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Quantitative Value
Seeking Excess Returns on the Stock Market

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Preface

This thesis is submitted towards a M.Sc. degree in Financial Economics and counts for 30 ECTS credits. The thesis is done in cooperation with Júpiter Capital Management and I would like to thank them for giving me the opportunity to work on this project and especially my instructor, Þorlákur Helgi Hilmarsson, for great support and guidance throughout. I would also like to thank Dr. Ásgeir Jónsson for his invaluable advice. Finally, I am forever grateful for the unconditional support provided by my family.
Abstract

The objective of this thesis is to develop and back-test an investment strategy created by professors Wesley R. Gray and Tobias E. Carlisle in their book *Quantitative Value*, published in 2013. Gray and Carlisle construct a quantitative strategy based on Warren Buffet’s investment philosophy and when back-tested, show that the strategy has been able to outperform the S&P500 TR Index for the last 40 years. The author tries to replicate the results shown by Gray and Carlisle for the US stock market which, despite the short period analyzed, gives promising results as the strategy generates a positive Jensen’s alpha that is statistically significant. When implemented for the Icelandic stock market the results are very impressive as the model’s return is significantly higher than the market’s. The model also manages to outperform Icelandic equity funds over a recent 18 month period, generating the highest Jensen’s alpha that is also statistically significant. The author set out to see if the model could be improved by introducing a new measure; return on invested capital (ROIC). The model’s results with ROIC included were impressive but did not improve the performance of the original model. However, due to the small sample size, the author believes that the result give cause to further research. The results support Gray and Carlisle’s findings that they have managed to find a model that systematically picks value stocks that generate excess returns.
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1 Introduction

In the summer of 1968 Ralph Waldo Gerard invited Ed Thorp, a math professor, to a game of bridge with the now famous value investor, Warren Buffett. Gerard was an early investor in Buffett Partners and Ed Thorp had just recently started investing in the stock market using an unusual quantitative investment strategy. At the table therefore sat two investors, Buffett who treats stocks as part ownership of a business valued through analysis of fundamental financial statement data, and Thorpe who values stocks on a probabilistic basis using quantitative methods. Although there appears a deep philosophical void between the two investors and their strategies they agreed on one important point: the stock market could be beaten.

Buffett’s strategy, value investing, was established by Benjamin Graham more than 75 years ago and is widely employed in the investment industry and generally accepted by academia. Value investors use fundamental analysis to find securities whose intrinsic value is less than the market price, or in other words, they seek to pay less than the security’s value. Despite the growth in computing power, the widespread adoption of the philosophy and ubiquity of financial data the value phenomenon persists. Perhaps the best answer for the existence of the value phenomenon and the reason for why it will still remain is that human behavior is not always rational.

While investment tools have advanced, humans remain subject to the cognitive biases that limit our ability to make rational decisions. Although investors may not be able to conquer their behavioral weaknesses, they can adapt their investment process to minimize them. This is where Thorp’s quantitative investment strategy comes into play. The term quantitative might conjure images of complex equations and powerful computers but it can also be thought of as the antidote to behavioral error. The quantitative model serves both to protect investors from these errors and to exploit the errors of others. The model need not be complex to achieve this end; in fact there is evidence to suggest that simple statistical models outperform the best experts.

In the book Quantitative Value: A Practitioner’s Guide to Automating Intelligent Investment and Eliminating Behavioral Errors (2013), authors Wesley R. Gray and Tobias
E. Carlisle sought to bring the two aforementioned investment strategies together which results in a quantitative model that picks stocks based on measures of price and quality. They describe in detail the method and criteria for picking stocks and examine the historical performance of the model. The results are very impressive as the strategy manages to beat the market consistently, as well as performing notably well compared to famous and well performing mutual funds.

This thesis is, to a large extent, based on Gray and Carlisle’s book as the author will try to replicate the historical returns for the US stock market they demonstrate in their book. Another feature of this thesis is to look at the historical performance of the model on another notably smaller and a less efficient stock market; the Icelandic stock market. It is well known that the US stock market has been one of the best performing stock markets and the most efficient one as well. By looking at the Icelandic stock market the author hopes to answer the question if Gray and Carlisle’s investment strategy, Quantitative Value (QV), can demonstrate the same impressive historical performance when used on a relatively small, young and inefficient market. Finally, the author looks at weaknesses or criticism of the model and possible improvements on the strategy.
2 Value Investing

2.1 History

The history of value investing began in the early 20th century with Benjamin Graham who is now considered the originator of the concept. He graduated from Colombia University at the age of twenty and then embarked on a career as an analyst on Wall Street after turning down an offer to pursue a doctorate in philosophy, mathematics or English. He soon discovered that analysts on Wall Street didn't fully appreciate the value of the information data services were feeding them. He wrote in his autobiography: “In 1914 this mass of financial information was largely going to waste in the area of common-stock analysis” (Graham, 1996, p. 142) and he found Wall Street to be a “virgin territory” for analyzing stocks. Observing this opportunity, Graham started giving his clients recommendations using simple arithmetic based on companies' financial statements and those who listened to him made healthy profits (Fox, 2011).

Realizing that his investment strategy generated excellent returns Graham set up a money management operation of his own and in 1927 began teaching a class named “Security Analysis” at Columbia. It was always Graham's intention to convert his course material into a textbook and in 1934 he and David Dodd, a student at the time, published Security Analysis which is today widely regarded as the first practical and comprehensive approach to security analysis. In their book Graham and Dodd advocated the use of careful and thorough analysis of a companies' financial statements to look for bargain stocks (Graham, 2009). With the publication of the book and the impact of his Colombia class the number of value investors and analysts examining financial statements quickly grew and Graham's influence didn't stop there. The New York Society of Security Analysts was founded in 1937 and was later joined by other similar associations to form the CFA Institute which today is a leading global association of investment professionals (Fox, 2011).

This development caused Graham to change his views on investing. Following the growth in jobs for analysts and the vast amount of research being implemented on companies' financial statements Graham stated in an interview that he was, to a limited
extent, “on the side of the efficient market school of thought” (“A Conversation with Benjamin Graham,” 1976) which was, and to a degree still is, generally accepted by academia. The efficient market hypothesis states that the price and value of a security cannot be distinct in practice because all information about a security’s value is immediately incorporated into the price (Bodie, Kane, & Marcus, 2009). Those that fully support the efficient market hypothesis therefore regard fundamental analysis useless.

Graham shut down his money management firm in 1956 having reported an impressive annual return of 17%. Despite Graham’s own admission that his methods no longer applied considering the new circumstances his influence on security analysis and investing continued. In 1949 he published another book, The Intelligent Investor, which later became known as the value investing bible, where he had refined his approach, although the philosophy remained the same (Graham, 2003). He continued to teach his Security Analysis class at Columbia until 1956 when he left the university. Although many students graduated from the class there was one student who would later go on to replace Graham as the figurehead of value investing; a Nebraskan named Warren Buffett (Fox, 2011).

Warren Buffett is perhaps the best and most noteworthy example of an investor that uses Graham’s philosophy and investment strategy to beat the market and gain impressive stock returns. Buffett was an excellent student and the only one to get an A+ in Grahams’ class. Upon graduating from Columbia University in 1951 Buffett started investing in stocks himself, ignoring Graham’s advice that he should stay away from stocks at least until the next crash (Fox, 2011). In 1956 Buffett created Buffett Associates Ltd with seven other limited partners. Ten years after its funding, the partnership’s assets were up 1,156% while the Dow was up 122.9%. Despite the profitable returns Buffett could no longer rationalize the high prices being paid for stocks and liquidated all of the holdings in his partnership except for two; one of them a textile manufacturing company called Berkshire Hathaway. After gaining a 49% share of the common stock in Berkshire Hathaway Buffett named himself director and tweaked the management of the company which had been run dreadfully. Not long after taking control he started handling the company as a source of cash to use elsewhere in the market and adding even more “cash machines” like insurance companies, banks and
newspapers. Using this method he acquired See's Candy, invested large positions in GEICO, Coke, Nike and other stocks that represented good value to him at the time of purchase (Kennon, n.d.).

Buffett's views on the stock market through the years have been well documented, especially from his Berkshire Hathaway shareholder letters which have become an essential reading for any enthusiastic investor. In his 1988 shareholder letter he dismissed the efficient market hypothesis which his mentor, Benjamin Graham, had started to accept, writing:

This doctrine [the efficient market hypothesis] became highly fashionable—indeed, almost holy scripture in academic circles during the 1970s. Essentially, it said that analyzing stocks was useless because all public information about them was appropriately reflected in their prices. In other words, the market always knew everything. As a corollary, the professors who taught EMT said that someone throwing darts at the stock tables could select a stock portfolio having prospects just as good as one selected by the brightest, most hard-working security analyst. Amazingly, EMT was embraced not only by academics, but also by many investment professionals and corporate managers as well. Observing correctly that the market was frequently efficient, they went on to conclude incorrectly that it was always efficient. The difference between these propositions is night and day (Buffett, 1988).

Buffett therefore always believed that the market could be beaten and is perhaps the best example that the efficient market hypothesis doesn't hold as he has beaten the market (the S&P500 Index) on a yearly basis 39 times out of 47 (Loomis, 2012). It is hard to pinpoint the secret to Buffett's success in the stock market but his ability to ignore the state of the market and focus on stocks that represent a bargain has been remarkable. His investment performance is without a doubt one of the most successful of all time as Buffett has seen his personal wealth rise up to $62.5 billion, and the stock price of Berkshire Hathaway balloon from $7.60 per share up to $192,470 as of July 2014 (Warren Buffett, 2014).

2.2 Methodology

2.2.1 Fundamental Analysis

The influence of Benjamin Graham and the success of Warren Buffett have had a profound impact on the literature about value investing as investors have adopted and
modified their own philosophies. Although investors might have different methods to value investing, the fundamental theory is to thoroughly analyze a security's financial statements to get a conservative valuation of the security. If the result of the valuation is less than the market price of the security it should be purchased (Graham, 2003). Warren Buffett's famous quote “price is what you pay; value is what you get” states the logical argument for value investing, i.e. seeking to exchange money for the value of the security where the money paid is less than the intrinsic value. The problem here is that the intrinsic value is not observable and according to the efficient market hypothesis it is the same as the market price. Therefore value investors need to estimate the intrinsic value using models, ratios and data from the past to forecast the future.

A favorite of academics and practitioners is the discounted cash flow (DCF) model which uses the cash flow of the company rather than accounting-based earnings to estimate intrinsic value. In the DCF model the weighted average cost of capital (WACC) is used to discount the cash flow available to all investors. The claims on cash flow of debt and other nonequity holders are then subtracted from enterprise value to determine the equity holders' value. Other common models based on discounting future cash flow include the dividend discount model (DDM) and equity valuation model. The final output of these models is a number which represents the total equity holders' value and when applied correctly should all yield the same result. To determine the intrinsic value per share the equity holders' value is divided by the number of current shares outstanding. If this number is higher than the market price the stock is undervalued by the market and therefore presents a value for the investor and should be purchased. Other models used to determine a firm's intrinsic value include the residual income model (RI), adjusted present value (APV) and discounted economic profit (Koller & McKinsey and Company, 2010).

The DCF method is widely regarded as the most accurate and flexible model to determine the value of a company but if an investor wants to triangulate the results of his model or compare the firm's market value to other firms, multiples or comparables are often used. Using comparables can help determine the validity of the cash flow forecast, compare the performance of the firm relative to its competitors and detect under-or overvalued firms relative to other firms. The most common multiples include
enterprise value to EBITDA (EV/EBITDA), price to earnings (P/E) and price to book (P/B) (Koller & McKinsey and Company, 2010).

