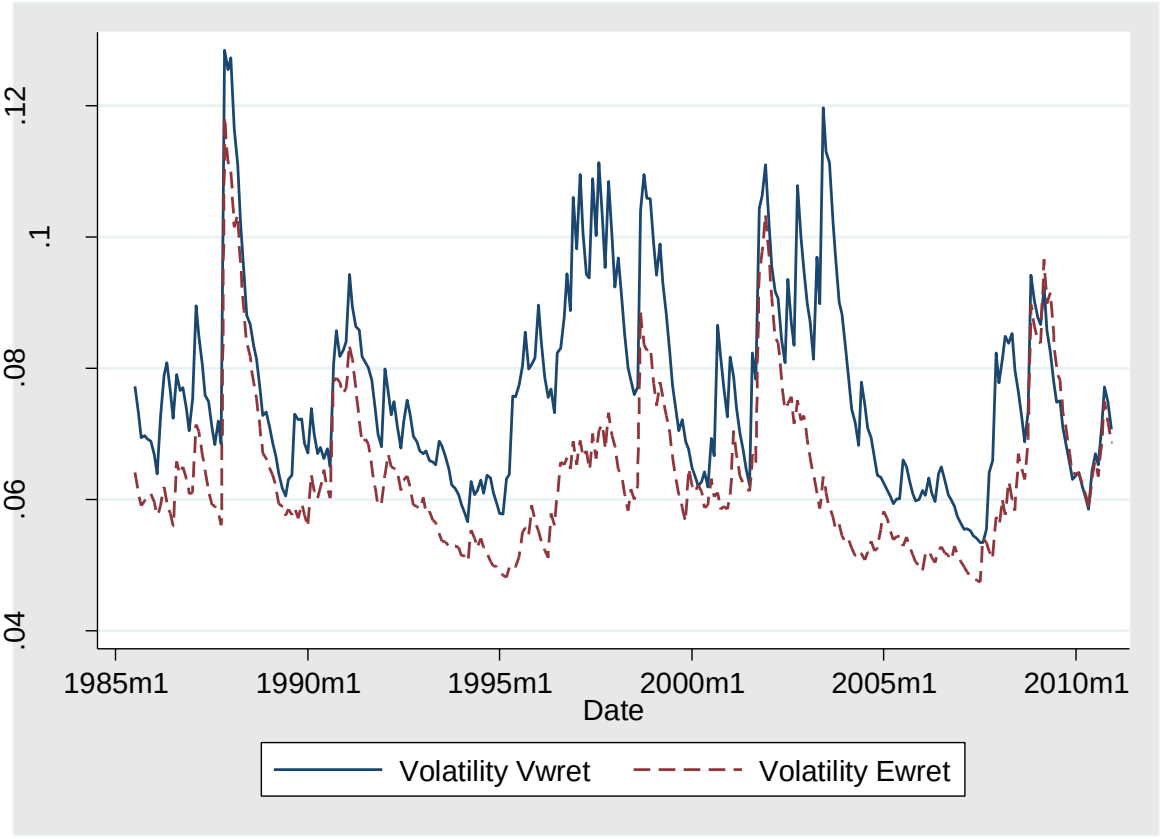
Graph 1:
Cumulative raw returns measured from 1985 to June 2010 for top ranked portfolio[a]



[a]Graph 1 shows cumulative raw returns from 1985 to June 2010 where the returns on the value weighted and equally weighted are consecutively Vwret and Ewret. Value weighted and equally weighted cumulative raw market returns are Vwmkt and Ewmkt and based on the NYSE, AMEX and NASDAQ indices. The S&P500 line is the Standard and Poor 500 index.

Graph 1 clearly indicates that both value weighed and equally weighted cumulative returns strongly outperform the markets during our sample period. Furthermore, it seems that the magic formula portfolios begin a strong outperformance starting in 1995. As expected, 2007 and 2008 exhibit a strong negative return due to the Financial Crisis. The strategy is not able to uphold positive returns during a strong economic downturn.

Graph 2:
Volatility measured from 1985 to June 2010 for top ranked portfolio



For illustrating purpose the volatility is measured during the sample period in an attempt to compare the riskiness of the value weighted approach relative to the equally weighted approach. The graph confirms earlier observations that the equally weighted portfolio tends to be less risky than the value weighted portfolio.

Thus far the descriptive results make a strong case for the Magic Formula Investment approach. Strong positive raw returns arise during the sample period. The strategy will now be tested on the risk adjusted returns. In order for the MF strategy to work Jensen's (1968) alpha must be positive and significantly different from zero. A wide range of well-known asset pricing models is used to see if these models are able to explain the variations generated by the MF strategy.

Table 4:

Regression statistics of the top ranked portfolio formed on the 30 highest ROC & EY stocks[a]

	CAPM		**3-Factor model**		**4-Factor model**		**Benchmark model**		**Liquidity model**	
	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret
	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t
mkt-rf	1.130***	1.107***	1.097***	1.031***	1.112***	1.008***	1.121***	1.025***	1.098***	1.030***
	16.3	*23.58*	*15.16*	*25.15*	*14.91*	*24.05*	*13.68*	*22.21*	*15.14*	*25.09*
HML			0.068	0.163**	0.087	0.133*			0.073	0.159*
			0.61	*2.61*	*0.77*	*2.09*			*0.65*	*2.52*
SMB			0.297**	0.691***	0.294**	0.695***			0.300**	0.688***
			2.88	*11.84*	*2.85*	*11.99*			*2.9*	*11.74*
MOM					0.057	-0.088*	0.027	-0.117**		
					0.84	*-2.3*	*0.37*	*-2.86*		
rms5							0.736***	0.739***		
							3.37	*6.01*		
r2rm							0.203	0.759***		
							1.11	*7.36*		
s5vs5g							-0.313	-0.247*		
							-1.61	*-2.26*		
rmvrmg							0.19	0.159		
							0.81	*1.21*		
r2vr2g							0.04	0.03		
							0.16	*0.21*		
LIQ_V									0.037	-0.037
									0.45	*-0.77*
Constant	0.009**	0.008***	0.008*	0.007***	0.008*	0.008***	0.007*	0.009***	0.008*	0.008***
	2.64	*3.76*	*2.53*	*4.06*	*2.35*	*4.42*	*2.21*	*4.81*	*2.43*	*4.13*
R2	0.466	0.647	0.481	0.759	0.482	0.763	0.495	0.768	0.481	0.76

[a]The portfolios are constructed as follows. Each year *t* from 1985 to 2010 portfolios are formed by ranking the highest ROC & EY stocks measures in July of *t*. Portfolios are annually rebalanced using the highest 30 stocks as indicated by their combined ROC & EY score. Additionally all stocks are required to have a minimum market capitalization of 50 million in May of year *t*. Both value weighted (Vwret) and equally weighted (Ewret) returns are calculated. Equally weighted return is measures by dividing the return of each stock with the total stocks in the portfolio, in this case, thirty. Value-weighted return is measures by calculating the lagged market capitalization of May and adjusted monthly by cumulatively multiplying the May market value times one month trailing return (excluding dividends), similar to Fama-French (1993). This procedure is repeated every July of year *t*. Portfolio returns are adjusted for the risk free rate. The excess returns are tested using an ordinary least squares regression (OLS). Mkt-rf is the excess market return. HML and SMB is the Fama & French (1992) High minus Low and Small minus Big factor respectively. MOM is the momentum factor as added by Carhart(1997). Cremers, et al. (2008) alternative factor model introduces several factors RMS5 is the mid minus large cap factor, R2RM is the small versus large cap factor, S2VS5g is the large cap value minus growth factor, RMVRMG is the midcap value minus midcap growth factor, r2vr2g is the mid versus large cap factor. LIQ_V is the liquidity factor by Pastor and Stambaugh (2003). Significance is measured using the p-value where *p<0.05, **p<0.01, ***p<0.001 indicate weak, semi-strong and strong significance respectively.

Table 4 provides the results from the statistical tests using several asset pricing models. The value of importance is Jensen's alpha. Jensen (1968) tested the performance of mutual funds by observing the parameter of alpha (α_j). The parameter defines whether a strategy is able to

outperform or underperform relative to the market index. The null hypothesis is given by: H_0: $\alpha_j = 0$. A positive and significant α_j for the MF portfolios would suggest that the strategy is able to earn significant abnormal returns in excess of the market-required return for the portfolio's given riskiness. The constant (α_j) shows significant returns with an average value of 0.8 percent for both value-weighted and equally-weighted returns. The value-weighted returns do tend to exhibit weak significance for all factor models and a semi-strong significance when tested with the CAPM. The beta (β) provides information about the slope of returns. A positive value for β indicates an upwards sloping movement when the risk, indicated by β, increases. β close to one indicates that the MF strategy does not exhibit a higher amount of risk relative to the market benchmark. To elucidate, the CAPM is unable to explain the generated risk adjusted returns with market variations alone for MF portfolio. The same applies to other factor models. Fama-French 3-factor model provide more information about the dataset. Especially equally-weighted returns exhibit that the MF portfolio mainly contains stocks with a low market capitalization, so called small stocks. The equally-weighted return has a β of 0.691 for SMB concluding that additional return might be explained due to the large amount of small cap stocks in the MF portfolio. Similarly, HML required a value premium to incorporate the risk carried by value stocks relative to growth stocks. The value-weighted portfolio does not provide the same clear results. SMB shows semi-strong significance with evidence that the portfolio contains small stocks. HML is insignificant so no conclusions can be made, but we can observe a small presence of a value premium. The addition of the Momentum factor is unable to explain the MF returns. The only information we can interpret is the weak-form significance in the equally-weighted portfolio indicating a negative momentum. A negative return yesterday means a positive return today. Similar results are found when using Cremers, et al. (2008) model. This asset pricing model should eliminate any alpha generated by the used benchmark, which in this case are the value-weighted NYSE, AMEX and NASDAQ indices combined. The MF portfolios are formed using the same indices; I thus expect the factors used in Cremers, et al. (2008) to be insignificant. The OLS regression with said factors on the value-weighted MF portfolio does indeed exhibit insignificance of those factors, with the exception of the mid-large cap factor. The MF portfolio predominantly contains small cap stock, as seen in the Fama-French SMB factor, thus offering an explanation for these results. Furthermore, the regression results from the equally-weighted MF portfolio do exhibit strong significance; results that might be explained by the use of a value-

weighted benchmark relative to an equally weighted MF portfolio. The alpha does increase to a 0.9 percent with a stronger significance indicating that the elimination of the SMB and HML leaves more unexplained variance. The explanatory power of the model does increase to 76.8 percent, but this could be due to the additional amount of factors used (additional 6 factors alongside the excess market return instead of 2 as used by the 3-factor model). The final model by Pastor and Stambaugh (2003) is unable to explain the excess returns as generated by the MF portfolios. The insignificance of the liquidity factors indicate that market liquidity is unable to explain why the MF portfolios generated alpha. The MF strategy again shows to be a very promising method of investing. The strategy remains unexplained by the used asset pricing models and earns a risk adjusted return of 0.8 percent monthly. The portfolios are best balanced equally offering strong significance for the generated alphas and with lower risk.

Descriptive and statistical returns offer evidence that the MF strategy works. My results thus confirm the claims as made by Greenblatt. The research in this paper is extended by looking at the inverse of the MF strategy. The worst 30 stocks are used to form a portfolio with annual rebalancing. Greenblatt stated that a long-short strategy where the investor buys the top-30 stocks and sells the bottom-30 would not provide the desired results[12]. I researched this claim in an attempt to exhibit a pattern with returns from best-to-worst with the top portfolios offering positive returns relative to the worst portfolio with negative returns. ***Appendix A*** elaborates on these findings. The results confirm Greenblatt's claims. The inverse of the MF exhibits high risk with high returns. A long-short portfolio would not yield optimal results. On many occasions the bottom MF portfolio earns higher returns than the top portfolio, but at a much greater risk. There is no clear pattern in the returns from the highest ranked stocks, towards the lowest ranked stocks. To further investigate whether a pattern in returns exits 10 decile portfolios are formed using the ranked scores based on the highest EY and ROC to the lowest. To reiterate, the ranked stocks are grouped in 10% breakpoints from the highest ranked to the lowest. ***Appendix B*** contains the statistics, raw returns and the regression results of each group. The average raw returns decrease from decile 1 to 5 before increasing after decile 7. The results could indicate that the MF does not prove useful when a negative ROC and EY occur. Furthermore, no clear pattern is found in the returns from best to worst, confirming earlier results from the inverse of

[12] "The little book that still beats the market" pp. 159; Greenblatt states that the sometimes the top-ranked stocks go down when the bottom-ranked stocks are going up.

the magic formula. The worst stocks tend to earn a higher return, but with a higher standard deviation. Also, the generated alpha is not as clear-cut for the inverse or the grouped deciles. For example the CAPM is able to reject the generated returns in the inverse portfolios, but other factor models are not. Furthermore, only the first three decile portfolios exhibit a significant alpha. For the other deciles the null-hypothesis that the alpha is significantly different from zero is rejected. The results reject the hypothesis that the MF exhibits a clear pattern in returns ranked from best to worst. The screening process of the MF seems to work, but only to identify stocks that are worth investing in. The inverse does not hold true, validating the remarks made by Greenblatt (2010) that a long-short portfolio does not work.

5.2 Alterations:

Results thus far have all been annually rebalanced. Greenblatt narrated that the magic formula approach is based on a long-term perspective, for this reason the results are extended over a longer holding period of 3 and 5 years and with a higher minimum required market capitalization of 1 billion dollars as of May in year *t*.

Table 5:

Descriptive statistics of the top ranked portfolio formed on the 30 highest ROC & EY stocks for different holding periods and market capitalization[a]

Statistics	**Small Stocks (over $50 Million)**						**Large stocks (over $1 billion)**						**Market Returns**		
	1 year		3 years		5 years		1 year		3 years		5 years		Market Average		S&P500
	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	
Mean	0.0185	0.0182	0.0215	0.0160	0.0153	0.0168	0.0155	0.0159	0.0184	0.0163	0.0142	0.0145	0.0092	0.0111	0.0072
sd	0.0771	0.0639	0.0738	0.0594	0.0754	0.0587	0.0613	0.0580	0.0600	0.0541	0.0536	0.0591	0.0465	0.0559	0.0455
min	-0.3073	-0.3209	-0.3043	-0.2938	-0.3043	-0.2938	-0.2265	-0.2342	-0.2044	-0.2523	-0.2044	-0.2523	-0.2254	-0.2722	-0.2176
max	0.2670	0.1785	0.2332	0.1724	0.2933	0.1675	0.1956	0.2214	0.2289	0.1574	0.1601	0.3325	0.1285	0.2250	0.1318
Sharpe	**0.1961**	**0.2313**	**0.2447**	**0.2113**	**0.1571**	**0.2281**	**0.1969**	**0.2144**	**0.2492**	**0.2390**	**0.2006**	**0.1869**	**0.1246**	**0.1374**	**0.0834**
T-Test	4.2070	4.9480	5.0920	4.7050	3.5420	5.0120	4.4210	4.7830	5.3580	5.2880	4.6260	4.2830	3.4660	3.4760	2.7750

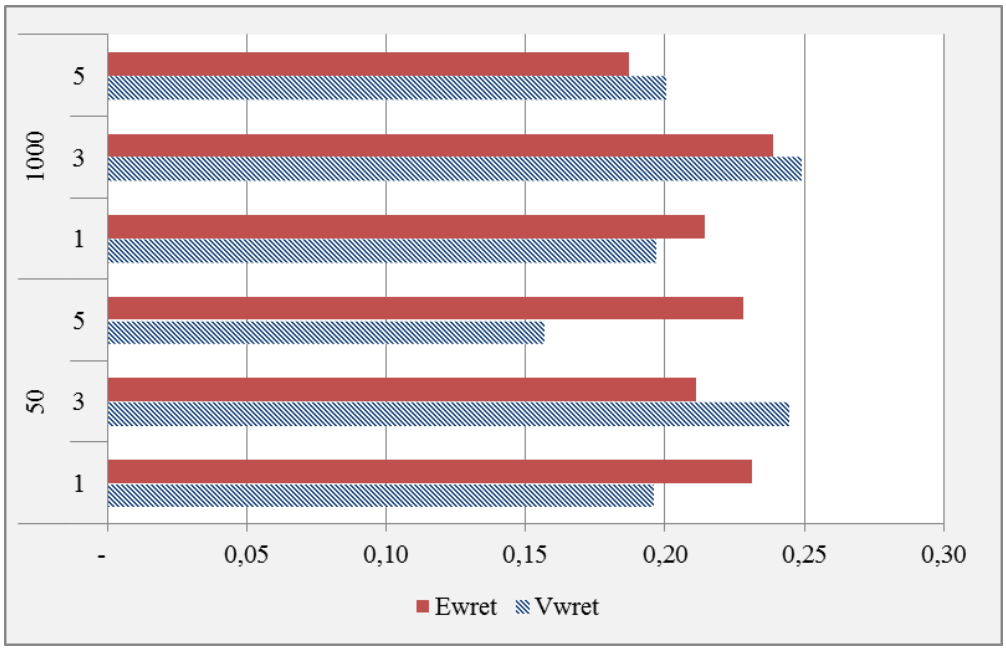
[a]The portfolios are constructed as follows. Each year of *t* from 1985 to 2010 portfolios are formed by ranking the highest ROC & EY stocks measures in July of *t, t+3 or t+5* depending on their holding period. For each portfolio the 1-, 3-, and 5 year holding-period returns are computed. Portfolios are rebalanced every 1-, 3-, and 5 years using the highest 30 stocks as indicated by their combined ROC & EY score. Additionally all stocks are required to have a minimum market capitalization of 50 million or 1 billion in May of year *t*. Both equally weighted and value weighted returns are calculated. Equally weighted return (Ewret) is measures by dividing the return of each stock with the total stocks in the portfolio, in this case, thirty. Value-weighted return (Vwret) is measures by calculating the lagged market capitalization of June and adjusted monthly by cumulatively multiplying the June market value times one month trailing return (excluding dividends), similar to Fama-French (1993). Market average return, both value weighted and equally weighted, are returns on the NYSE, AMEX & NASDAQ combined for the same period as the magic formula portfolios. The Sharpe ratio is calculated using a one month US treasury bill for the risk free rate. The mean risk free rate is equal to 0.34 percent. Also, a student's t-test is added.

The results in table 5 provide descriptive statistics when increasing the holding period from 1-, to 3-, and 5 years. Results are also posted when the minimum market capitalization increases to 1 billion. As seen in table 4 the MF strategy held a significant amount of small stocks in the portfolios. The increase in market capitalization could mean a lower return, albeit with by lower risk. Furthermore, the increase in holding periods provides evidence whether or not this increase moves conjunctly with higher returns. Greenblatt recommends the annual rebalancing for tax purposes, which remain out of the scope of this paper. Aforementioned recommendation taken aside, I would like to answer whether or not the MF remains persistent under varying conditions. Table 5 can be used to make early observations. The Sharpe ratio remains relatively stable as can be seen in graph 3. The MF strategy yields optimal results with a holding period of 3 years for

both large stocks (market capitalization > 1 billion) and small stocks (market capitalization > 50 million), especially when holding a value-weighted portfolio. The MF strategy remains promising even under varying conditions. Based on the Sharpe ratio the MF outperforms the market under all conditions.

Graph 3:

The Sharpe ratio under varying conditions for the top ranked portfolios[a]



[a]Ewret indicates the equally weighted MF portfolio and Vwret indicates the value-weighted MF portfolio. Ratios are stacked using the holding period and market capitalization as the y-axis identifiers.

Graph 3 provides an overview of how the Sharpe ratio tends to move under varying conditions. Years 3 with large stocks shows to be the most promising indicating that the magic formula still performs very well, even when small stocks are taken out of the picture(market capitalization higher than 1 billion dollar) . Results do exhibit that the large stocks earns a lower return, but with a lower risk. The large cap stocks are the saver investment in line with the size effect as first discussed by Banz (1981). This observation holds true under all conditions.