### 2.2.2 Value Investing

Hypothetically, one could say that all investors are value investor because everyone who uses fundamental analysis and finds an undervalued stock would purchase it, hoping that the stock price would later reach its intrinsic value. However, value investors distinguish themselves from other investors in certain important and distinctive aspects. According to finance professor Aswath Damodaran there are three types of value investors (Damodaran, 2012):

- **Passive screeners**: Value investors that most closely follow Benjamin Graham’s philosophy and screen for stocks that are likely to have the attribute of undervalued stocks. This method is the one that most closely resembles the method used in Quantitative Value and will therefore get the greatest emphasis.

- **Contrarian investors**: A strategy based on investing in companies that most recently have performed poorly or do not have a bright future and thus many people have given up on them.

- **Activist investors**: A strategy where an investor tries to change the way poorly managed companies are run by investing in them and gaining control, a method which Warren Buffett has used to great success.

As an example of passive screening it is useful to take a look at criteria that Benjamin Graham put forward in his book, *The Intelligent Investor* (2003), where he set out to systematically screen for stocks that were cheap, had low leverage, enough liquidity to provide margin of safety and growing as well as stable earnings:

1) An earnings to price yield of twice the AAA bond rate.

2) A P/E ratio of less than 40% of the highest P/E ratio for the stock over the previous 5 years.

3) A dividend yield higher than 2/3 of the AAA bond yield.

4) A stock price less than 2/3 of the tangible book value per share.

5) A stock price less than 2/3 of net current asset value (NAV) per share, where $NAV = \text{Current assets} - (\text{Total liabilities} + \text{Preferred stock})$. 


6) Total debt less than tangible book value of equity.

7) Current ratio higher than 2, where Current ratio = Current assets/Current liabilities.

8) Total debt less than twice the NAV.

9) Earnings growth over the prior ten years of at least 7% compounded.

10) Over the last ten years, earnings may not have declined more than 5% twice.

The first five criteria are price indicators to find relatively cheap stocks, criteria six to eight examine stocks with low leverage and adequate liquidity while the last two are indicators of companies with growing and stable earnings. The question is, however, how well do the screens work for picking cheap stocks? In his article, Oppenheimer (1984) studied the performance of a portfolio consisting of stocks that fitted the above criteria and the results were that an investor would have made an annual return well in excess of the market.

Despite his success Graham modified his approach to stock picking. He was no longer an advocate of complicated techniques of security analysis but rather encouraged a simplified approach. He proposed two strategies; the first was based on a company's net current assets where the strategy is to purchase common stocks at less than their working-capital value. Despite its appeal the stocks were too small and infrequently available and this strategy is uncommon today. For the second strategy Graham recommended creating a portfolio of minimum 30 stocks that had a P/E ratio below 10 and debt-to-equity of less than 50%. An investor should then hold those stocks until they had generated a return of 50% but if a stock didn't manage that then sell it at the end of the second calendar year from purchase. In *Quantitative Value*, Gray and Carlisle (2013) decided to test this simple strategy to see if it could manage to outperform the market (using the S&P500 TR Index as a proxy) over the period 1976 to 2011. Surprisingly, this simple strategy managed to outperform the market with a yearly compounded annual return of 17.80% compared to the market's return of 11.05%. The drawback was that the strategy had a standard deviation of 23.93% compared to the market's 15.40%. Also, not many stocks fulfilled the criteria at certain times and during 2004 the portfolio was fully concentrated in only one stock.
2.3 Historical Performance

Although the logical argument for value investing is fairly theoretical the empirical argument is decisive; value stocks exhibit high historical returns. Probably the most famous and cited study on stock returns and value vs. growth stocks is the Fama and French study, “The Cross-Section of Expected Stock Returns” (1992), where they show that value stocks (defined as high book-to-market firms) have outperformed the broader market over the past 30 years. Another research by Rosenberg, Reid and Lanstein (1985) showed that stocks with high book-to-market ratios have yielded an excess return of 4.5% a year. Damodaran (2012) updated these two studies in his paper, “Value Investing: Investing for Grown Ups?”, to see whether the results persisted over the period 1991-2010. His findings were that stocks with high book-to-market ratios earned an excess return of 5.44% over the recent period and also reports that these findings are not unique to the United States. A study by Dimson, Marsh and Staunton (2011) reports that high book-to-market stocks have earned a premium relative to the market in 16 of the 20 markets they studied between 1975 and 2010.

It is therefore evident that value stocks have, over long horizons, yielded returns higher than the market. But why aren't more investors using this simple method? Both Damodaran (2012) and Fama and French (1992) in their studies argue that these stocks are inherently more risky where risk is defined as the additional volatility of the high book-to-market stocks. Although this argument has some truth to it, finance researchers Lakonishok, Shleifer, and Vishny (1994) argue in their paper, “Contrarian Investment, Extrapolation, and Risk” that value stocks yield higher returns not because they are riskier but because investors follow strategies which they call “naive”. These strategies include overreacting to bad news and therefore overselling stocks that are undervalued as well as assuming that a downward trend in stock prices will persist. Contrarian investors, on the other hand, speculate against these strategies, investing in underpriced stocks and beating the market. Whatever the reason for why investors aren’t following the value strategy the empirical evidence is unqualified; value stocks have beaten both growth stocks and the market over the long term.
3 Quantitative Investing

3.1 History

During the 1950s modern financial theory was revolutionized with Markowitz's (1952) seminal work on portfolio theory. In his ground-breaking work Markowitz put forward a model based on statistical concepts where an investor seeks to construct a portfolio that maximizes return for a given risk level. Markowitz defined the risk in security prices as the standard deviation in the returns of the stock price; better known as volatility. He also introduced the third dimension into portfolio analysis: correlation. Correlation is a statistical measure of how two securities move in relation to each other. Using a simple portfolio of two stocks, Markowitz showed that when two stocks have a perfectly negative correlation an investor could eliminate the risk of the portfolio. When picking securities for his portfolio an investor would therefore have to take into account its correlation with the portfolio. His model, called the mean-variance model, was fundamental for further application of mathematical statistics to finance in the next decades. Building on Markowitz's work the Capital Asset Pricing Model (CAPM) was developed by Treynor, Sharpe and Lintner in the 1960s. Using statistical methods, such as regression analysis, the CAPM model describes the relationship between risk and return and could be used to determine the prices of securities (Bodie et al., 2009).

The next stage in the application of mathematical statistics to finance was the problem of how to value financial derivatives, especially warrants and stock options. That problem was solved in the 1970s when Black and Scholes (1973) presented their work on option pricing. Based on a “risk-neutral” pricing methodology, Black and Scholes derived a partial differential equation that could be used to determine the value of an option over time. Fischer and Black’s breakthrough created a new field, quantitative analysis, and soon the most sought after employees on Wall Street were mathematicians and physicists with PhDs. For the next two decades there was a vast amount of research focusing on quantitative finance as academics continued to develop models to price complex financial derivatives, forecast interest rates and security prices as well as constructing models to manage the volatility of a portfolio. Another
important advancement was the increased power of computers and knowledge of programming as these complex models required significant computational power.

While academics were occupied with their models a young math professor at the University of California, Irvine, named Ed Thorp had published a book called *Beat the Market: A Scientific Stock Market System* (1967). Thorp had initially become famous for his book on blackjack card counting, *Beat the Dealer: A Winning Strategy for the Game of Twenty-One* (1966), where he had found a strategy that could significantly reduce the house edge in blackjack. Thorp used the strategy to his advantage at casinos and made $25,000 in the process. However, he soon gave up on blackjack as he didn't think it was profitable enough – and the casinos started taking counter-measures, even threatening him with physical harm. He had found his new passion; the stock market. While working at UCI he developed an investment strategy based on the famous random walk theory which states that security prices move randomly. With this theory he could use a probabilistic approach to invest in the stock market. Just like in the blackjack betting system, Thorp could exploit a small edge to beat the market (Patterson, 2010).

Thorp could not resist the urge to put his strategy to work so he established his own hedge fund, Princeton-Newport Partners. His investment strategy was highly technical and describing it is unfortunately beyond the scope of this thesis. Summed up briefly the strategy relied on a probabilistic approach to valuation and the construction of large enough portfolios to capture the probabilities. The fund’s performance was remarkable; when it closed in 1988 it had generated a return of 15.1% annually after fees, outperforming the market’s 8.8% return easily and even managing to do that with lower volatility. He later launched another fund and by 1998 he claimed that he had returned 20% a year since 1969 with a standard deviation of just 6% (Poundstone, 2006). Thorp is therefore not only one of the first investors to implement a quantitative investment strategy but also one of the most successful.

### 3.2 Methodology

The methodology behind quantitative investing is fairly comprehensive and diverse. On one end are simple strategies based on factor models such as the CAPM or Arbitrage Pricing Theory (APT) which use one or multiple factors to determine the price of a security. The factors used in the model depend on the type of security being
considered. For example, in the CAPM model a stock's covariance with the market as a whole is calculated and divided by the market’s variance which results in a factor called the *beta*. This measure determines how the returns of the stock and the market move together. Other common factors include growth in gross domestic product (GDP), interest rate variables and book-to-market values (Bodie et al., 2009).

On the other end are more complex multivariate statistical models based solely on a stock's statistics, e.g. returns, volatility and correlation. An example of this is principle component analysis (PCA) and pairs trading. PCA is closely related to the factor models but is different in that it uses a correlation matrix of assets to identify the factors that explain the movements of the assets. These factors can then be used to make investment decisions; for example forecasting portfolio returns and developing asset allocation algorithms for equity portfolios. Pairs trading, also related to factor models, uses what is called statistical arbitrage to sell overvalued stocks and buy undervalued stocks systematically (Tsay, 2010). The Quantitative Value model does not rely on these complex models; it is based on investing systematically using extensive screening to identify value stocks and to optimize returns. By using a quantitative model and sticking to it, an investor can eliminate the common behavioral errors among investors as will be discussed further in the next chapter.

### 3.3 Quantitative Investing Minimizes Behavioral Errors

Behavioral finance researchers have found that investors use what is called heuristics when making investment decisions. Heuristics are mental shortcuts that allow people to solve problems more efficiently and quickly but are also very prone to error. This leads to cognitive biases in people’s minds which disrupt their decision making. Investors therefore behave irrationally and lack the temperament to make good investment decisions. How important is it to have temperament to invest successfully? According to Warren Buffett it is very important as he once said in an interview: “Success in investing doesn't correlate with I.Q. once you're above the level of 25. Once you have ordinary intelligence, what you need is the temperament to control the urges that get other people into trouble in investing.” (Stone, 1999). From an investor's perspective there are certain cognitive biases which particularly impact his decision making and although
this list is not exhaustive it highlights some of the more common behavioural errors (Bodie et al., 2009):

- **Forecasting errors**: In a study by Kahneman and Tversky (1973) they found that people do not give enough weight to prior beliefs but too much weight to recent experience when making forecasts. When applied to investing this means that investors, when viewing the most recent positive earnings update by a firm, are too optimistic about the firm's prospect based on this information.

- **Overconfidence**: Overconfidence is when people have the tendency to overestimate their ability and this applies especially to investors who overestimate their stock picking ability. Almost 100% of the fund managers in a study by Montier (2006) believed that their performance was better than average. Another study by Barber and Odean (2001) argues that overconfident investors conduct more trades on average and that higher trading activity is predictive of poor investment performance.