Table 6:
Raw returns in percentages of the top ranked portfolio formed on the 30 highest ROC & EY stocks with varying holding periods and market capitalization[a]

	Small Stocks (over $50 Million)						Large stocks (over $1 billion)					
	1 year		3 years		5 years		1 year		3 years		5 years	
year	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret
1985	49.67	55.95	49.67	55.95	49.67	55.95	35.61	41.91	35.61	41.91	35.61	41.91
1986	16.65	19.94	23.86	19.64	23.86	19.64	23.00	25.72	30.78	31.04	30.78	31.04
1987	6.22	12.66	-20.28	-3.11	-20.28	-3.11	-3.70	-1.09	-9.33	-6.47	-9.33	-6.47
1988	6.53	12.92	6.53	12.92	12.33	6.90	43.38	20.44	46.08	22.52	21.34	23.47
1989	7.56	15.35	23.58	17.66	-7.21	2.41	17.45	12.81	14.44	9.99	12.97	4.10
1990	6.41	10.24	13.27	15.05	6.57	10.56	11.28	16.78	18.83	17.35	11.16	16.47
1991	27.24	23.69	27.24	24.98	30.64	13.11	8.63	14.41	8.63	14.41	9.63	11.57
1992	39.52	26.80	7.09	14.80	-1.89	1.48	16.51	19.41	23.27	14.10	7.18	9.91
1993	6.12	13.09	2.72	16.95	5.22	20.71	2.80	4.47	9.51	7.76	6.79	13.91
1994	84.81	44.86	84.89	42.56	28.64	42.21	59.61	50.22	59.61	50.22	25.43	29.62
1995	-8.21	31.21	15.50	16.86	-8.09	31.82	16.44	17.30	31.07	18.88	16.44	17.30
1996	129.65	47.06	79.58	26.63	38.83	17.27	58.88	44.66	53.02	34.06	61.33	39.67
1997	32.26	12.58	32.26	12.58	-17.24	7.24	50.00	18.25	49.36	16.62	13.72	2.79
1998	7.10	7.13	109.96	16.01	27.32	29.71	40.33	36.42	82.18	38.27	40.56	21.34
1999	37.06	41.01	115.67	24.13	132.97	52.43	-12.13	9.37	18.78	38.38	61.35	26.08
2000	63.90	58.16	64.82	57.77	64.37	57.51	16.34	40.23	17.19	31.36	12.68	28.50
2001	-14.20	12.05	24.54	50.32	24.54	50.32	-2.94	9.60	6.09	16.60	4.81	17.76
2002	6.97	13.07	-1.36	0.09	-1.36	0.09	5.58	13.45	-8.29	-0.14	-8.29	-0.14
2003	16.59	32.33	16.66	33.91	34.77	44.42	25.69	40.91	24.44	39.02	26.13	29.76
2004	29.09	27.96	30.96	11.29	12.38	14.32	25.75	19.82	23.37	12.52	7.17	4.16
2005	9.66	22.35	15.86	-2.12	9.02	20.21	13.65	9.95	17.48	10.15	13.65	9.95
2006	22.87	33.14	22.87	33.14	17.09	20.84	28.04	31.01	27.89	30.48	19.06	24.12
2007	8.53	-26.90	-32.30	-24.97	-25.73	-25.04	-1.84	-18.99	-1.77	-20.57	-10.62	-23.62
2008	-26.32	-17.65	-18.87	-18.75	-12.41	-13.53	-27.39	-21.32	-26.90	-6.24	-14.78	-4.52
2009	17.39	20.90	17.39	20.90	59.25	43.53	19.72	23.95	21.03	23.68	36.32	57.62
AAR	**23.32**	**22.00**	**28.48**	**19.01**	**19.33**	**20.84**	**18.83**	**19.19**	**22.89**	**19.44**	**17.24**	**17.05**

[a]The portfolios are constructed as stated in Table 5 from July of 1985 to June of 2010. The stated returns are raw returns and are cumulatively compounded from monthly to annual returns. The returns have not been adjusted with the risk-free rate. Value-weighted returns are indicated using Vwret and equally-weighted returns as Ewret. Market average return, both value weighted and equally weighted, are returns on the NYSE, AMEX & NASDAQ combined for the same period as the magic formula portfolios.

Annual results confirm earlier observations that a 3-year holding period offers the best results when value-weighted. Furthermore, the difference in small stocks and large stocks remains present. Large stocks earn a lower return, but where still able to outperform the market. The S&P 500 had an average annual rate of 8.21 percent. The value-weighted NYSE, AMEX and NASDAQ earned 10.6 percent and when equally-weighted earned 12.31 percent.

Table 7:
Regression statistics of the top ranked portfolio formed on the 30 highest ROC & EY stocks by varying holding periods and market capitalization

		Small Stocks (over $50 Million)						**Large stocks (over $1 billion)**					
		1 year		3 years		5 years		1 year		3 years		5 years	
		Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret
CAPM	*a*	0.009**	0.008***	0.012***	0.007**	0.006	0.008***	0.006**	0.006***	0.009***	0.007***	0.005**	0.005**
	t(a)	*2.64*	*3.76*	*3.80*	*3.23*	*1.72*	*3.62*	*2.79*	*3.76*	*4.48*	*4.93*	*2.96*	*2.65*
	b	1.130***	1.107***	1.085***	1.025***	1.072***	0.985***	1.038***	1.091***	1.060***	1.039***	0.936***	1.080***
	t(b)	*16.3*	*23.58*	*16.38*	*23.46*	*15.34*	*21.73*	*22.35*	*31.39*	*25.24*	*34.77*	*24.28*	*28.01*
	R2	0.466	0.647	0.469	0.644	0.436	0.608	0.622	0.764	0.677	0.799	0.66	0.721
Fama & French	*a*	0.008*	0.007***	0.013***	0.006***	0.005	0.007***	0.006**	0.005***	0.009***	0.006***	0.006**	0.003
	t(a)	*2.53*	*4.06*	*4.08*	*3.45*	*1.64*	*3.53*	*2.75*	*3.4*	*4.68*	*4.69*	*3.09*	*1.94*
	b	1.097***	1.031***	1.006***	0.953***	1.029***	0.940***	1.042***	1.095***	1.033***	1.030***	0.913***	1.123***
	t(b)	*15.16*	*25.15*	*14.69*	*25.07*	*14.17*	*22.07*	*21.19*	*30.55*	*23.39*	*33.95*	*22.51*	*29.44*
	HML	0.068	0.163**	-0.212*	0.145*	0.053	0.204**	0.003	0.160**	-0.119	0.122**	-0.077	0.370***
	t(HML)	*0.61*	*2.61*	*-2.03*	*2.51*	*0.47*	*3.14*	*0.04*	*2.93*	*-1.76*	*2.63*	*-1.24*	*6.35*
	SMB	0.297**	0.691***	0.239*	0.649***	0.344***	0.545***	-0.017	0.177***	0.026	0.216***	0.047	0.194***
	t(SMB)	*2.88*	*11.84*	*2.45*	*12.00*	*3.32*	*8.98*	*-0.24*	*3.47*	*0.41*	*5.01*	*0.81*	*3.56*
	R2	0.481	0.759	0.493	0.76	0.457	0.691	0.622	0.776	0.681	0.815	0.663	0.756

[a]The portfolios are constructed as follows. Each year of *t* from 1985 to 2010 portfolios are formed by ranking the highest ROC & EY stocks measures in July of *t, t+3 or t+5* depending on their holding period. For each portfolio the 1-, 3-, and 5 year holding-period returns are computed. Portfolios are rebalanced every 1-, 3-, and 5 years using the highest 30 stocks as indicated by their combined ROC & EY score. Additionally all stocks are required to have a minimum market capitalization of 50 million or 1 billion in May of year *t.* Both equally weighted and value weighted returns are calculated. Equally weighted return is measures by dividing the return of each stock with the total stocks in the portfolio, in this case, thirty. Value-weighted return is measures by calculating the lagged market capitalization of May and adjusted monthly by cumulatively multiplying the May market value times one month trailing return (excluding dividends), similar to Fama-French (1993). This procedure is repeated every July of year *t*. Portfolio returns are adjusted for the risk free rate. The excess returns are tested using an ordinary least squares regression (OLS). Mkt-rf is the excess market return. HML and SMB is the Fama & French (1992) High minus Low and Small minus Big factor respectively. Significance is measured using the p-value where *p<0.05, **p<0.01, ***p<0.001 indicate weak, semi-strong and strong significance respectively.

Table 7 shows that the earned abnormal returns remain persistent under varying conditions. Under the CAPM Jensen's alpha *(α)* exhibits strong significance for most of the results, with the exception of the value-weighted MF portfolio with a 5-year holding period. An increase in holding period coincides with a decrease in the slope of excess market risk as indicated by beta *(b).* The equally-weighted MF portfolio with a 5-year holding period even earns a 0.8 percent abnormal return with strong significance with a beta lower than the market, indicating the strategy yields higher returns than the market with lower risk. Above results remain strongly positive towards the MF strategy. The level in which the CAPM can explain the variation in returns of the MF portfolio is indicated by the R^2, which provide surprising results. The CAPM consistently has less explanatory power for the value-weighted returns, relative to the equally-

weighted returns. The results are surprising as the benchmark; the excess return on the NYSE, AMEX and NASDAQ, is value-weighted. Included in ***Appendix C*** is the complete overview of all asset-pricing models used. If the significant α is generated due to the used benchmark, the benchmark model by Cremers et al. (2010) would capture this discrepancy. As seen in ***Appendix C*** the benchmark model is unable to explain the variations in the MF portfolio returns relative to the used index factors, indicating that the generated α remains unexplained. All results indicate the MF strategy yields optimal results when rebalancing the portfolio every 3 years. The returns decrease again when held for a 5-year period. As stocks are picked at the moment they have a high ROC and EY, one can reason that this position changes over time. The good, yet underpriced, stocks regain momentum and become more expensive as the MF portfolio is held. Of course assuming the MF strategy works. The stock might become overpriced and a market correction might ensue. Above results do not provide a clear conclusion of this event, but observations can be made that this point lies around a 3-year holding period.

5.3 Sub-sample

The MF strategy clearly remains persistent during the regressions as seen by the excess returns generated. The evidence provided indicates that MF is a market anomaly, a method of investing that remains unexplained by the EMF and traditional asset pricing models. Proponent of the equilibrium model refute this idea by stating that it is impossible to test the CAPM as the true market portfolio at heart of the model is theoretically and empirically elusive (Roll, 1997). To test upon the CAPM academics merely use a proxy for the market portfolio. More interesting in this instance is whether the "publication" of the MF strategy has led to its demise. Even though the information used by Greenblatt is inherently public, (and thus should be incorporated in the share price rejecting the existence of abnormal return) the method and approach was not. Foregoing literature closely examined the EY[13] and its reciprocal the Price-Earnings ratio[14], but less interest has been placed in combining it with the ROC value. Furthermore, Greenblatt uses an adjusted measure for the EY and ROC. The method and calculation became public knowledge when Greenblatt released the best-selling book "The little book that beats the market". Does the MF strategy's abnormal return exhibit persistence after the publication of said strategy? Due to

[13] See; Chan, Hamao, and Lakonishok (1991), Brouwer, et al. (1997) Gregory, et al. (2001) ,Strong and Xu (1997)

[14] See; Basu 1977, Chan, Hamao, and Lakonishok (1991), Fama and French (1992), Lakonishok, Shleifer and Vishny (1994)

the small sample size, ranging from July of 2006 to December of 2010, the formed portfolios are only rebalanced annually with a minimum market capitalization of 50 million dollars. Initial expectations are that two events are able to affect the returns, the publication of the MF strategy and the occurrence of the Financial Crisis. If significant abnormal returns are exhibited the MF strategy remains persistent in outperforming the market after the publication and during the Financial Crisis. Further research would be an event study around the publication date of the book, but this will remain out of the scope of this paper. ***Appendix D*** provides the descriptive statistics and the regression results from the used subsample. The α remains insignificant in all instances indicating no direct conclusions can be drawn. The insignificance can be attributed to the overall downturn in the market, or indeed that the publication of the MF strategy led to it becoming public knowledge on a large-scale.

6. Conclusion

The conclusion will be comprised of two parts. Firstly, the made hypotheses will be answered using the results posted above. Secondly, the concluding remarks with possible implications of the results.

6.1 Hypotheses

The hypotheses formed center around the main hypothesis as stated in the 'Introduction':

The magic formula outperformed the broad based U.S. Market indices from July of 1985 to June of 2010.

Using the above stated Empirical Results I am able to confirm that indeed the Magic formula seems to show significant risk-adjusted abnormal returns over the given period. Firstly using Hypotheses ***1A*** and ***1B*** the raw returns are addressed and compared with the market returns. Both for the highest ranked thirty stocks with a market capitalization of 50 million dollars, and under varying conditions, the returns remain higher than that of the S&P500 and both value-weighted and equally weighted combined NYSE, AMEX and NASDAQ indices. Moreover using a simple metric of comparison, the Sharpe ratio, the relative return compared to risk is higher under all conditions than that of the Market returns as seen in table 5. The returns do tend to be lower

when increasing the required market capitalization to 1 billion dollars, allowing the inference that the magic formula has a preference for small stocks. The optimal return can be achieved using a value weighted portfolio with a minimum market capitalization of 50 million dollars and a holding period of 3 years. However, Greenblatt recommends 1 year for tax purposes, which remain out of the scope of this paper. Looking at the OLS regressions the earlier stated optimal portfolio is confirmed by the CAPM to earn the highest risk-adjusted alpha of 1.2% monthly. In conclusion hypotheses ***1A*** and ***1B*** cannot be rejected as the MF indeed shows higher raw returns than exhibited by the market during the same period. The thirty highest ranked stocks during the period of June of 1985 to July of 2010 remain significant in all asset pricing models used, exhibiting a strong significance for all equally weighted returns, and a weak significance for value-weighted returns. The results lead to the rejection of hypothesis ***2A***, that Asset pricing models are able to explain the generated returns by the Magic formula. Moreover, a similar rejection can be made for hypothesis ***2B***. Under varying condition of minimum market capitalization and holding period, returns remain significant with the exception of a holding period of 5 years. Both equally-weighted and value-weighted returns exhibit insignificance when using the Fama-French three-factor model. There is however no clear pattern that the significance decreases substantially when using more extensive asset pricing models like Carhart (1997) and Cremers, et al (2010). No asset pricing model is clearly able to explain the returns generated the MF.

To obtain an in-depth understanding of the magic formula several more hypotheses are formed. The results of which can be found in the Appendix. Hypothesis 3A and 3B build upon hypotheses 1A and 2A but address a sub-sample of the dataset ranging from July of 2006 to December of 2010. The specific subsample is chosen to research if the MF strategy remains persistent after the publication in 2006. The descriptive statistics show that the MF actually performs worse than the market during this period. However, a simple student t-test done denotes all returns to be insignificant so no clear conclusions can be made. This observation is confirmed by regressions against the used asset pricing models. The results in ***Appendix D*** indicate that both hypothesis ***3A*** and ***3B*** are rejected. The α remains insignificant in all instances indicating no direct conclusions can be drawn. The insignificance can be attributed to the overall downturn in the market, or indeed that the publication of the MF strategy led to it becoming public knowledge on a large-scale.

The research is extended to look at the inverse of the magic formula. Greenblatt claims that "..the magic formula appears to be very powerful. It not only seems to work for the top-ranked stocks, but its ranking seems to have meaning throughout the total universe of stocks "and "…over the long term the formula appears to work in order with group 1 beating group 10 by a wide margin". It is this claim that is addressed in hypotheses ***4A***, ***4B*** and ***5***. Firstly, ***4A*** claims that during the period of July of 1985 to June of 2010 the inverse MF *underperformed* the market and secondly, ***4B*** claims that Asset pricing models are able to explain the returns generated by the inverse MF thus exhibiting insignificant returns. The author was surprised to find that the inverse MF actually exhibited higher raw returns than the "good" MF strategy. The higher returns are however accompanied by a higher risk. The Sharpe ratio for the inverse MF is lower than the Sharpe ratio of the top MF portfolio. The higher risk can be seen in the volatility graph 2 in ***Appendix A***. The inverse does however have a higher Sharpe ratio and return relative to the market, leading to only a partial rejection of hypothesis ***4A***. The inverse MF outperformed the market but underperformed relative to the top MF portfolio when incorporating riskiness. The regressions against current asset pricing model reveals insignificant abnormal returns for the CAPM but does offer a weak to strong significant returns for other asset pricing models tested. The beta clearly shows the strategy yield these returns at a much higher risk than the market. Again the results lead to a partial rejection of hypothesis ***4B***. The CAPM is able to explain the generated returns by using the excess market return; other models do not fare so well. The incorporation of additional explanatory variables undermines the predictive power of the market excess return allowing the alpha to exhibit significance.

Using ***hypothesis 5*** I would like to either confirm or deny that a pattern exists in the rankings of the magic formula. Similar to Greenblatt I hope to find that the top ranked portfolios perform better than low ranked portfolios. With hypotheses ***4A*** and ***4B*** the results already indicated that the inverse does not show the results as expected. ***Hypothesis 5*** again confirms these findings. The hypothesis claims that a clear pattern can be found when all stocks are grouped in deciles from 1 to 10 based on their ranked score according to the MF. Returns drop from group 1 until group 5, but from there on actually increase in returns (Appendix B, Table 2). This, again, confirms earlier evidence seen from the inverse MF portfolios. The descriptive statistics do however exhibit a general decrease in the Sharpe ratio, confirming that the top MF contains relatively 'save' companies. Not surprisingly when considering the inverse MF portfolio holds

overpriced companies (low EY) that have shown bad past performance (low ROC). The combination of low EY and low ROC do offer interesting companies with a very high risk/return combination, for the investor with a large risk appetite. The regression results in turn do provide surprising results. The CAPM is able to explain the generated returns for all groups except group 1, the top ranked stocks. The Fama-French three factor model in turn is able to explain all groups expect group 2 and 3 which exhibit weak significance and group 1 which exhibits strong significance. The beta remains relatively stable around 1, with the exception of groups 9 and 10. The results allow for a strong rejection of ***hypothesis 5***. I do not find a clear pattern in the returns, nor do I find results similar as those posted by Greenblatt. Hypothesis 4 and 5 allows the inference that the "magic" only seems to work for a small section of stocks in the top ranked category. This is however actually what Greenblatt says the MF is supposed to do.

"…I want to mention again one of the little flaws about the magic formula. The formula just isn't very cooperative. It doesn't always work. Sometimes the top-ranked stocks go down at the same time the bottom-ranked stocks are going up. Of course, over the long term the formula appears to work… It's just the that over the short term, Mr. Market can decide to go the other way."

Mr. Greenblatt, The little book that Still beats the market, pp. 159.

6.2 Conclusion

The main purpose of this paper was to either validate or invalidate the stated results posted by Greenblatt in his book "The little book that beats the market". The results are tested by performing an extensive back-test from July of 1985 to June of 2010. Aforementioned results confirm the viability of the Magic Formula as a method of investing for the "common" investor. If the investors started in 1985 and rebalanced the portfolio on an annual basis he would have earned an average annual return of 23.32 percent. If the investor started with 1000 dollars to invest in the magic formula and reinvested any earnings obtained, the cumulative return would have earned him 92,277.74 dollars in 2010, an impressive cumulative return of 9128 percent. The S&P500 during the same period exhibited an average annual return of 8.21 percent and would have earned the investor 5,372.48 dollars or 437 percent cumulatively. The above mentioned figures are raw return and not adjusted with the risk free rate. Regression results

confirm that the strategy is able to produce alpha. The used combination of earnings yield and return on capital might offer significant risk-adjusted abnormal returns, yet when looking at the two criteria in an individual light we need to be more careful. For example, there might be several reasons why a very high ROC is found within a company other than it simply being "good". Consider a company that goes into bankruptcy. The company would usually mark down some of their capital assets and shed long-term debt, resulting in an abnormally large ROC. Even though the company might have advantages after the bankruptcy, as soon as it reinvests, the ROC will decrease to a level that is more common within that industry (Roger Ison, 2006[15]). The high ROC that was used when constructing the MF portfolio might suffer a sharp decline during the consecutive year. Complications as such are not revealed using a simple screening. The high earnings yield exhibited by the company would in turn be tainted as well. In this case the high earnings yield does not indicate "cheapness", but is accurately priced by the market due to uncertain state of the company. The MF provides results that seem to have relatively low risk for the amount of return earned at a significant level. The danger is that there might be an unknown risk that is simply not captured by traditional asset pricing models. Greenblatt explains the phenomenon by stating that in the long run stock prices do reflect risk in an average way, but are inaccurate in the short term. The same conclusion was made earlier by Benjamin Graham (1965) that while the stock market in the short run may be a voting mechanism, in the long run it is a weighing mechanism. True value will win out in the end[16]. Despite limitations the magic formula allows the investor to screen for relatively save stocks that are able to earn high returns. It is however advisable to perform due diligence on the stocks that are obtained from the MF. The problems discussed earlier can be spotted and excluded from the portfolio. So, to narrate, is the MF truly magic? Plainly said, no, the strategy in itself is denoted as a Growth at a Relative Price (GARP) strategy. GARP can be seen as a subset of value investing where the investor seeks stocks that are both cheap and profitable. Haugen (2008) states that these strategies produce superior returns by exploiting the heuristic that the market tends to over-value currently profitable companies and under-value currently unprofitable ones. Similar conclusions were found by de Bondt and Thaler (1985) and Lakonishok, et al. (1994). Haugen (2008) narrates that the merit of "the little book that beats the market" is not to provide magic, but merely to

[15] Roger Ison, 27 Febuary 2006, Investing according to Greenblatt; http://snapdsp.wikispaces.com/Greenblatt
[16] Malkiel (2003)

publicize the power of GARP investing. Like Haugen (2008) stated, the magic formula tends to work due to a market anomaly that can be explained by behavioral heuristics, in this case the representative heuristic first described by Tversky and Kahneman (1974). Maikal (2003) remains skeptical in this respect. He states: " *Before the fact, there is no way in which investors can reliably exploit any anomalies or patterns that might exist. I am skeptical that any of the "predictable patterns" that have been documented in the literature were ever sufficiently robust so as to have created profitable investment opportunities, and after they have been discovered and publicized, they will certainly not allow investors to earn excess returns".* The results in this paper confirm that after the publication of "the little book that beats the market" the strategy is unable to generate alpha. However, it is hard to isolate the publication from the subsequent "financial crisis" years that follow shortly after. The two events do not allow any clear conclusion to be drawn. Aside from the behavioural explanation Fama and French (1993) provide a risk based explanation as to why the market anomaly is able to persist. They state that the market return alone is unable to measure the riskiness of a company that operates under certain conditions. The persistence of an anomaly is not because of behavioral attributes, but due to a misspecification of the CAPM. However, testing against multiple asset pricing models, including the Three-factor model, the returns generated by the MF remain persistent.