- **Gambler's fallacy**: The gambler’s fallacy arises from an individual who, erroneously, believes that a certain event is less likely to occur succeeding a series of events. A common example is to think that following a series of 10 coin flips that resulted in *heads* increases the likelihood of *tails* coming up on the next coin toss. Among investors it is easy to apply this to the mistake that following a series of days that a stock has gone down to think it is more likely to go up the next day.

- **Representativeness**: Representativeness is when people view a pattern based on a sample they tend to deduce the pattern too far into the future without taking into account the sample size. Investors might therefore alter their views on a stock and buy it based on a short-lived run of good earnings reports or high stock return; thus exaggerating the price of the stock.

- **Framing**: People make decisions based on how choices are framed. For example, if an individual is given two scenarios which have two outcomes, gain and loss, the individual is more likely to act risk averse in terms of gains but risk seeking in terms of losses despite the scenarios having the exact same expected payoff.
Eliminating these behavioral errors should therefore significantly improve an investor’s decision making when picking stocks. To do that and protect them from these cognitive biases people rely on models that are free from all emotional connection to reality. Numerous studies have found that simple quantitative models outperform the judgment of experts in multiple fields, even when those experts are given the results of the model. For example, studies both in psychology and law have shown that models performed better at predicting the outcome of an experiment or a test than the experts; even though those same experts where given the output of the models (Ayres, 2008; Goldberg, 1968).

The same results have also been observed in the field of finance. Greenblatt (2012) conducted a study to see if investors could to better than his model. He offered two choices for investors, the first choice was to invest in a “self-managed” account where they could see the result of the model and elect which stocks to keep and which to discard. The second choice was to invest in a “professionally managed” account which relied solely on the output of his model. The result was that during a two year period from May 1, 2009, to April 30, 2011, the self-managed account underperformed the professionally managed account by 24.7% and even underperformed the market by 3.3%. When looking at the trades that the investors were making, Greenblatt observed that investors didn't buy many of the biggest winners but were instead avoiding them. This is a classic case of representativeness as investors are scared of these stocks at the time of purchase as they look out of favor, perhaps due to recent bad news concerning the stock. However, it is for this particular reason that the stock is likely to be undervalued and ends up being the biggest winner. Another observation was that the investors had the tendency to sell stocks after periods of bad performance and to buy after good performance which, according to Greenblatt, is certain to lower long-term investment returns.

Greenblatt’s result shows that even though investors are presented with the “correct” results they fail to follow the model and therefore decrease their returns. The reason is not complete ignorance among investors but cognitive biases manifested in humans when making decisions. Relying on a quantitative model therefore protects investors from their own cognitive biases as well as exploiting behavioral errors among other investors.
3.4 Historical Performance

The history of using quantitative models to implement an investment strategy is younger than strategies based on fundamental analysis. It wasn’t until the late 1980s - early 1990s that large financial institutions, especially hedge funds, starting trading using quantitative models. Most empirical research on quantitative funds observes the performance of hedge funds as a proxy and since 1994 there are multiple hedge fund indices available that track the performance of hedge funds. One example is the Credit Suisse Hedge Fund Index which was the first of its kind and remains the leading asset-weighted hedge fund index. The index’s annual return from its inception in 1994 to 2013 is roughly 8.6%, similar to the S&P500’s return during the same period (Sober Look, 2013). However, on a risk-adjusted basis the hedge funds are outperforming the market as the volatility for the S&P500 is almost double the volatility of the hedge fund index on a monthly basis. As the hedge funds often rely on models to implement their trading strategy they eliminate the cognitive biases that might encourage them to trade with higher frequency and therefore higher volatility.

Quantitative funds became very popular around the millennia and some researchers maintain that these funds grew at twice the rate of all other funds from 2000 to 2005 (Fabozzi & CFA Institute, 2008). This growth was driven by their excellent performance but shortly before the 2007-2008 financial crisis this growth diminished and performance declined. Since the crisis quantitative funds have been performing rather poorly and some argue that they have become out of fashion. The reason for the diminishing growth and bad performance, notably from 2007 to 2008, is the massive growth in assets under management which were more often than not highly leveraged. The high leverage caused the funds to be extremely reliant on liquidity which dried up during the crisis and for that the funds suffered (Cecutto, 2013).

Now that the methodology and history of the two investment strategies, value investing and quantitative investing, have been introduced it is time to present Gray and Carlisle’s Quantitative Value strategy.
4 Quantitative Value

4.1 History

Benjamin Graham’s screening method described in chapter 2.2.2 is perhaps one of the first and most basic quantitative value strategy as it uses multiple criteria to identify value stocks. However, it is only a screening method and doesn’t systematically rank one criterion higher than another, therefore it is hard to recognize it as a quantitative model. With Warren Buffet’s success in the stock market many investors have tried to replicate his investment strategy and today there are mutual funds that try to mirror Buffett’s strategy. One investor, Joel Greenblatt, not only wanted to know if he could replicate Buffett’s strategy but also if he could quantify it. Before he became famous for his book, *The Little Book that Beats the Market* (2005), Greenblatt was known as an excellent corporate finance specialist, focusing on events like mergers and acquisitions, spin-offs, restructurings and liquidations. His firm, Gotham Capital, had an exceptional track record; returning 40% annually before fees from 1985 to 1995 (Gray & Carlisle, 2013).

In 2002, Greenblatt performed an experiment where he wanted to know if he could quantify Warren Buffett’s investment strategy. To understand Buffett’s way of thinking he browsed through his Berkshire Hathaway shareholder letters trying to find Buffett’s rationale for his famous saying that “It’s far better to buy a wonderful company at a fair price than a fair company at a wonderful price.” (Buffett, 1989). Greenblatt speculated what would happen if he could find a strategy that mechanically bought shares in good businesses available at bargain prices. Greenblatt’s task was therefore to determine how to quantify “a good business” and “a bargain price”. After some research he decided to use a modified return on capital ratio to measure a good business:

\[
\text{Return on Capital (ROC)} = \frac{\text{Earnings Before Interest and Taxes (EBIT)}}{\text{Net Property, Plant and Equipment + NWC}}
\]

(1)

Where: Net working capital (NWC) = Current assets - current liabilities
The ratio measures how efficiently management is using the capital invested in the company. By excluding cash and interest-bearing securities this measure focuses only on assets that are truly used in the business to generate the return. To find bargain prices Greenblatt uses the inverse of the TEV/EBIT multiple or what he calls the earnings yield:

\[
\text{Earnings yield} = \frac{\text{EBIT}}{\text{Total Enterprise Value (TEV)}}
\]

Where: \( \text{TEV} = \text{Market capitalization} + \text{total debt} - \text{excess cash} + \text{preferred stock} + \text{minority interests} \)

By using EBIT/TEV rather than the popular price-to-earnings (P/E), an investor can use formula (2) to compare stocks' earnings regardless of their capital structure. The P/E ratio only includes market capitalization and is therefore dependent on a company's capital structure. Greenblatt then ranked stocks on these two criteria and combined their rankings to find the stocks that most closely resembled a wonderful company at a fair price (Gray & Carlisle, 2013).

The results were so good that Greenblatt named the strategy the Magic Formula; published a book based on it and later, in 2010, abandoned his special situations strategy for the Magic Formula. Impressed with his findings, authors Gray and Carlisle set out to examine Greenblatt’s strategy as well as going through comprehensive research to try and improve it.

4.2 The Quantitative Value Model

Building on Greenblatt’s research, Gray and Carlisle set out to develop an improved quantitative investment strategy based on Graham’s and Buffett’s ideology. They analyzed multiple ratios that serve as a proxy for bargain price and develop a detailed screening method for finding stocks that have a good business by looking at a firm’s franchise power as well as financial strength. An important feature of their strategy was that they also developed a method to identify stocks that could cause a permanent loss of capital. In the next three chapters detailed explanations of these steps will be discussed as well as the motivation for each of them.
4.2.1 Avoid Stocks at Risk of Sustaining a Permanent Loss of Capital

The first step is to identify stocks that are likely to cause a loss of capital as these stocks can have a severe effect on the overall performance of an investor’s portfolio as a loss of 50% requires a gain of 100% to break even. There are three scenarios that embody a total loss of capital: financial statement manipulation, fraud, and financial distress and bankruptcy. All three scenarios are closely related and are often found together; a manager may be involved in manipulating a company’s financial statement to cover up losses which are likely to culminate in financial distress and bankruptcy. These stocks should be avoided at all costs and are therefore removed from the investable universe. The steps to identify these stocks can be further divided into identifying potential frauds and manipulators and stocks at a high risk of financial distress (Gray & Carlisle, 2013).

Identify Potential Frauds and Manipulators

For managers to be able to manipulate earnings they need to have some discretion of their financial statements. According to accrual accounting, an accounting method used by most companies today, companies should record revenues or expenses when they are incurred even though it doesn’t involve a cash transaction. All recordings that don’t involve cash transaction are labelled as accruals. This method gives managers the option to hide losses or inflate earnings. Most practitioners and academics agree that cash accounting is more reliable than accrual accounting, i.e. that cash flows are more reliable than earnings. This is because cash flows are not estimated like earnings that contain accruals and to manipulate cash flows companies have to incur real expenses. Because accruals require estimation, there is a distinct possibility of an estimation error which reduces the ability of earnings to accurately reflect future cash flows (Dechow & Schrand, 2004).

Accruals therefore allow managers to manage earnings because they require them to make forecasts, estimates and judgments. Discretional accruals are the most popular for managers to manipulate as it is easy for managers to make adjustments in the accounts that allow for more discretion. An example of these accounts includes; accounts receivables, inventory, property, plant, and equipment (PPE) and other current assets. Dechow and Schrand (2004) argue that managerial optimism is the only rational
explanation for managers to engage in accruals management as “Managers must believe that the accruals reversals will go undetected in future periods when earnings are sufficiently high to absorb the reversals.” (p. 41). When the economy slows down and managers find it hard to meet the high earnings standard they have set, it is likely that earnings manipulations will surface and the performance of the business declines.

There is significant research on the relationship between accruals, manipulation and stock returns. A common result found in many studies is that companies with high accruals are more likely to be engaging in financial statement manipulation or even fraud. The most recognized research on accruals is Sloan’s (1996) article where he evaluated whether cash flow and accrual components of current earnings reflect information about future earnings. Sloan found that for each $1.00 of earnings that represents cash flows, 85.5 cents will carry through to next year’s earnings compared to only 76.5 cents for earnings backed by accruals. This means that cash flows are more persistent in representing earnings than accruals. The reason for this difference is that accruals are likely to be over- or understated in current periods and are adjusted by way of accruals in later periods (Dechow & Schrand, 2004).

Since Sloan’s findings, multiple studies have investigated whether relatively sophisticated users of financial statements, including financial analysts, institutional investors and managers understand the “accrual anomaly”. Bradshaw, Richardson, and Sloan (2001) argue that analysts only partially correct their forecasts for these effects. Beineish and Vargus (2002) suggest that insiders of a company reporting high accruals are net sellers while those of companies with low accruals are net purchasers. Lev and Nissim (2004) found that after Sloan’s publication institutions started to trade on the accrual anomaly; implying that experts did not know about it before. Janes (2011) provided evidence that accruals can be used to predict financial distress and that lenders do not fully utilize these predictable effects. The evidence does suggest that well informed and sophisticated users of financial statements do not fully understand that accruals are less reliable than cash flows.