In conclusion, the magic formula seems to offer the returns as advocated by Greenblatt. Yet, blindly investing in the strategy remains unadvisable as stated by Ison (2006). The MF strategy, which can be seen as a GARP strategy, is a great way for the small investor to earn money, without any magic being involved.

An investment operation is one which, upon thorough analysis promises safety of principal and adequate return.

Benjamin Graham (1965)

7. Recommendations

This paper attempts to perform an accurate back-test of the magic formula within the United States. It must however be noted that the magic formula as stated by Greenblatt is far from transparent. It has been a hardship to find the exact composition of what Greenblatt means by Enterprise value and several other key components to the formula. By using a traditional approach to the formula the initial results where strange and often meaningless. Several key components to the formula needed an exact definition before a reasonable comparison between companies could be made in order to rank them (for example: Net working capital and Excess cash). This is obviously a strong downside for the "common Investor" whom wants to perform a stock-screen without the use of the website constructed by Greenblatt. The exact composition of the formula has a very strong effect on whether the formula works or not.

Furthermore, this paper concentrates around the U.S. market and excludes any international ADR's. The magic formula thus allows for more research in an international context. The only research found in this direction is a master thesis composed by Persson and Selander (2009)[17] for the Nordic region. They find that the MF is unable to generate significant returns tested against the CAPM and Fama French's three factor model. Perhaps similar results are found for other European countries.

There is also an opportunity for further research in line with Fama-French (1993) by constructing factors from the EY and ROC returns. Portfolios can be formed to determine whether the mimicking portfolios of ROC and EY capture common factors in stock returns related to Book-to-Market equity, size, ROC and EY. The time series regressions are able to explain the cross-section of average returns with the premiums for the common risk factors in returns. Moreover, the results could provide an answer if high ranked stocks earn a premium from the constructed ROC and EY factors.

[17] Persson, V., Selander, N., 2009, Back testing "The Magic Formula" in the Nordic region.

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APPENDIX A: # Inversed Magic

Table 1:
Descriptive statistics of the bottom ranked portfolio formed on the 30 lowest ROC & EY stocks

Statistics	Value Weighted	Equally Weighted	Market average - Value weighted	Market average - Equally weighted	S&P 500
mean	0.0219	0.0230	0.0092	0.0111	0.0072
median	0.0165	0.0185	0.0150	0.0164	0.0114
sd	0.1231	0.1175	0.0465	0.0559	0.0455
min	-0.3479	-0.3536	-0.2254	-0.2722	-0.2176
max	0.9054	0.7589	0.1285	0.2250	0.1318
Sharpe	**0.1499**	**0.1669**	**0.1246**	**0.1374**	**0.0834**

[a]The portfolios are constructed as follows. Each year *t* from 1985 to 2010 portfolios are formed by ranking the lowest ROC & EY stocks measures in July of *t*. Portfolios are annually rebalanced using the lowest 30 stocks as indicated by their combined ROC & EY score. Additionally all stocks are required to have a minimum market capitalization of 50 million in May of year *t*. Both equally weighted and value weighted returns are calculated. Equally weighted return is measures by dividing the return of each stock with the total stocks in the portfolio, in this case, thirty. Value-weighted return is measures by calculating the lagged market capitalization of June and adjusted monthly by cumulatively multiplying the June market value times one month trailing return (excluding dividends), similar to Fama-French (1993). This procedure is repeated every July of year *t*. Market average return, both value weighted and equally weighted, are returns on the NYSE, AMEX & NASDAQ combined for the same period as the magic formula portfolios. The Sharpe ratio is calculated using a one month US treasury bill for the risk free rate. The mean risk free rate is equal to 0.34 percent.

The initial hypothesis is that if the MF strategy offers positive significant returns using the 30 highest stocks by their combined ranking of EY and ROC, then the inverse must exhibit lower if not negative returns. The descriptive statistics do not confirm this claim. Both value-weighted and equally-weighted returns are higher than the top ranked portfolios. Respectively the top results are 1.85 percent and 1.81 percent against 2.19 percent and 2.3 percent. The standard deviation however is clearly much higher. Furthermore the riskiness of the bottom ranked portfolios can be seen from the Sharpe ratio. The top ranked portfolios offer a Sharpe ratio of 0.1961 when value-weighted and 0.2294 when equally-weighted. The top ranked portfolios perform better based on the Sharpe ratio; however the results for the bottom portfolio are much higher than expected. It is this unexpected result that might undermine the MF strategy. If no clear pattern can be determined then the selected stock are picked arbitrarily. More research is needed before a conclusion can be drawn.

Table 2:
Raw returns in % of the bottom ranked portfolio formed on the 30 lowest ROC & EY stocks

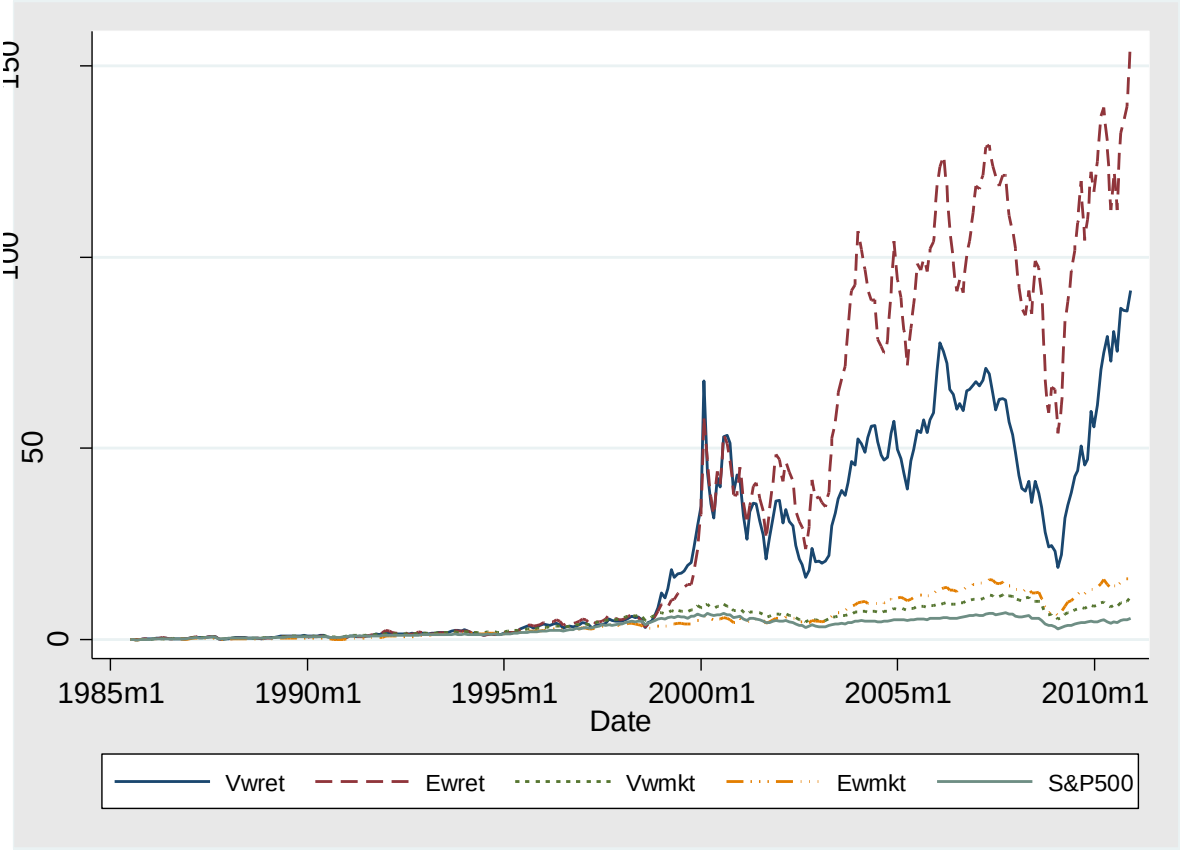
	Magic Formula			Market average		
year	Value weighted	Equally weighted	Greenblatt results	Value weighted	Equally weighted	S&P 500
1985	48.28	50.13		34.31	30.25	30.75
1986	6.78	11.99		19.52	9.52	21.19
1987	-4.33	-18.23		-6.25	-9.56	-10.03
1988	24.91	25.30	27.10	18.78	9.26	16.26
1989	13.79	10.53	44.60	12.64	-0.46	12.59
1990	-17.71	-8.01	1.70	6.90	5.99	3.67
1991	42.15	44.42	70.60	13.95	23.62	9.96
1992	14.05	11.39	32.40	16.19	29.58	10.39
1993	-17.42	-16.37	17.20	0.81	6.02	-1.39
1994	62.46	63.43	22.00	24.23	18.34	22.62
1995	28.84	52.18	34.00	25.68	30.74	23.11
1996	-1.77	-2.70	17.30	28.75	9.85	31.99
1997	43.38	19.77	40.40	28.08	16.20	28.10
1998	160.42	92.24	25.50	18.81	6.42	21.07
1999	137.90	242.72	53.00	11.05	24.18	5.97
2000	-15.85	-6.44	7.90	-16.04	-1.35	-15.82
2001	-29.67	-16.78	69.60	-16.73	-2.39	-19.16
2002	32.73	65.34	-4.00	2.35	19.43	-1.55
2003	67.59	55.13	79.90	21.67	41.75	17.07
2004	-11.03	-1.23	19.30	8.94	12.07	4.43
2005	28.15	11.98	11.10	11.23	15.44	6.62
2006	0.43	25.51	28.50	21.31	18.98	18.36
2007	-43.48	-30.91	-8.80	-10.89	-20.40	-14.86
2008	6.72	12.96	-39.30	-26.91	-15.44	-28.18
2009	87.50	16.42	42.90	16.58	29.73	12.12
AAR	**26.59**	**28.43**	**23.80**	**10.60**	**12.31**	**8.21**

[a]The portfolios are constructed as stated in Table 5 from July of 1985 to June of 2010. The stated returns are raw returns and have not been adjusted with the risk-free rate. In this construct I mimic Table 1 as provided by Greenblatt. Market average return, both value weighted and equally weighted, are returns on the NYSE, AMEX & NASDAQ combined for the same period as the magic formula portfolios.