Another research by Desai, Rajgopal, and Venkatacalam (2004) claims that companies with high accruals are more likely to be growth stocks, i.e. expensive stocks with high growth potential, while companies with low accruals more likely to be value
stocks. They base their findings on the fact that growth stocks tend to have a low ratio of cash flow to price \( \text{CF/P} \) but value stocks high \( \text{CF/Ps} \). Focusing on a company with low accruals minimizes the likelihood that a company is engaging in manipulation or fraud and is more likely to identify value stocks. In the Quantitative Value model, Gray and Carlisle propose three measures to reduce the probability of investing in a company whose management is engaged in financial statement manipulation or fraud; scaled total accruals (STA), scaled net operating assets (SNOA) and probability of manipulation (PROBM).

**Scaled total accruals (STA):** Sloan (1996) found that by constructing a portfolio that buys stocks with low accruals and shorts high-accrual stocks he could manage exceptional returns. To measure the magnitude of accruals Sloan used a measure based on information both from the income statement and the balance sheet:

\[
\text{STA} = \frac{(\text{CA} - \text{CL} - \text{DEP})}{\text{Total Assets}}
\]

Where:
- \( \text{CA} \) = Change in current assets - change in cash and equivalents
- \( \text{CL} \) = Change in current liabilities - change in LT debt included in current liabilities - change in income taxes payable
- \( \text{DEP} \) = Depreciation and amortization expense

A high STA indicates a high-accrual stock while a low STA indicates a low-accrual stock. In accordance, stocks with low STA receive a high ranking while stocks with high STA receive a low ranking in the Quantitative Value model.

**Scaled net operating assets (SNOA):** Hirshleifer, Hou, Teoh, and Zhang (2004) developed another accrual metric in their paper “Do Investors Overvalue Firms with Bloated Balance Sheets?”. They observe that the balance sheet becomes bloated when growth in cumulative accruals overtakes the growth in cumulative free cash flow. A bloated balance sheet makes it more difficult for a company to preserve its earnings growth. During their sample period (1964-2002) the authors find that a high SNOA is a strong signal of poor long-term stock returns. Gray and Carlisle create a ratio based on Hirshleifer et al. to measure a bloated balance sheet:
SNOA = \frac{(\text{Operating Assets} - \text{Operating Liabilities})}{\text{Total Assets}}

Where: 
OA = \text{Total assets - cash and equivalents} \\
OL = \text{Total assets - ST debt - LT debt - minority interest - preferred stock - book common equity}

The SNOA strategy gives stocks with low SNOA a high ranking and stocks with high SNOA a low ranking.

**Probability of manipulation (PROBM):** The STA and SNOA methods are based on accruals to assess the possibility of manipulation. Dr. Beneish (1999) laid out in his paper “The Detection of Earnings Manipulation” a different method designed to detect financial statement manipulation. Beneish included variables that are designed to capture effects of manipulation or conditions that might cause managers to engage in such activity. His model, which he called the “PROBM” model, could predict likely financial statement manipulators. The model correctly predicted 12 of the 17 most notable fraud cases between 1998 and 2002 and was successful in predicting perhaps the most famous incident, the bankruptcy of Enron Corporation in 2001. A year before the bankruptcy the PROBM model was sending out strong indicators of fraudulent accounting on Enron’s financial statements. Not only could it predict manipulation but it was also a strong indicator of stock returns. Stocks that were flagged by the model as likely earnings manipulators or accounting frauds returned 9.7% lower returns each year than stocks that were not flagged during the period 1993 to 2007 (Messod Daniel Beneish, Nichols, & Lee, 2011). The following are the eight components of the PROBM model and the mean index of manipulators and nonmanipulators. The mean indices can be interpreted as such: if a company’s score is close to the mean index of manipulators it is more likely to be manipulating its financial statements.

- **Days’ sales in receivables index (DSRI):** Measured as the ratio of days’ sales in receivable in year T to year T-1. Disproportionate increases in receivables relative to sales may suggest attempts by management to inflate revenues. Mean index (nonmanipulators) = 1.031, mean index (manipulators) = 1.465.

- **Gross margin index (GMI):** Measured as the ratio of the gross margin in year T-1 to the gross margin in year T. When GMI is greater than 1 it indicates that gross
margin has deteriorated. All else being equal, a firm with poor prospects is more likely to engage in manipulation. *Mean index (nonmanipulators) = 1.014, mean index (manipulators) = 1.193.*

- **Asset quality index (AQI):** Measured as the ratio of non-current assets less property, plant and equipment to total assets. This ratio indicates the proportion of total assets for which future benefits are potentially less certain, which may indicate attempts at cost deferrals in the form of intangible assets. *Mean index (nonmanipulators) = 1.039, mean index (manipulators) = 1.254.*

- **Sales growth index (SGI):** Measured as the ratio of sales in year T to sales in year T-1. High growth in sales might make it harder for managers to manage expectations and at the first indication of a slowdown may have greater incentives to manipulate earnings. *Mean index (nonmanipulators) = 1.134, mean index (manipulators) = 1.607.*

- **Depreciation index (DEPI):** Measured as the ratio of the rate of depreciation in year T-1 to the corresponding rate in year T. DEPI greater than 1 indicates that the rate at which assets are depreciated has slowed down. The firm might have adopted a new depreciation method to temporarily boost earnings. *Mean index (nonmanipulators) = 1.001, mean index (manipulators) = 1.077.*

- **Sales, general and administrative expenses index (SGAI):** Measured as the ratio of SGA to sales in year T relative to the corresponding measure in year T-1. Growing SGA may indicate managers who are capturing firm value via higher salaries. *Mean index (nonmanipulators) = 1.054, mean index (manipulators) = 1.041.*

- **Leverage index (LVGI):** Measured as the ratio of total debt to total assets in year T relative to the corresponding ratio in year T-1. A LVGI ratio higher than 1 indicates an increase in leverage, which may increase the probability of breaching a debt covenant and later bankruptcy. *Mean index (nonmanipulators) = 1.037, mean index (manipulators) = 1.111.*

- **Total accruals to total assets (TATA):** Measured as the change in working capital accounts other than cash minus depreciation. As discussed before, higher
accruals indicate a higher likelihood of earnings manipulation. *Mean index (nonmanipulators) = 0.018, mean index (manipulators) = 0.031.*

Beneish used regression analysis to find the coefficients for each variable which resulted in an eight factor model where the variables are weighted as follows:

\[ \text{PROBM} = -4.84 + 0.92 \times \text{DSRI} + 0.528 \times \text{GMI} + 0.404 \times \text{AQI} + 0.892 \times \text{SGI} \\
+ 0.115 \times \text{DEPI} - 0.172 \times \text{SGAI} + 4.679 \times \text{TATA} - 0.327 \times \text{LVGI} \] (5)

To implement the model the PROBM score of every single stock in the investable universe is calculated and transformed into a more meaningful statistics by using the cumulative density function (CDF) for a standard normal distribution. This value, called PMAN, is easier to understand as it is simply the probability of manipulation. A stock that has a PMAN value of zero suggests no chance of manipulation, while a stock with a PMAN value of one would indicate that manipulation is certain (Gray & Carlisle, 2013).

**Identify Stocks at High Risk of Financial Distress**

Academics and professionals have for a long time been trying to find the best predictor of financial distress as the financial health of a company is critical for its stock’s performance. Early attempts to predict stocks in financial distress include Benjamin Graham’s simple passive screening strategy as it required to have a debt-to-equity ratio of no more than 50%. However, it is difficult to look at a single predictor as a company’s financial health can be depicted in many different ways. Altman (1968) was one of the first to develop a comprehensive model to predict bankruptcy in his paper “Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy”. Altman collected a sample of 33 publicly listed manufacturing stocks that went bankrupt between 1945 and 1965 and then went through every bankruptcy looking for likely predictors. Although he started with 22 predictors he ended up with 5 that contributed the most to the explanatory power of his model. These predictors were: working capital/total assets, retained earnings/total assets, EBITDA/total assets, market value of equity/book value of total liabilities and sales/total assets. Each predictor was then weighted with its relative coefficient, depending on its contribution to the model. At
first, Altman suggested a cut-off point of 2.675 for the “Z-score”, so if a stock scored below 2.675 Altman classified the stock as bankrupt; he dropped it to 1.81 after conducting three further tests. The Z-score did well forecasting bankruptcy one year ahead and two years ahead as it correctly predicted 94% and 72% of bankrupt stocks, respectively. The results imply that the model does very well in forecasting bankruptcy one year ahead but looking further into the future the model’s accuracy diminishes.

Taking one of the most infamous and biggest bankruptcy files in history as an example, the bankruptcy of WorldCom in 2001, the Z-score for WorldCom was 0.798, less than half the cut-off point and indicating obvious financial troubles (Gray & Carlisle, 2013). Despite its success, Altman’s Z-score came under criticism because of its limitation as it was only developed for manufacturing companies and Altman had used financial data not available to investors in real time while constructing his model. Improving on Altman’s model, Shumway (1999) developed a model using not only accounting variables but also stock market variables such as past stock returns and standard deviation. His findings were that the new and improved model outperformed the Altman Z-score and he came to the conclusion that many of the variables in the Z-score were no longer good predictors of bankruptcy.

Observing that until 2008 most papers on bankruptcy had focused on predicting bankruptcy in the short term, authors Campbell, Hilscher, and Szilagyi (2008) argue that this method was about as useful as “predicting a heart attack by observing a person dropping to the floor clutching his chest.” (p. 2900). When looking at long horizons they claim that market capitalization, the price-to-book ratio and standard deviation are the most significant predictors. They also find that stocks with high leverage, low profitability, low past stock returns, low cash holdings and low price per share have a higher probability of filing for bankruptcy. All the variables are fairly intuitive except for low price per share but Campbell et al. argue that the variable captures distressed firms as they tend to trade at low prices per share. At last, they showed that their model performed better than Shumway’s model for forecasting bankruptcies. The model consists of the following input:

- **NIMTA:** Weighted average of quarter’s net income / market value of total assets (MTA), where MTA = book value of liabilities + market capitalization
- **TLMTA**: Total liabilities / MTA
- **CASHMTA**: Cash and equivalents / MTA
- **EXRET**: Weighted average of \( \log(1 + \text{stock's return}) - \log(1 + \text{S&P500 return}) \)
- **SIGMA**: Annualized stock’s daily standard deviation over the previous three months
- **RSIZE**: \( \log(\text{stock market cap} / \text{S&P500 total market value}) \)
- **MB**: MTA / adjusted book value, where adjusted book value = book value + 0.1 x (market capitalization – book value)
- **PRICE**: \( \log(\text{most recent stock price}) \), capped at \$15, so a stock with a stock price of \$20, would be given a value of \( \log(15) \) instead of \( \log(20) \)

The variables that contain weighted average are calculated as follows: \( XAVG = 0.5333 x_t + 0.2666 x_{t-1} + 0.1333 x_{t-2} + 0.0666 x_{t-3} \). When calculating NIMTA, the most recent quarter’s net income would therefore have a coefficient of 0.5333, the second 0.2666, etc. Campbell et al. use a statistical technique called “logistic regression” where the independent variables are the ones listed above and the dependent variable is “logit probability of financial distress” or LPDF, calculated as follows:

\[
\text{LPFD} = -20.26 \times \text{NIMTAAVG} + 1.42 \times \text{TLMTA} - 7.13 \times \text{EXRETAvg} + 1.41 \times \text{SIGMA} - 0.045 \times \text{RSIZE} - 2.13 \times \text{CASHMTA} + 0.075 \times \text{MB} - 0.058 \times \text{PRICE} - 9.16 \tag{6}
\]

To transform the LPFD value into probability the following equation is used:

\[
PFD = \frac{1}{1 + e^{-\text{LPFD}}} \tag{7}
\]

Where: \( PFD = \text{Probability of financial distress} \)

The PFD ranges between 0% and 100% where 0% implies no probability of financial distress but 100% certain financial distress. The PFD is used to measure the probability that a stock will find itself in financial distress in the next 12 months and can be used as a filter to avoid stocks at risk of sustaining a permanent loss of capital (Gray & Carlisle, 2013).
**Scrubbing the Universe of Fraudulent and Distressed Firms**

The next step is to scrub the investable universe of the stocks that are likely to cause a permanent loss of capital. There are four different values used to measure the risk of manipulation, fraud and financial distress: STA, SNOA, PMAN and PFD. The value of these measures is calculated for all the stocks in the universe, the stocks ranked on their performance in each measure and a stock’s percentile in each measure is calculated. In all these measures it is better to get a low value and therefore it is better to be in the lower percentiles. If the universe consists of 1,000 stocks and a stock receives a ranking of 100 in PMAN its percentile is 90%, as the stock’s PMAN value is higher than 90% of the other stocks in the universe on that particular measure. For the STA and SNOA values, a stock’s average percentile in these two measures is calculated and interpreted as a new measure, COMBOACCRUAL. To clean the universe the top 5% of stocks in the COMBOACCRUAL, PMAN and PFD measures are removed.

Gray and Carlisle examined the performance of their model with and without the cleansing method. The results were that the compounded annual growth (CAGR) of the cleaned universe was 11.04% compared to a 10.80% return for the un-cleaned universe. Although the difference is marginal the cleaned universe also had a lower standard deviation, 15.31% compared to 15.49%. This evidence suggests that they have found a tool that can help them further identify and assess quality and price which is the subject of the next two chapters.

### 4.2.2 Find Cheapest Stocks

Finding a bargain price is the next step in the Quantitative Value model and perhaps the most important one as it enables investors to identify cheap stocks. Gray and Carlisle not only examine multiple single metric price ratios but also consider long-term price ratios as well as a combination of price ratios. Their rationale for using long-term price ratios is that using a single period, usually 12 months, can be dangerous since it might cause the model to favor stocks that have had unusually good earnings in that particular period. It is possible that the period of 12 months was not representative of a company’s true earnings power and that the model would pick stocks only at the peak of their business cycle. The appeal of a combination of price ratios is that they are more
likely to be able to distinguish between firms that look cheap on one metric but expensive on the other two.

Despite their strong arguments for the use of long-term and composite ratios they are not able to find conclusive evidence that these ratios have historically performed better than a single period metric. In what follows is a list of the single metric price ratios, the argument for each one, and Gray and Carlisle’s historical simulation of the performance of each ratio to determine the eventual winner. The investment simulation criteria, assumptions and data used by Gray and Carlisle is set out and explained in chapter 4.4. All the price ratios are expressed in a yield format for ease of comparison and to make them comparable to interest rates; a higher yield is therefore more desirable for all ratios.

**Earnings Yield**

An intuitive way to think of a stock’s value is as a multiple of its earnings. One of the most popular earnings multiples is the price-to-earnings (P/E) ratio. Its intuition is that, in general, if a stock has a high P/E ratio there are high expectations of earnings growth but low expectations if a stock has a low P/E ratio (Damodaran, 2002). The earnings yield is simply the inverse of the P/E ratio:

\[
\text{Earnings yield} = \frac{E}{M}
\]

Where: \( E = \) Earnings before extraordinary items - preferred dividends + income statement deferred taxes, if available
\( M = \) Market capitalization

\[\text{(8)}\]

**Enterprise Yield (EBITDA and EBIT Variations)**

The enterprise yield is a company enterprise value multiple since it not only includes market capitalization in the denominator but also all liabilities of the enterprise unlike the earnings yield. By using the enterprise yield the acquirer of the enterprise can vary the mix of debt and equity in the capital structure which affects the amount paid in interest and taxes. Unlike the earnings yield, the two variations (EBITDA and EBIT) are less likely to be negative, making comparison more logical. The EBITDA variation also
adjusts for different depreciation methods across companies since depreciation and amortization do not affect EBITDA (Damodaran, 2002). The enterprise yield (EBITDA variation) is calculated as follows:

\[
\text{Enterprise Yield} = \frac{\text{EBITDA}}{\text{TEV}}
\]

Where: \(\text{EBITDA} = \text{Earnings before interest, taxes, depreciation and amortization}\)

\(\text{TEV} = \text{Market capitalization} + \text{total debt} - \text{excess cash} + \text{preferred stock} + \text{minority interest}\)

Excess cash = \(\text{Cash} + \text{current assets} - \text{current liabilities}\)

The EBIT variation simply substitutes EBIT for EBITDA.

**Free Cash Flow Yield**

Similar to the enterprise yield the free cash flow yield uses total enterprise value in the denominator but substitutes free cash flow for EBITDA. The motivation for using free cash flow is that it accounts for the maintenance of capital expenditure and other ongoing costs needed to keep the business running and growing (Gray & Carlisle, 2013). The free cash flow yield is calculated as follows:

\[
\text{Free Cash Flow Yield} = \frac{\text{FCF}}{\text{TEV}}
\]

Where: \(\text{FCF} = \text{EBIT}(1 - \text{tax rate}) + \text{depreciation and amortization} - \text{working capital change} - \text{capital expenditures}\)

**Gross Profits Yield**

Gross profit is simply the profit when cost of goods sold has been deducted from sales. It is the highest profit figure in the income statement and is therefore very difficult to manipulate (Gray & Carlisle, 2013). The gross profits yield uses the total enterprise value in the denominator and is calculated as follows:

\[
\text{Gross Profits Yield} = \frac{\text{GP}}{\text{TEV}}
\]

Where: \(\text{GP} = \text{Revenue} - \text{cost of goods sold}\).
**Book-to-Market**

The book-to-market ratio is the inverse of the popular price-to-book (P/B) ratio. There are two common reasons why investors find the price-to-book ratio useful. The first is that it can be easily used to identify under- or overvalued firms when comparing similar firms. The second is that, when compared to the market price, the book value can provide an intuitive measure of value (Damodaran, 2002). The book-to-market ratio is calculated as follows:

\[
\text{Book-to-Market} = \frac{B}{M}
\]

Where: \( B = \text{Common equity} + \text{preferred stock par value or assets - liabilities} - \text{preferred stock} + \text{balance sheet deferred taxes and investment tax credit, if available.} \) (12)

**Forward Earnings Estimate**

The forward earnings estimate is very similar to the earnings yield but instead of historical earnings it uses estimates of future earnings. The argument for its use is that investments are made with an eye to the future (Gray & Carlisle, 2013). The forward earnings estimate is calculated as follows:

\[
\text{Forward Earnings Estimate} = \frac{FE}{M}
\]

Where: \( FE = \text{Consensus Institutional Brokers' Estimate System (I/B/E/S) earnings forecast of EPS for the fiscal year.} \) (13)

**Results of the Price Ratio Race**

Gray and Carlisle analyzed the compound annual growth rates of each price ratio between 1964 and 2011 for market capitalization-weighted decile portfolios. They find that the EBIT variation of the enterprise multiple is the best-performing price ratio based on a compound annual growth rate as it generated a CAGR of 14.55% per year over the full period. Their findings are consistent with a study by Loughran and Wellman (2010) who found that the enterprise multiple significantly outperformed the book-to-
market ratio favored by many academics, including Fama and French (2011). The worst performer is the forward earnings estimate generating a CAGR of only 8.63%; underperforming the S&P500 by almost 1%. Investors should therefore beware when looking at the forward earnings estimates provided by the wizards of Wall Street.

Gray and Carlisle also classified the lowest decile as growth stocks and the highest decile as value stocks and the spread between the returns in these portfolios as the “value premium”. By measuring the size of the value premium the authors argue that they can find the ratio that is most successful at sorting the stocks. The ratio with the biggest premium will be the one that is best at distinguishing between value and growth stocks; separating winners from losers. Table 1 presents the CAGRs of the decile portfolios sorted into value (decile 10) and growth (decile 1) deciles between 1964 and 2011.

Table 1 Compound annual growth rates for all price measures (Gray & Carlisle, 2013)

<table>
<thead>
<tr>
<th></th>
<th>Earnings Yield</th>
<th>Enterprise Multiple (EBITDA)</th>
<th>Enterprise Multiple (EBIT)</th>
<th>Free Cash Flow Yield</th>
<th>Gross Profits Yield</th>
<th>Book-to-Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth</td>
<td>7.77%</td>
<td>7.55%</td>
<td>7.09%</td>
<td>9.05%</td>
<td>7.42%</td>
<td>8.62%</td>
</tr>
<tr>
<td>2</td>
<td>8.04%</td>
<td>8.20%</td>
<td>8.58%</td>
<td>9.55%</td>
<td>7.08%</td>
<td>9.20%</td>
</tr>
<tr>
<td>3</td>
<td>10.70%</td>
<td>8.76%</td>
<td>8.77%</td>
<td>9.13%</td>
<td>7.96%</td>
<td>9.79%</td>
</tr>
<tr>
<td>4</td>
<td>8.76%</td>
<td>8.22%</td>
<td>8.29%</td>
<td>9.71%</td>
<td>9.18%</td>
<td>9.29%</td>
</tr>
<tr>
<td>5</td>
<td>9.20%</td>
<td>8.16%</td>
<td>9.70%</td>
<td>8.80%</td>
<td>9.86%</td>
<td>9.62%</td>
</tr>
<tr>
<td>6</td>
<td>9.00%</td>
<td>10.00%</td>
<td>11.04%</td>
<td>11.19%</td>
<td>10.89%</td>
<td>10.13%</td>
</tr>
<tr>
<td>7</td>
<td>11.75%</td>
<td>11.06%</td>
<td>11.00%</td>
<td>9.74%</td>
<td>12.02%</td>
<td>11.44%</td>
</tr>
<tr>
<td>8</td>
<td>12.45%</td>
<td>11.73%</td>
<td>11.63%</td>
<td>9.98%</td>
<td>13.71%</td>
<td>11.45%</td>
</tr>
<tr>
<td>9</td>
<td>12.92%</td>
<td>13.70%</td>
<td>12.08%</td>
<td>12.83%</td>
<td>13.43%</td>
<td>11.80%</td>
</tr>
<tr>
<td>Value</td>
<td>12.44%</td>
<td>13.72%</td>
<td>14.55%</td>
<td>11.68%</td>
<td>13.51%</td>
<td>13.11%</td>
</tr>
<tr>
<td>Premium</td>
<td>4.67%</td>
<td>6.17%</td>
<td>7.45%</td>
<td>2.63%</td>
<td>6.09%</td>
<td>4.49%</td>
</tr>
</tbody>
</table>

The EBIT enterprise multiple has the biggest value premium, 7.45%, and is therefore the most effective measure to separate value stocks from growth stocks. The other enterprise multiple (EBITDA variation) also generates a big spread at 6.17% and the gross profits yield gives the enterprise multiples a run for their money at 6.09%. The
The worst performer is the free cash flow yield with a spread of 2.63%. There is one thing that stands out in table 1; growth stocks have performed dreadfully. The S&P500’s compounded annual growth rate during the same period was 9.52% which means that every ratio’s growth decile underperformed the market.