Table 2 shows average annual returns higher than both the market and the top ranked MF portfolio, which are 23.32 percent and 21.83 percent respectively. The worst seems to outperform the best. A close look does show a very volatile pattern of returns. 1998 and 1999 are the years which exhibit an all-time high. A large quantity of dot.com companies could explains the high returns prior to 2000 and the sharp drop in 2000 and 2001. The bottom MF portfolios rebound more quickly from the Financial Crisis than the market, outperforming the market by about 30% in 2008. The bottom ranked companies which exhibit low ROC and low EY are high risk high payoff companies. In this respect it is the inverse of the MF portfolio

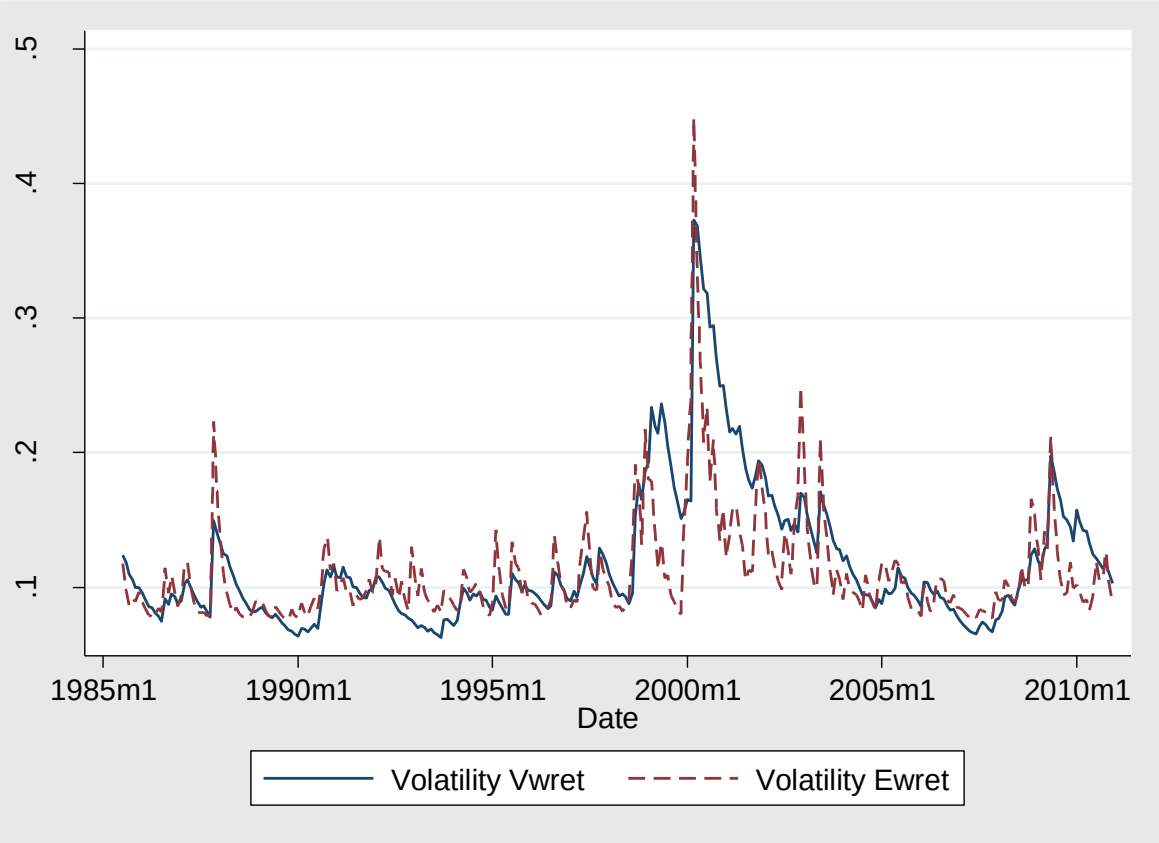
which looks for cheap and good companies and selects save investments relative to the high risks seen from the bottom ranked portfolios. From these initial observations I expect to see Small Growth stocks when testing the excessive returns against the Fama-French three-factor model. Before doing so the cumulative returns and volatility are graphically illustrated.

Graph 1:
Cumulative raw returns measured from 1985 to June 2010 for bottom ranked portfolio[b]



The bottom MF portfolio starts off with moderate returns before employing a steep increase in 1998 and 1999. We observe that that the cumulative return decreases sharply due to the dotcom bubble burst before regaining strength in the year 2003. The returns tend to move more erratically after that with a sharp decline in 2007 and 2008 due to the Financial Crisis, before return its path upwards.

Graph 2:
Volatility measured from 1985 to June 2010 for bottom ranked portfolio



The observed pattern in the annual returns of strong volatility around 2000 and 2001 is confirmed by graph 1. The volatility reaches and all time high of 45 percent in 2000. In contract, the volatility of the top MF portfolios reached 6 percent in 2000. The pattern confirms the large presence of dotcom companies in the portfolio. The Financial Crisis has less of an impact on our portfolio then the dotcom bubble. During the Financial Crisis the bottom MF portfolio reaches 20 percent volatility, the top MF portfolio is more than half that at about 9 percent.

Table 3:

Regression statistics of the bottom ranked portfolio formed on the 30 lowest ROC & EY stocks[a]

	CAPM		**3-Factor model**		**4-Factor model**		**Benchmark model**		**Liquidity model**	
	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret
	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t
mkt-rf	1.736***	1.687***	1.371***	1.312***	1.338***	1.250***	1.095***	1.047***	1.365***	1.307***
	15.13	*15.63*	*14.81*	*16.49*	*14.07*	*15.49*	*10.95*	*11.69*	*14.81*	*16.5*
HML			-0.552***	-0.529***	-0.595***	-0.610***			-0.577***	-0.553***
			-3.9	*-4.35*	*-4.13*	*-4.99*			*-4.09*	*-4.56*
SMB			1.640***	1.735***	1.646***	1.746***			1.621***	1.717***
			12.44	*15.31*	*12.5*	*15.63*			*12.32*	*15.19*
MOM					-0.125	-0.235**	-0.164	-0.305***		
					-1.44	*-3.21*	*-1.85*	*-3.85*		
rms5							1.009***	0.956***		
							3.79	*4.01*		
r2rm							1.331***	1.520***		
							5.96	*7.59*		
s5vs5g							0.529*	0.223		
							2.23	*1.05*		
rmvrmg							-0.796**	-0.615*		
							-2.79	*-2.41*		
r2vr2g							-0.657*	-0.663*		
							-2.14	*-2.41*		
LIQ_V									-0.201	-0.190*
									-1.89	*-2.08*
Constant	0.008	0.01	0.010*	0.011**	0.011**	0.013***	0.015***	0.018***	0.011**	0.013***
	1.56	*1.95*	*2.43*	*3.2*	*2.64*	*3.75*	*3.67*	*4.78*	*2.7*	*3.5*
R2	0.43	0.445	0.668	0.731	0.671	0.74	0.707	0.742	0.672	0.735

[a]The portfolios are constructed as follows. Each year *t* from 1985 to 2010 portfolios are formed by ranking the lowest ROC & EY stocks measures in July of *t*. Portfolios are annually rebalanced using the lowest 30 stocks as indicated by their combined ROC & EY score. Additionally all stocks are required to have a minimum market capitalization of 50 million in May of year *t*. Both value weighted (Vwret) and equally weighted (Ewret) returns are calculated. Equally weighted return is measures by dividing the return of each stock with the total stocks in the portfolio, in this case, thirty. Value-weighted return is measures by calculating the lagged market capitalization of May and adjusted monthly by cumulatively multiplying the May market value times one month trailing return (excluding dividends), similar to Fama-French (1993). This procedure is repeated every July of year *t*. Portfolio returns are adjusted for the risk free rate. The excess returns are tested using an ordinary least squares regression (OLS). Mkt-rf is the excess market return. HML and SMB is the Fama & French (1992) High minus Low and Small minus Big factor respectively. MOM is the momentum factor as added by Carhart(1997). Cremers, et al (2010) alternative factor model introduces several factors RMS5 is the mid minus large cap factor, R2RM is the small versus large cap factor, S2VS5g is the large cap value minus growth factor, RMVRMG is the midcap value minus midcap growth factor, r2vr2g is the mid versus large cap factor. LIQ_V is the liquidity factor by Pastor and Stambaugh (2003). Significance is measured using the p-value where *p<0.05, **p<0.01, ***p<0.001 indicate weak, semi-strong and strong significance respectively.

Statistical tests exhibit higher alpha's than the top MF portfolios. However, the generated alphas by the CAPM are insignificant. No conclusion can be drawn from these returns. The market risk,

denoted by beta, is significant and at 1.736 and 1.687, for value-weighted and equally-weighted MF portfolios. This again confirms earlier observations that bottom MF portfolio has a high risk, much higher than the top MF portfolios. The return is higher but comes with greater risk, abiding to the expectations of the CAPM. Conversely, the R^2 indicates that the market risk alone is unable to explain much of the variation in the returns. The Fama-French 3-factor model does a better job with an R^2 of 66.8 percent and 73.1 percent for value-weighted and equally-weighted returns respectively. The Fama-French 3 factor model incorporates two additional factors to account for the risk of firms that have a high expectancy of financial distress. The stocks that have a low EY and ROC tend to be overpriced companies with bad performance, if the inverse of the MF holds true. The Fama-French factors must be high and statistically significant to incorporate the additional risk taken by investing in these companies. The SMB and HML confirm earlier expectations that the portfolio is constructed of Small-cap Growth stocks. The top MF portfolios were predominately value stocks with moderate dominance of small-cap stocks. The analysis shows that the bottom MF portfolio is able to attain monthly risk-adjusted returns of 1.0 percent and 1.1 percent with weak and semi-strong significance for value weighted and equally weighted returns respectively.

APPENDIX B:

Group portfolios

Table 1:
Average annual returns for group portfolios reported by Greenblatt[a]

Annualized returns (1988-2009)	
group 1	15,2%
group 2	12,7%
group 3	12,1%
group 4	11,5%
group 5	10,7%
group 6	10,2%
group 7	8,8%
group 8	7,1%
group 9	4,1%
group 10	-2,0%

[a]source: The little book that still beats the market, page 158.

Greenblatt posted a table providing a pattern of returns from the highest ranked group of stocks (1) to the lowest ranked group of stocks (10).The dataset used by Greenblatt has several differences with the dataset used in this paper. However, the pattern should remain visible when the ranking criteria remain equal. I hope to either validate or invalidate the returns posted by the Greenblatt. A clear pattern would strengthen the magic formula as having predictive powers, instead of a method that arbitrarily picks several stocks with good characteristics.

Table 2:
Descriptive statistics of 10 decile portfolios ranging from the top ranked group 1 to the bottom ranked group 10 from July of 1985 to June of 2010.

Statistics	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9	Group 10
mean	0.0126	0.0079	0.0081	0.0060	0.0069	0.0055	0.0055	0.0079	0.0089	0.0085
sd	0.0553	0.0497	0.0526	0.0469	0.0480	0.0443	0.0465	0.0533	0.0761	0.0900
median	0.0174	0.0119	0.0120	0.0085	0.0085	0.0070	0.0104	0.0135	0.0132	0.0168
min	-0.2709	-0.2112	-0.2189	-0.1937	-0.2051	-0.2086	-0.2292	-0.2793	-0.3342	-0.3515
max	0.1929	0.1544	0.2101	0.1366	0.1430	0.1403	0.1291	0.1655	0.2306	0.3014
Sharpe	**0.1651**	**0.0906**	**0.0881**	**0.0560**	**0.0731**	**0.0478**	**0.0441**	**0.0849**	**0.0716**	**0.0565**
T-test	3.9700	2.7890	2.6800	2.2570	2.5260	2.1890	2.0590	2.6090	2.0390	1.6530

Within the dataset in this paper I am unable to replicate the returns posted by Greenblatt. There is no clear pattern in the returns, other than that group 1 indeed performs the best, with high returns and a high Sharpe ratio.