To measure the performance of the ratios on a risk adjusted basis Gray and Carlisle use the Sharpe and Sortino ratios as well as various different measures of drawdown risk. Sharpe (1966) developed the Sharpe ratio, also known as the reward-to-volatility ratio, as a risk-adjusted performance measure to take into account the extra risk fund managers took to generate their returns. A higher Sharpe ratio is better as it means that a higher return is generated for each additional unit of volatility. The Sharpe ratio is calculated by using the following formula:

\[ S_p = \frac{\bar{r}_p - \bar{r}_f}{\sigma_p} \]

Where: \( \bar{r}_p \) = Expected portfolio return
\( \bar{r}_f \) = Risk free rate
\( \sigma_p \) = Portfolio standard deviation

The Sortino ratio is similar to the Sharpe ratio but is different in one important way; it only measures downside volatility. Downside volatility focuses only on returns that fall below a certain minimum acceptable return and that return is used instead of the risk free rate in formula (14). Gray and Carlisle use a minimum acceptable return of 5% in their model. Drawdown risk is used to measure the extent to which each portfolio has fallen in the past, in other words, it seeks to describe the worst absolute performance of the price metric (Gray & Carlisle, 2013). The CAGR of all ratios, along with their risk-adjusted performance’s and absolute measures of risk can be found in table 2.
Table 2 Performance and risk measures for the value decile of all price ratios (Gray & Carlisle, 2013)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CAGR</td>
<td>12.44%</td>
<td>13.72%</td>
<td>14.55%</td>
<td>11.68%</td>
<td>13.51%</td>
<td>13.11%</td>
<td>9.52%</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>17.62%</td>
<td>17.25%</td>
<td>17.20%</td>
<td>16.42%</td>
<td>18.35%</td>
<td>17.39%</td>
<td>15.19%</td>
</tr>
<tr>
<td>Downside Deviation</td>
<td>12.17%</td>
<td>11.49%</td>
<td>11.34%</td>
<td>11.00%</td>
<td>12.93%</td>
<td>11.12%</td>
<td>10.66%</td>
</tr>
<tr>
<td>Sharpe Ratio</td>
<td>0.46</td>
<td>0.53</td>
<td>0.58</td>
<td>0.44</td>
<td>0.50</td>
<td>0.50</td>
<td>0.33</td>
</tr>
<tr>
<td>Sortino Ratio (5%)</td>
<td>0.68</td>
<td>0.82</td>
<td>0.89</td>
<td>0.68</td>
<td>0.73</td>
<td>0.80</td>
<td>0.50</td>
</tr>
<tr>
<td>Worst Drawdown</td>
<td>-49.01%</td>
<td>-43.45%</td>
<td>-37.25%</td>
<td>-44.54%</td>
<td>-56.87%</td>
<td>-49.20%</td>
<td>-50.21%</td>
</tr>
<tr>
<td>Worst Month Return</td>
<td>-22.02%</td>
<td>-18.66%</td>
<td>-18.43%</td>
<td>-20.83%</td>
<td>-24.86%</td>
<td>-22.37%</td>
<td>-21.58%</td>
</tr>
<tr>
<td>Best Month Return</td>
<td>25.75%</td>
<td>16.95%</td>
<td>17.21%</td>
<td>16.56%</td>
<td>29.74%</td>
<td>28.59%</td>
<td>16.81%</td>
</tr>
<tr>
<td>Profitable Months</td>
<td>60.42%</td>
<td>62.85%</td>
<td>61.46%</td>
<td>61.11%</td>
<td>61.63%</td>
<td>61.63%</td>
<td>60.94%</td>
</tr>
</tbody>
</table>

The results in table 2 show that not only did the EBIT variation of the enterprise multiple generate the highest CAGR but it also had the highest Sharpe- and Sortino ratios. Relative to other ratios it also performs well in drawdown risk, showing a worst overall drawdown of -37.25% and a worst monthly drawdown of -18.43%. The EBITDA variation comes in as a close second, scoring well on both the Sharpe and Sortino ratios.

Gray and Carlisle’s official winner, the EBIT version of the enterprise multiple, seems to outperform the other price ratios on a fairly comprehensive analysis. It generated the highest CAGR, gives the best risk-adjusted return and is the best at distinguishing between value and growth stocks. In the Quantitative Value model, Gray and Carlisle calculate the EBIT enterprise value for each stock and then rank all stocks on based on their value.

4.2.3 Find Highest-Quality Stocks
To identify Warren Buffett’s “wonderful companies” Gray and Carlisle set out to find high quality companies with an economic franchise and exceptional financial strength. A franchise should protect a firm’s business and stock returns against competitors and therefore provide a margin of safety. A company exhibiting superior financial strength is able to withstand shocks from the business cycle as well as competition from competitors.
Franchise Power

For a company to have franchise power it must have a competitive advantage such as being able to charge a price premium and/or having cost and capital efficiency. This enables the business to generate returns on capital in excess of cost of capital which is what drives the value of a business and ultimately the stock’s performance (Damodaran, 2007). Warren Buffett puts a lot of effort into finding a company that possesses pricing power and probably his most famous and profitable investment, chocolate manufacturer See’s Candies, is a typical example of a company with excellent franchise power. Buffett bought See’s Candies in 1972 for $25 million when the company’s pre-tax earnings were less than $5 million. From 1972 to 2007 the company grew exponentially because of its ability to charge a premium for its chocolate. During these 35 years pre-tax earnings cumulated to $1.35 billion and of those $1.35 billion Buffett only had to reinvest $32 million to fund the growth of the business. The rest went back to Buffett who could use the money to invest in other businesses and grow Berkshire Hathaway (Gray & Carlisle, 2013).

To identify companies like See’s Candies, Gray and Carlisle propose five metrics that measure a company’s ability to generate excess returns on capital as well as the growth and stability of profit margins. The metrics used focus on long-term averages for a set of simple measures. They argue that “eight years are likely to capture a boom-and-bust cycle for the typical stock and there are sufficient stocks with eight years of data.” (p. 102).

**Long-Term Free Cash Flow (FCF):** This first metric, long-term free cash flow, seeks to measure how much cash a company has generated in excess of capital expenditures during an eight-year business cycle. At the end of 2011 the long-term free cash flow metric identifies some common company names one would expect to possess a franchise, including Coca-Cola, Google, Apple and Microsoft (Gray & Carlisle, 2013). One of those, Apple, has been especially known to have generated a lot of cash in the last few years. The measure is calculated as follows:
\begin{equation}
\text{CFOA}_i = \frac{\sum_{t=1}^{8} \text{FCF}_{i,t}}{\text{Total Asset}}
\end{equation}

Where: \( \text{FCF} = \text{Net income} + \text{depreciation and amortization} - \text{changes in working capital} - \text{capital expenditures} \)

\( t = \text{Years} \)

\( i = \text{An individual firm} \)

**Long-Term Geometric Return on Assets (8yr\_ROA):** Return on assets (ROA) measures how successful a company is in generating profits from its assets and is often used to assess the operational efficiency of the management (Damodaran, 2002). Return on assets is calculated as follows: \( \text{ROA} = \frac{\text{Net Income before Extraordinary Items}}{\text{Total Assets}} \) and the long-term geometric ROA is described as follows:

\begin{equation}
8\text{yr\_ROA}_i = \left[ \prod_{t=1}^{8} \left(1 + \text{ROA}_{i,t}\right) \right]^{1/8} - 1
\end{equation}

Where: \( \text{ROA} = \text{Return on assets} \)

\( t = \text{Years} \)

\( i = \text{An individual firm} \)

**Long-Term Geometric Return on Capital (ROC):** ROC uses earnings before interest and taxes (EBIT) in the numerator unlike the ROA and therefore not only represents the earnings to equity but all forms of capital. ROC is calculated as follows: \( \text{ROC} = \frac{\text{EBIT} \ (1-\text{Tax Rate})}{(\text{Book Value of Debt} + \text{Book Value of Equity} - \text{Cash})} \). When a company has a substantial portion of their total liabilities in current or non-interest bearing liabilities the ROC measure provides a better assessment of the true return earned on capital. To arrive at a high ROC a company either has to increase its profit margin and/or utilize its capital more efficiently, exactly what a franchise should be able to do (Damodaran, 2002). The long-term geometric ROC is described as follows:

\begin{equation}
8\text{yr\_ROC}_i = \left[ \prod_{t=1}^{8} \left(1 + \text{ROC}_{i,t}\right) \right]^{1/8} - 1
\end{equation}

Where: \( \text{ROA} = \text{Return on capital} \)

\( t = \text{Years} \)

\( i = \text{An individual firm} \)

43
**Profit Margin Growth (MG):** Perhaps the most obvious indicator of a franchise power is high profit margins as profit margins are a function of price and cost. If a company has a high profit margin it is more likely to possess pricing power or it is showing that it can control its costs more efficiently. To measure profit margin strength Gray and Carlisle propose two measures and the first one is profit margin growth, calculated as follows:

\[
MG_i = \left[ \prod_{t=1}^{8} \left( 1 + \frac{GM_{i,t+1}}{GM_{i,t}} \right) \right]^{1/8} - 1
\]

Where: \( GM = \) Gross margin  
\( t = \) Years  
\( i = \) An individual firm

The MG simply measures the compounded annual growth rate in profit margins for the last eight years. By using a geometric mean the metric penalizes stocks with inconsistent profit margin growth.

**Profit Margin Stability (MS):** Not only is it important to measure the growth in profit margins but also the stability. A mature franchise is more likely to maintain its profit margin over a business cycle, even during a downturn. To measure profit margin stability the MS measure is used and is calculated as follows:

\[
MS_i = \frac{\frac{1}{t} \sum_{t=1}^{8} \left[ GM_{i,t} \right]}{\sqrt{\frac{1}{t-1} \sum_{t=1}^{8} \left[ GM_{i,t} - \overline{GM}_{i} \right]^2}} = \frac{\text{Average}(GM)}{\text{STD}(GM)}
\]

Where: \( GM = \) Gross margin  
\( t = \) Years  
\( i = \) An individual firm

Average = Sample average  
STD = Sample standard deviation

This measure rewards a company that, although hasn’t shown much growth in profits margins, has shown stable profit margins. An example is Procter & Gamble (P&G), who from 2004 to 2011 had a very high profit margin of around 50% but because they have not been growing, would not perform well on the MG metric. It is fairly
obvious that P&G does possess a franchise and the MS measure captures their ability to maintain stable and high profit margins (Gray & Carlisle, 2013).

**Max Margin:** Since the two measures of profit margin strength assess two different aspects of profit margin performance, growth and stability, there is an obvious conflict between the two. If a stock performs well on the MG measure it will by definition perform poorly on the MS measure. To compare stocks where one has a very high profit margin growth while the other has very stable profit margin, Gray and Carlisle created a new variable which combines both measures of profit margin strength. The new variable is called maximum margin (MM) and is calculated as follows:

$$MM = \text{Max}[\text{Percentile (MG)}, \text{Percentile (MS)}]$$

The maximum margin measure rewards a stock on its best performing metric; if a stock scores 70 in the margin growth but 52 on margin stability it is awarded with a score of 70.

Being able to identify a franchise is very important as the See’s Candies example demonstrates. A franchise is valuable since it is more likely to be able to pay out capital to owners without limiting its growth or it can reinvest the capital in the business year after year to increase growth and profitability. The other step to identify a quality business is finding a company that exhibits strong financial strength, is able to withstand shocks of the business cycle and attacks by competitors.