Table 3:

Raw returns for 10 decile portfolio´s from July 1985 to June 2010

Year\GROUP	1	2	3	4	5	6	7	8	9	10
1985	42.32	23.96	37.56	31.79	25.03	22.02	24.98	21.15	9.28	27.87
1986	22.54	19.55	14.27	24.11	17.33	17.76	15.92	17.35	18.30	4.99
1987	-12.96	-11.34	-14.22	-7.85	-4.71	-11.02	-9.08	-1.20	-5.35	-20.75
1988	25.28	17.73	8.21	11.63	8.22	5.66	9.61	13.36	-2.03	5.14
1989	4.60	7.54	6.37	9.98	16.96	2.78	0.12	9.94	2.24	-0.17
1990	2.31	1.97	8.67	0.34	0.32	-0.01	-6.93	-9.12	8.93	-15.43
1991	6.42	6.07	11.50	8.00	12.93	6.77	9.61	-1.64	4.96	8.23
1992	19.82	-3.12	12.19	3.32	7.40	14.52	16.03	31.66	33.55	22.81
1993	4.08	0.27	-0.20	-3.93	-8.66	-2.58	3.06	3.57	2.31	0.88
1994	31.55	29.53	26.55	31.40	15.89	10.03	20.48	14.21	30.08	29.33
1995	25.37	19.28	22.58	21.17	17.00	14.76	9.97	14.21	9.23	32.00
1996	41.31	25.64	26.31	24.31	16.80	15.23	14.03	15.21	-2.67	8.96
1997	19.47	13.39	19.06	23.08	26.47	27.38	21.43	9.46	4.09	10.76
1998	56.43	40.03	8.89	17.06	2.37	18.88	27.49	22.11	44.68	86.97
1999	26.83	19.60	38.88	4.75	18.83	11.08	-6.42	6.70	29.12	58.80
2000	6.47	-26.13	-31.65	-34.23	-17.37	-19.47	-25.38	-9.55	-42.71	-42.54
2001	1.22	4.11	-2.16	-20.02	-23.71	-13.46	-21.69	-26.80	-53.61	-45.63
2002	-5.02	-4.17	0.00	1.87	-3.13	-4.94	-2.58	10.65	17.48	25.00
2003	28.87	22.90	19.37	16.65	16.23	7.46	27.99	36.72	31.71	23.43
2004	14.41	7.96	-0.41	-3.81	4.19	12.94	19.80	11.26	2.12	-14.37
2005	5.52	8.10	7.32	0.40	6.65	10.23	11.31	26.32	26.31	14.10
2006	24.21	13.88	19.21	13.66	24.05	12.47	19.65	13.00	26.65	-1.97
2007	-3.28	-8.90	-9.34	-9.07	-5.07	-5.43	-11.38	-3.50	-22.18	-22.25
2008	-28.55	-26.65	-21.63	-18.61	-14.13	-28.09	-31.07	-34.42	-21.22	-25.94
2009	8.05	18.60	14.84	21.08	16.44	14.44	17.12	21.27	107.19	32.12
AAR	**14.69**	**8.79**	**8.89**	**6.68**	**7.05**	**5.58**	**6.16**	**8.48**	**10.34**	**8.09**

Table 3 :

Regression results for 10 decile portfolios ranging from the top ranked group 1 to the bottom ranked group 10 from June of 1985 to July of 2010.

		Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9	Group 10
CAPM	*a*	0.0067***	0.0023	0.0022	0.0007	0.0015	0.0004	0.0002	0.0020	0.0008	-0.0005
	t(a)	*4.0120*	*1.9620*	*1.6220*	*0.6290*	*1.2910*	*0.4520*	*0.1480*	*1.4570*	*0.3490*	*-0.1620*
	b	1.0156***	0.9797***	1.0142***	0.9310***	0.9355***	0.8804***	0.9179***	1.0222***	1.3920***	1.5548***
	t(b)	*28.5730*	*40.0080*	*35.2390*	*42.1810*	*37.3440*	*42.3480*	*40.1900*	*34.4800*	*28.2150*	*23.5040*
	R2	0.7287	0.8404	0.8033	0.8541	0.8210	0.8551	0.8416	0.7964	0.7237	0.6450
Fama & French	*a*	0.0071***	0.0027*	0.0029*	0.0014	0.0017	0.0006	-0.0002	0.0016	0.0015	0.0013
	t(a)	*4.2499*	*2.4313*	*2.2265*	*1.3981*	*1.4102*	*0.5840*	*-0.1928*	*1.1946*	*0.6989*	*0.6254*
	b	0.9907***	0.9353***	0.9714***	0.9294***	0.9398***	0.8831***	0.9408***	1.0032***	1.2769***	1.2944***
	t(b)	*26.5519*	*38.1339*	*33.0971*	*43.2140*	*35.6740*	*40.3638*	*39.5455*	*33.6476*	*27.5298*	*27.6471*
	HML	-0.1126*	-0.1194**	-0.1951***	-0.1673***	-0.0341	-0.0305	0.0965**	0.0941*	-0.2024**	-0.5414***
	t(HML)	*-1.9768*	*-3.1879*	*-4.3541*	*-5.0942*	*-0.8480*	*-0.9136*	*2.6567*	*2.0663*	*-2.8587*	*-7.5741*
	SMB	0.0175	0.1336***	0.0276	-0.2011***	-0.0709	-0.0553	-0.0248	0.2405***	0.4812***	0.9830***
	t(SMB)	*0.3291*	*3.8248*	*0.6605*	*-6.5658*	*-1.8897*	*-1.7741*	*-0.7314*	*5.6646*	*7.2860*	*14.7462*
	R2	0.7330	0.8570	0.8170	0.8760	0.8230	0.8570	0.8460	0.8160	0.7820	0.8410

APPENDIX C: MF complete regression statistics

		Small Stocks (over $50 Million)						Large stocks (over $1 billion)					
		1 year		3 years		5 years		1 year		3 years		5 years	
		Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret
CAPM	*a*	0.009**	0.008***	0.012***	0.007**	0.006	0.008***	0.006**	0.006***	0.009***	0.007***	0.005**	0.005**
	t(a)	*2.64*	*3.76*	*3.8*	*3.23*	*1.72*	*3.62*	*2.79*	*3.76*	*4.48*	*4.93*	*2.96*	*2.65*
	b	1.130***	1.107***	1.085***	1.025***	1.072***	0.985***	1.038***	1.091***	1.060***	1.039***	0.936***	1.080***
	t(b)	*16.3*	*23.58*	*16.38*	*23.46*	*15.34*	*21.73*	*22.35*	*31.39*	*25.24*	*34.77*	*24.28*	*28.01*
	R2	0.466	0.647	0.469	0.644	0.436	0.608	0.622	0.764	0.677	0.799	0.66	0.721
Fama & French	*a*	0.008*	0.007***	0.013***	0.006***	0.005	0.007***	0.006**	0.005***	0.009***	0.006***	0.006**	0.003
	t(a)	*2.53*	*4.06*	*4.08*	*3.45*	*1.64*	*3.53*	*2.75*	*3.4*	*4.68*	*4.69*	*3.09*	*1.94*
	b	1.097***	1.031***	1.006***	0.953***	1.029***	0.940***	1.042***	1.095***	1.033***	1.030***	0.913***	1.123***
	t(b)	*15.16*	*25.15*	*14.69*	*25.07*	*14.17*	*22.07*	*21.19*	*30.55*	*23.39*	*33.95*	*22.51*	*29.44*
	HML	0.068	0.163**	-0.212*	0.145*	0.053	0.204**	0.003	0.160**	-0.119	0.122**	-0.077	0.370***
	t(HML)	*0.61*	*2.61*	*-2.03*	*2.51*	*0.47*	*3.14*	*0.04*	*2.93*	*-1.76*	*2.63*	*-1.24*	*6.35*
	SML	0.297**	0.691***	0.239*	0.649***	0.344***	0.545***	-0.017	0.177***	0.026	0.216***	0.047	0.194***
	t(SML)	*2.88*	*11.84*	*2.45*	*12.00*	*3.32*	*8.98*	*-0.24*	*3.47*	*0.41*	*5.01*	*0.81*	*3.56*
	R2	0.481	0.759	0.493	0.76	0.457	0.691	0.622	0.776	0.681	0.815	0.663	0.756
Carhart 4-factor model	*a*	0.008*	0.008***	0.011***	0.006***	0.004	0.007***	0.006**	0.007***	0.009***	0.007***	0.006**	0.005**
	t(a)	*2.35*	*4.42*	*3.45*	*3.37*	*1.32*	*3.67*	*2.77*	*4.14*	*4.4*	*4.93*	*3.18*	*3.09*
	b	1.112***	1.008***	1.070***	0.954***	1.060***	0.929***	1.037***	1.059***	1.047***	1.017***	0.906***	1.068***
	t(b)	*14.91*	*24.05*	*15.52*	*24.34*	*14.24*	*21.18*	*20.46*	*29.46*	*23.05*	*32.67*	*21.66*	*28.84*
	HML	0.087	0.133*	-0.128	0.147*	0.094	0.189**	-0.004	0.114*	-0.1	0.105*	-0.087	0.298***
	t(HML)	*0.77*	*2.09*	*-1.23*	*2.48*	*0.84*	*2.84*	*-0.05*	*2.09*	*-1.46*	*2.22*	*-1.38*	*5.31*
	SML	0.294**	0.695***	0.228*	0.649***	0.338**	0.547***	-0.016	0.183***	0.023	0.218***	0.048	0.203***
	t(SML)	*2.85*	*11.99*	*2.39*	*11.97*	*3.28*	*9.02*	*-0.23*	*3.68*	*0.37*	*5.07*	*0.83*	*3.96*
	MOM	0.057	-0.088*	0.243***	0.005	0.121	-0.044	-0.018	-0.134***	0.053	-0.049	-0.03	-0.209***
	t(MOM)	*0.84*	*-2.3*	*3.89*	*0.15*	*1.8*	*-1.12*	*-0.39*	*-4.11*	*1.28*	*-1.74*	*-0.8*	*-6.22*
	R2	0.482	0.763	0.517	0.76	0.462	0.692	0.622	0.788	0.683	0.817	0.664	0.784
Cremers et al (2010) Benchmark model	*a*	0.007*	0.009***	0.011***	0.007***	0.003	0.008***	0.006*	0.006***	0.009***	0.007***	0.005**	0.004**
	t(a)	*2.21*	*4.81*	*3.39*	*3.79*	*1.01*	*3.86*	*2.5*	*3.95*	*4.37*	*4.84*	*2.82*	*2.74*
	b	1.121***	1.025***	1.105***	0.962***	1.107***	0.957***	1.066***	1.071***	1.050***	1.045***	0.933***	1.115***
	t(b)	*13.68*	*22.21*	*14.5*	*22.43*	*13.62*	*20.12*	*19.49*	*28.62*	*20.93*	*30.65*	*20.23*	*29.17*
	rms5	0.027	-0.117**	0.200**	-0.023	0.057	-0.076	-0.062	-0.159***	0.026	-0.062*	-0.052	-0.241***
	t(rms5)	*0.37*	*-2.86*	*2.96*	*-0.6*	*0.8*	*-1.81*	*-1.27*	*-4.82*	*0.59*	*-2.06*	*-1.29*	*-7.13*
	r2rm	0.736***	0.739***	0.025	0.771***	0.812***	0.728***	0.322*	0.694***	0.02	0.369***	-0.013	0.725***
	t(r2rm)	*3.37*	*6.01*	*0.12*	*6.75*	*3.75*	*5.74*	*2.21*	*6.96*	*0.15*	*4.06*	*-0.10*	*7.12*
	s5vs5g	0.203	0.759***	0.458**	0.652***	0.24	0.578***	-0.081	-0.004	0.026	0.205**	0.096	0.076
	t(s5vs5g)	*1.11*	*7.36*	*2.69*	*6.8*	*1.32*	*5.44*	*-0.66*	*-0.05*	*0.23*	*2.69*	*0.93*	*0.89*
	rmvrmg	-0.313	-0.247*	-0.319	-0.254*	-0.635**	-0.327**	-0.527***	-0.325***	-0.260*	-0.182*	-0.201	-0.385***
	t(rmvrmg)	*-1.61*	*-2.26*	*-1.76*	*-2.5*	*-3.29*	*-2.89*	*-4.06*	*-3.66*	*-2.18*	*-2.25*	*-1.83*	*-4.24*
	r2vr2g	0.19	0.159	-0.195	0.232	0.121	0.231	*0.350**	0.258*	0.151	0.082	-0.166	0.156
	t(r2vr2g)	*0.81*	*1.21*	*-0.9*	*1.9*	*0.52*	*1.7*	*2.25*	*2.42*	*1.05*	*0.85*	*-1.26*	*1.43*
	R2	0.495	0.768	0.523	0.766	0.483	0.706	*0.644*	0.815	4.37	4.84	0.668	0.814
Liquidity Factor model	*a*	0.008*	0.008***	0.013***	0.006**	0.005	0.006***	0.006**	0.005**	0.009***	0.006***	0.005**	0.003
	t(a)	*2.43*	*4.13*	*4.13*	*3.23*	*1.52*	*3.36*	*2.73*	*2.98*	*4.51*	*4.27*	*2.89*	*1.63*
	b	1.098***	1.030***	1.005***	0.954***	1.030***	0.941***	1.041***	1.098***	1.034***	1.032***	0.915***	1.125***
	t(b)	*15.14*	*25.09*	*14.65*	*25.11*	*14.17*	*22.08*	*21.14*	*30.91*	*23.39*	*34.33*	*22.53*	*29.61*
	HML	0.073	0.159*	-0.219*	0.152**	0.06	0.209**	0.002	0.174**	-0.114	0.133**	-0.071	0.381***
	t(HML)	*0.65*	*2.52*	*-2.08*	*2.61*	*0.54*	*3.2*	*0.02*	*3.19*	*-1.68*	*2.89*	*-1.14*	*6.54*
	SML	0.300**	0.688***	0.234*	0.654***	0.349***	0.549***	-0.017	0.187***	0.029	0.225***	0.051	0.201***
	t(SML)	*2.9*	*11.74*	*2.39*	*12.06*	*3.36*	*9.02*	*-0.25*	*3.69*	*0.46*	*5.24*	*0.88*	*3.71*
	LIQ_V	0.037	-0.037	-0.052	0.051	0.056	0.041	-0.008	0.107**	0.038	0.090*	0.048	0.083
	t(LIQ_V)	*0.45*	*-0.77*	*-0.66*	*1.17*	*0.67*	*0.83*	*-0.14*	*2.61*	*0.76*	*2.59*	*1.02*	*1.91*
	R2	0.481	0.76	0.494	0.761	0.458	0.692	0.622	0.781	0.682	0.819	0.664	0.759