**Financial Strength**

Fama and French’s (1992) study that value stocks have, on average, beaten the market and performed better than growth stocks inspired Piotroski’s (2001) study. In the study he set out to find a way for investors to sort out financially healthy stocks that are cheap from cheap stocks that are in financial distress. Using a comprehensive financial statement analysis, business performance and assessment of financial health Piotroski settled on nine financial measures that he found to be the best indicator of financial strength and called his measure the F_SCORE. One of his most important and interesting findings is that a majority (approximately 57%) of value stocks underperform the market over one- and two-year stretches, despite the overall strong performance of
value stocks. He reckoned that by eliminating the stocks that underperformed the market from a portfolio an investor could greatly improve the performance of the portfolio. Piotroski identified stocks that were financially strong according to his F_SCORE and eliminated those that were not and found that he could improve the return of the value portfolio by at least 7.5% a year, a quite an extraordinary achievement.

Piotroski’s nine measures can be divided into three separate sections; profitability, financial leverage/liquidity and operating efficiency. He then classified each stock’s value as either good or bad, giving it a binary value of one (good) and zero (bad). The aggregate of each measure is then summed up to the final F_SCORE where a high score represents a company with many good signals and a low score a company with few good signals. Gray and Carlisle use a very similar measure to Piotroski but with a few details changed; they have 10 metrics in their FS_SCORE formula and the sections are classified into current profitability, stability and recent operational improvements.

**Current Profitability:** Gray and Carlisle use three metrics to measure a stock’s current profitability. The first is ROA which divides net income before extraordinary items by most recent total assets. If ROA is positive they define the variable FS_ROA as one and zero otherwise. The second is similar to the ROA but it divides free cash flow by most recent total assets and is called FCFTA. If FCFTA is positive they define the variable FS_FCFTA one, and zero otherwise. The third metric is ACCRUAL and it is defined as a stock’s current year’s net income before extraordinary items less cash flow from operations, divided by beginning of the year total assets. The variable FS_ACCRUAL is marked one if ACCRUAL is positive, and zero otherwise. All three measures are fairly intuitive, measuring if a company has been profitable for the most recent fiscal year.

**Stability:** There are three metrics in Gray and Carlisle’s stability section and they measure changes in capital structure as well as the stock’s ability to meet future debt obligations. ∆LEVER is the change in the ratio of total long-term debt to total assets, FS_∆LEVER is one if the stock’s leverage ratio fell in the preceding year, and zero otherwise. The second is ∆LIQUID, measured as the year-over-year change in the ratio of current assets to current liabilities. The variable FS_∆LIQUID is one if stock’s liquidity improved, and zero otherwise. The third and last metric is NEQISS which is equity
repurchases minus equity issuance. FS_NEQISS is one if repurchases exceed equity issuance, and zero otherwise. These metrics assume that a decrease in leverage, an improvement in liquidity or the use of internal financing is good for financial strength.

**Recent operational improvements:** To verify if a business has momentum in its operations Gray and Carlisle propose four measures. $\Delta$ROA is the current year’s ROA less prior year’s ROA. If it is greater than zero, the variable FS_$\Delta$ROA is marked one, and zero otherwise. $\Delta$FCFTA is the current year’s FCFTA less the prior year’s FCFTA. If it is greater than zero, the variable FS_$\Delta$FCFTA is marked one, and zero otherwise. $\Delta$MARGIN is measured as the stock’s current gross margin ratio less the prior year’s gross margin ratio. If it is positive, the variable FS_$\Delta$MARGIN receives a marking of one, and zero otherwise. $\Delta$TURN is the stock’s current year asset turnover ratio, measured as total sales divided by total assets, less the prior year’s asset turnover ratio. If $\Delta$TURN is positive, the variable FS_$\Delta$TURN is marked one, and zero otherwise. These metrics are used to avoid stocks that are seemingly cheap but the stock’s business is deteriorating and therefore likely to get more expensive relative to its fundamentals.

The FS_SCORE formula has a final score from 0 to 1, where 1 is the best score possible and 0 the worst. It is calculated as follows:

$$\text{FS\_Score} = \text{Sum}(\text{FS\_ROA}, \text{FS\_FCFTA}, \text{FS\_ACCRUAL}, \text{FS\_LEVER}, \text{FS\_LIQUID}, \text{FS\_NEQISS}, \text{FS\_AROA}, \text{FS\_AFCFTA}, \text{FS\_AMARGIN}, \text{FS\_ATURN})/10$$

Gray and Carlisle (2013) measure the performance of their FS_SCORE compared to Piotroski’s F_SCORE over the period January 1, 1974, to December 31, 2011. The small tweaks made by Gray and Carlisle results in a CAGR of 11.89% (FS_SCORE) vs 11.29% (F_SCORE) and managing to do so with less standard deviation results in a Sharpe ratio of 0.46 vs 0.42; small but meaningful amounts.

This chapter described how to quantitatively identify high-quality stocks based on a stock’s ability to possess a franchise and financial strength. Combining these two measures gives a comprehensive look at a stock’s quality. It is therefore intuitive that a stock’s quality be calculated as the average of these two measures and the stocks then ranked on quality.
4.2.4 The Quantitative Value Checklist

Gray and Carlisle make a case for utilizing an investment checklist since the model involves a comprehensive fundamental analysis based on many critical steps. If investors try to implement the model from memory it is easy to forget a step and therefore a short checklist of the steps needed to complete the Quantitative Value model is presented in table 3. A more detailed and comprehensive checklist can be found in appendix 1.

Table 3 The Quantitative Value checklist

<table>
<thead>
<tr>
<th>Step 1. Avoid stocks that can cause a permanent loss of capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Financial statement manipulation (STA and SNOA)</td>
</tr>
<tr>
<td>2. Fraud (PMAN)</td>
</tr>
<tr>
<td>3. Financial distress and bankruptcy (PFD)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 2. Find stocks with the cheapest prices using the EBIT/TEV price ratio</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Step 3. Find stocks with the highest quality</th>
</tr>
</thead>
</table>

Check for franchise power

1. Long-term returns on assets
2. Long-term returns on capital
3. Long-term free cash flow on assets
4. Long-term gross margin growth
5. Long-term gross margin stability

Check for financial strength

1. Current profitability
2. Stability
3. Recent operational improvements

4.3 Data and Historical Performance of Quantitative Value

Conducting an investment simulation requires a vast amount of data and it is therefore imperative to use a database with data integrity to avoid faulty data and errors. For
fundamentals data Gray and Carlisle use Standard and Poor’s Compustat database which has annual data on companies’ financial statements from December 31, 1962. For returns data they use the Centre for Research in Security Prices (CRSP) database which includes data on delisted and bankrupt companies. To incorporate the delisted security data into their return they use an algorithm which merges the CRSP delisting information into a final returns database. This is highly important as the results change dramatically when delisted stocks are not included, a common error called survivorship bias. The stock prices used are adjusted for dividends, splits and corporate actions.

Stocks with small capitalization are more likely to be traded less frequently, have wide bid and ask spreads and therefore difficult to trade. Many investment strategies rely on methods that are very difficult in application since the stocks picked are small and illiquid. To combat this problem Gray and Carlisle only include common stocks that have a market capitalization larger than the 40th percentile of all stocks on the NYSE at any given point in time. Another error when conducting an investment simulation is to include data not available during the period analyzed, called look-ahead bias. As an example, annual financial statements are usually not reported until February or March the following year. If a strategy is tested that is rebalanced once a year on January 1 it fails to incorporate the fact that the information from the financial statements is not available to the public on January 1. Gray and Carlisle avoid this error by lagging the financial statement data by six months, making sure that all financial statement reports would be available to the public when rebalancing. In the simulation they therefore use annual data as of December 31 but assume the investor would not have the data available until June 30 of the following year, a standard practice in academic literature to avoid look-ahead bias. Other parameters used in their simulation include:

- **Exchanges used:** NYSE/AMEX/Nasdaq. Real estate investment trusts (REITs). Business development companies (BDCs). Tracking Stocks. Limited Partnerships (LPs). Master limited partnerships (MLPs).

- **Excluded Security Types:** Mortgage REITs. Royalty Trusts. Exchange-traded funds or notes (ETFs, ETNs). Closed-end funds. American depository receipts (ADRss) or American depository shares (ADSs). Special-purpose acquisition companies (SPACs).
• **Excluded industries:** Financials and Utilities. The Quantitative Value model is not applicable for the companies in these industries since their business and financial statements are very unique and harder to analyze as they are subject to regulatory supervision.

**Historical Performance**

Gray and Carlisle divide their investable universe into ten portfolios, or deciles, with decile 1 representing the stocks that most closely meet the criteria outlined in the Quantitative Value model. They compare the returns of decile 1 to the Standard and Poor’s 500 Total Return Index (S&P500 TR) which is a market capitalization-weighted index, meaning that each stock is weighted by the market capitalization within the portfolio to make the comparison more reliable. The index includes the effects of dividend reinvestment. Joell Greenblatt’s strategy, the Magic Formula (MF), outlined in chapter 4.1 is also used as a benchmark since Gray and Carlisle wanted to know if they could improve the Magic Formula. Another benchmark is a market capitalization-weighted index (MW Index) constructed from the entire universe of stocks included in the analysis, representing a passive investment in the universe of all stocks analyzed. All returns reported are without fees and transaction costs. Gray and Carlisle argue that it is very hard to incorporate transaction costs into an investment simulation but by limiting their analysis to a yearly rebalance and trading only in large capitalization stocks they minimize the bias caused by these costs.

There are four new performance measures introduced by Gray and Carlisle for the analysis of the Quantitative Value strategy. Rolling 5- and 10-year wins are the proportion of rolling 5 and 10 periods that the strategy beats identified benchmarks. Cumulative drawdown is the sum of the rolling 5-year period worst drawdowns for the designated strategy and the correlation demonstrates the extent to which a strategy and the benchmarks move together. Table 4 sets out the performance of the Quantitative Value from 1974 to 2011 compared to the Magic Formula, S&P 500 TR and the MW Index.
Table 4 shows that the Quantitative Value strategy has outperformed all three benchmarks with a CAGR of 17.68%. The strategy also had a lower standard deviation resulting in a significantly higher Sharpe ratio. Compared to the benchmarks the QV strategy had lower downside volatility which gives it a relatively high Sortino ratio of 1.18. The QV strategy has the lowest worst drawdown, cumulative drawdown and worst month return; highlighting its ability to minimize a loss of capital. Rolling 5- and 10-year wins are all over 90% which shows that the QV strategy consistently performs better than the benchmarks over relatively long periods.

Another analysis put forward by Gray and Carlisle is to gauge the performance of the QV strategy relative to legendary value investing funds. The funds chosen are the Sequoia Fund, Legg Mason Value Trust and Third Avenue Value Fund. The Sequoia Fund was established by William Ruane after Warren Buffett had asked him to set up a fund to handle all of Buffett’s former partners. Buffett chose him because he employed Graham’s value investing strategy and Ruane was the only person Buffett recommended. The Legg Mason Value Trust was managed by Bill Miller, who is widely known as the best money manager of the 90s, from its inception in 1991 to 2011. The fund is well known for managing to consecutively beat the market from 1991 to 2005. The Third Avenue Fund was founded in 1986 by Martin J. Whitman who is best known
as a pioneer of distressed investing as well as being a productive writer on value investing (Gray & Carlisle, 2013). Table 5 presents the performance of the QV strategy compared to these giants of the mutual fund industry from 1991 to 2011.