[a]The portfolios are constructed as follows. Each year of *t* from 1985 to 2010 portfolios are formed by ranking the highest ROC & EY stocks measures in July of *t, t+3 or t+5* depending on their holding period. For each portfolio the 1-, 3-, and 5 year holding-period returns are computed. Portfolios are rebalanced every 1-, 3-, and 5 years using the highest 30 stocks as indicated by their combined ROC & EY score. Additionally all stocks are required to have a minimum market capitalization of 50 million or 1 billion in May of year *t.* Both equally weighted and value weighted returns are calculated. Equally weighted return is measures by dividing the return of each stock with the total stocks in the portfolio, in this case, thirty. Value-weighted return is measures by calculating the lagged market capitalization of May and adjusted monthly by cumulatively multiplying the May market value times one month trailing return (excluding dividends), similar to Fama-French (1993). This procedure is repeated every July of year *t*. Portfolio returns are adjusted for the risk free rate. The excess returns are tested using an ordinary least squares regression (OLS). Mkt-rf is the excess market return. HML and SMB is the Fama & French (1992) High minus Low and Small minus Big factor respectively. MOM is the momentum factor as added by Carhart(1997). Cremers, et al. (2008) alternative factor model introduces several factors RMS5 is the mid minus large cap factor, R2RM is the small versus large cap factor, S2VS5g is the large cap value minus growth factor, RMVRMG is the midcap value minus midcap growth factor, r2vr2g is the mid versus large cap factor. LIQ_V is the liquidity factor by Pastor and Stambaugh (2003). Significance is measured using the p-value where *p<0.05, **p<0.01, ***p<0.001 indicate weak, semi-strong and strong significance respectively.

APPENDIX D: Subsample Statistics

Table 1:
Descriptive statistics from the top ranked portfolio formed on the 30 highest ROC & EY stocks ranging from July of 2006 until December of 2010

Statistics	Value-Weighted	Equally-Weighted	Market average - Value weighted	Market average - Equally weighted	S&P 500
mean	0,0084	0,0065	0,0092	0,0111	0,0072
median	0,0195	0,0197	0,0150	0,0164	0,0114
sd	0,0642	0,0670	0,0465	0,0559	0,0455
min	-0,1695	-0,1796	-0,2254	-0,2722	-0,2176
max	0,1250	0,1379	0,1285	0,2250	0,1318
Sharpe	**0,1054**	**0,0726**	**0,1632**	**0,1696**	**0,1229**
T-test	0,9609	0,7120	0,5498	0,7786	0,1758

Table 2:
Raw returns from the top ranked portfolio formed on the 30 highest ROC & EY stocks ranging from July of 2006 until December of 2010

	Magic Formula		Market average		
year	Value weighted	Equally weighted	Value weighted	Equally weighted	S&P 500
2006	22,87	33,14	21,31	18,98	18,36
2007	8,53	-26,90	-10,89	-20,40	-14,86
2008	-26,32	-17,65	-26,91	-15,44	-28,18
2009	17,39	20,90	16,58	29,73	12,12
2010	21,94	29,61	25,02	25,48	22,02
AAR	**8,89**	**7,82**	**5,02**	**7,67**	**1,89**

Table 3:
Regression statistics of the top ranked portfolio formed on the 30 highest ROC & EY stocks ranging from July of 2006 until December of 2010[a]

	CAPM		**3-Factor model**		**4-Factor model**		**Benchmark model**		**Liquidity model**	
	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret	Vwret	Ewret
	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t
mkt-rf	0.894***	1.039***	0.920***	0.904***	0.984***	0.901***	0.991***	0.935***	0.897***	0.911***
	9.34	*13.47*	*8.18*	*12.38*	*8.7*	*11.77*	*8.38*	*11.56*	*7.82*	*12.12*
HML			-0.21	-0.012	-0.072	-0.017			-0.061	-0.057
			-1.03	*-0.09*	*-0.34*	*-0.12*			*-0.24*	*-0.34*
SMB			0.158	0.863***	0.161	0.863***			0.129	0.872***
			0.63	*5.3*	*0.66*	*5.25*			*0.51*	*5.28*
MOM					0.194*	-0.007	0.12	-0.07		
					2.08	*-0.11*	*1.1*	*-0.94*		
rms5							0.273	0.573*		
							0.75	*2.3*		
r2rm							0.181	0.962***		
							0.56	*4.32*		
s5vs5g							-0.910*	-0.666*		
							-2.16	*-2.31*		
rmvrmg							0.453	0.497		
							0.74	*1.18*		
r2vr2g							0.118	0.025		
							0.23	*0.07*		
LIQ_V									0.132	-0.04
									1	*-0.46*
Constant	0.004	0.002	0.004	0	0.005	0	0.002	0	0.003	0
	0.82	*0.49*	*0.65*	*-0.06*	*0.85*	*-0.07*	*0.38*	*-0.09*	*0.49*	*0.01*
R2	0.627	0.777	0.636	0.859	0.665	0.859	0.703	0.873	0.643	0.86

[a]The portfolios are constructed as follows. Each year *t* from 2006 to 2010 portfolios are formed by ranking the highest ROC & EY stocks measures in July of *t*. Portfolios are annually rebalanced using the highest 30 stocks as indicated by their combined ROC & EY score. Additionally all stocks are required to have a minimum market capitalization of 50 million in May of year *t*. Both value weighted (Vwret) and equally weighted (Ewret) returns are calculated. Equally weighted return is measures by dividing the return of each stock with the total stocks in the portfolio, in this case, thirty. Value-weighted return is measures by calculating the lagged market capitalization of May and adjusted monthly by cumulatively multiplying the May market value times one month trailing return (excluding dividends), similar to Fama-French (1993). This procedure is repeated every July of year *t*. Portfolio returns are adjusted for the risk free rate. The excess returns are tested using an ordinary least squares regression (OLS). Mkt-rf is the excess market return. HML and SMB is the Fama & French (1992) High minus Low and Small minus Big factor respectively. MOM is the momentum factor as added by Carhart(1997). Cremers, et al. (2008) alternative factor model introduces several factors RMS5 is the mid minus large cap factor, R2RM is the small versus large cap factor, S2VS5g is the large cap value minus growth factor, RMVRMG is the midcap value minus midcap growth factor, r2vr2g is the mid versus large cap factor. LIQ_V is the liquidity factor by Pastor and Stambaugh (2003). Significance is measured using the p-value where *p<0.05, **p<0.01, ***p<0.001 indicate weak, semi-strong and strong significance respectively.