Table 5 Quantitative Value versus legendary value investing funds (Gray & Carlisle, 2013)

<table>
<thead>
<tr>
<th></th>
<th>Quantitative Value</th>
<th>Sequoia</th>
<th>Legg Mason</th>
<th>Third Avenue</th>
<th>S&amp;P500 TR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAGR</td>
<td>13.32%</td>
<td>12.16%</td>
<td>9.14%</td>
<td>10.72%</td>
<td>9.02%</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>16.20%</td>
<td>14.62%</td>
<td>19.62%</td>
<td>16.49%</td>
<td>15.05%</td>
</tr>
<tr>
<td>Downside Deviation</td>
<td>10.52%</td>
<td>10.02%</td>
<td>14.28%</td>
<td>13.49%</td>
<td>10.89%</td>
</tr>
<tr>
<td>Sharpe Ratio</td>
<td>0.81</td>
<td>0.64</td>
<td>0.38</td>
<td>0.50</td>
<td>0.43</td>
</tr>
<tr>
<td>Sharpe Ratio (5%)</td>
<td>1.08</td>
<td>0.76</td>
<td>0.40</td>
<td>0.49</td>
<td>0.44</td>
</tr>
<tr>
<td>Worst Drawdown</td>
<td>-29.85%</td>
<td>-40.72%</td>
<td>-68.91%</td>
<td>-58.23%</td>
<td>-50.21%</td>
</tr>
<tr>
<td>Worst Month Return</td>
<td>-15.69%</td>
<td>-14.69%</td>
<td>-21.35%</td>
<td>-18.95%</td>
<td>-16.70%</td>
</tr>
<tr>
<td>Best Month Return</td>
<td>16.34%</td>
<td>16.36%</td>
<td>14.61%</td>
<td>18.85%</td>
<td>11.41%</td>
</tr>
<tr>
<td>Profitable Months</td>
<td>63.49%</td>
<td>60.71%</td>
<td>61.11%</td>
<td>62.30%</td>
<td>63.49%</td>
</tr>
<tr>
<td>Rolling 5-year wins</td>
<td>--</td>
<td>65.28%</td>
<td>64.77%</td>
<td>76.17%</td>
<td>92.75%</td>
</tr>
<tr>
<td>Rolling 10-year wins</td>
<td>--</td>
<td>86.64%</td>
<td>58.65%</td>
<td>92.48%</td>
<td>100%</td>
</tr>
<tr>
<td>Cumulative Drawdown</td>
<td>-4.075%</td>
<td>-4.359%</td>
<td>-6.610%</td>
<td>-5.116%</td>
<td>-5.610%</td>
</tr>
<tr>
<td>Correlation</td>
<td>--</td>
<td>0.56</td>
<td>0.64</td>
<td>0.63</td>
<td>0.69</td>
</tr>
</tbody>
</table>

The results are again highly favorable for the QV strategy as it has the highest CAGR and the highest Sharpe ratio. The Sequoia Fund is the only one with a slightly lower downside deviation but because of the higher returns generated by QV it has a significantly lower Sortino ratio. The QV strategy also demonstrates its ability at protecting capital as it has the lowest worst drawdown, lowest cumulative drawdown and is only marginally outperformed by the Sequoia Fund on the worst month return metric. The rolling 5-year period shows that it has tended to outperform the funds, beating them on two out of every three rolling 5-year periods. For the rolling 10-year period the strategy has outperformed the funds on between six and nine out of every ten rolling 10-year periods. Looking at the overall performance the results are fairly conclusive, the Quantitative Value strategy performed well when compared with these excellent institutional investors.
5 Criticism of Quantitative Value

There is no such thing as the perfect investment strategy as every strategy is subject to criticism and the Quantitative Value strategy is no different. Building on the investment philosophy of arguably the most successful investor of all time, Warren Buffett, the strategy seeks to pick a stock that represents a wonderful company at a fair price. The strategy’s results are very impressive and Gray and Carlisle seem to have found a model that successfully picks stocks based on Buffett’s price and quality measures. However, there are a few points that the author feels are not clear or limit the performance of the Quantitative Value model.

Gray and Carlisle argue that stocks with small capitalization are more difficult to trade and therefore insert a filter of a minimum market capitalization equal to the 40th percentile of all stocks on the New York Stock Exchange. Although they offer convincing arguments for using this filter it seems they fairly arbitrarily choose the 40th percentile, which poses the question if a different method could be used to filter out stocks that are deemed illiquid. Fama and French (1992) showed in their study that small cap stocks have demonstrated higher expected returns and another study by Barad (2003) showed that stocks classified as small cap value have outperformed all other asset classes. It is therefore intriguing to ponder whether the performance of the Quantitative Value strategy could be further enhanced if the breakpoint would be lowered or other methods used to distinguish small cap stocks.

Another problem with the strategy is that unlike, for example, Graham’s simple quantitative strategy outlined in chapter 2.2.2 the Quantitative Value model requires access to a comprehensive database to implement the strategy. Graham’s strategy only requires a simple screening tool, available for free online on multiple websites. To be able to build the QV model an investor would need an access to a database similar to the Compustat database, something which is very expensive for a single investor. The strategy is therefore more suited for financial institutions or wealthy investors.

The third and last point is that despite the fact that the model is based on value investing there is no intuitive and robust metric that measures the value a stock
represents. The price and quality metrics are all sound and academically proven metrics but one metric that the author found missing was return on invested capital (ROIC). ROIC is very similar to the return on capital ratio used by Gray and Carlisle in chapter 4.2.3 but when used in conjunction with a company’s cost of capital is much more intuitive and useful. In the next chapter the author presents support for the use of this metric and where it belongs in the Quantitative Value model.
6 Improving Quantitative Value with Return on Invested Capital (ROIC)

The fundamental principle of corporate finance is that a company creates value by investing its capital to generate cash flows in the future at rates of return that surpasses its cost of capital. The amount of value created is the difference between the inflow of cash and the cost of the investment made, adjusted by the time value of money and the riskiness of future cash flows. This means that a company’s value creation ultimately comes down to its ability to sustain a ROIC that exceeds its cost of capital and a sustained revenue growth. The relationship of growth, ROIC and cash flow can be explained with a simple formula, $g = IR \times ROIC$, where $g$ is growth and $IR$ is investment rate or how much the company spends in capital expenditures. A simple example shows how important it is to have a high ROIC:

- Company A has an IR of 50%, ROIC of 10% and growth in profits of 5%.
- Company B has an IR of 25%, ROIC of 20% and growth in profits of 5%.

Because company B has a higher ROIC it generates more cash flow with the same earnings despite investing only 25% of its profits compared to the 50% investment rate for company A and also achieves the same growth in profits (Koller & McKinsey and Company, 2010).

The relationship between growth and ROIC is important for a company and its managers. Far too often managers focus on achieving high revenue growth and not enough on ROIC. Doing so can be very dangerous because if the company’s ROIC is lower than its cost of capital it is destroying value. The spread between a company’s ROIC and its cost of capital is important because if it is not positive the company should focus on achieving a higher ROIC or a lower cost of capital to create value. If the spread is positive the company should focus on sustaining the high ROIC and also on revenue growth. That does, however, not mean that all companies should not strive for growth because their ROIC is low. One exception are young, start-up companies who are unlikely to be able to achieve a high ROIC. The Quantitative Value model looks for mature, high-quality companies with a high market capitalization and a low ROIC could
indicate a flawed business model or unattractive industry structure. The spread between ROIC and cost of capital is therefore a suitable metric for the Quantitative Value model as it serves as a proxy for a company’s ability to create value. With the inclusion of the ROIC measure the model identifies three different features; VALUE, PRICE and QUALITY and ranks them accordingly.

6.1 Calculating ROIC

Return on invested capital is similar to the return on capital measure introduced in chapter 4.2.3 but is different in a few important ways. ROIC is defined as follows:

\[
\text{ROIC} = \frac{\text{NOPLAT}}{\text{Invested Capital}}
\]

Both measures use the same numerator, \( EBIT (1 - \text{Tax Rate}) \), also known as \( \text{NOPLAT} \) (net operating profit less adjusted taxes) where the tax rate is a company’s marginal tax rate. The denominator is very similar to the one used in the ROC measure but its definition is more detailed and its calculation requires a thorough analysis of a company’s financial statements. Invested capital sums operating working capital, fixed assets and net other long-term operating assets. Operating working capital equals operating current assets minus operating current liabilities. Operating current assets includes working cash balances, trade accounts receivables, inventory and prepaid expenses but excluded specifically are excess cash and marketable securities. Excess cash represents temporary imbalances in the company’s cash position and is cash greater than the operating needs of the business. Operating liabilities include accounts payable, accrued salaries, deferred revenue and income taxes payable. Interest-bearing liabilities are specifically excluded from operating liabilities and should not be netted from operating assets. The book value of net property, plant and equipment (net PPE) represents fixed assets and is always included in operating assets. Typical other long-term operating assets include deferred tax assets, prepaid pension assets, intangible assets related to pensions, nonconsolidated subsidiaries and other equity investments. These items are often found in the footnotes of a company’s financial statements (Koller & McKinsey and Company, 2010).
6.2 Calculating Weighted Average Cost of Capital

Weighted average cost of capital (WACC) represent the opportunity cost that an investor faces for investing his funds and is the most common measure used to estimate the cost of capital. WACC equals the weighted average of the after-tax cost of debt and cost of equity:

$$WACC = D \times K_d \times (1 - T) + E \times K_e$$

Where:
- $D$ = Target level of debt to enterprise value using market-based values
- $K_d$ = Cost of debt
- $T$ = Company's marginal income tax rate
- $E$ = Target level of equity to enterprise value using market-based values
- $K_e$ = Cost of equity

The cost of equity and cost of debt are the two numbers that require further explanations. Calculating the cost of equity requires a risk-free rate of return, a risk premium and a risk adjustment. The capital assets pricing model (CAPM) is based on these three factors and is the most widely used method to determine a company’s cost of equity. To estimate the risk-free rate a long-term government rate denominated in the same currency as the company’s cash flow is used. The risk adjustment factor is the company’s beta, described in chapter 3.2, and is estimated by levering the company’s industry beta to the company’s target debt-to-equity ratio. Various levels of market risk premium are used but academics and professionals point to a risk premium of between 4.5% and 5.5% for the US stock market and a specific country premium for company’s based in other countries (Fernandez, Linares, Acín, & Isabel, 2014). There are multiple different methods available to determine a company’s cost of debt. For companies with publicly traded debt the bond’s price and promised cash flows is observable and can be used to calculate its yield to maturity (YTM). For investment-grade companies, YTM on its long-term debt can be used and for companies whose debt is not traded or traded infrequently the company’s debt rating is used (Koller & McKinsey and Company, 2010).

6.3 Empirical Evidence for the use of ROIC

Koller et al. (2010) give a comprehensive empirical analysis of the relationship between ROIC and a stock’s performance in their book Valuation: Measuring and Managing the Value of Companies. Koller et al. show that the relative market value of a company is
determined by its spread of ROIC over its WACC as well as the company’s growth. Furthermore, a bigger positive spread between ROIC and WACC leads a company to gain more in relative market value from growth. However, when the spread is negative higher growth leads to lower valuations, indicating a correlation between a company’s stock price and its ROIC-WACC spread. The authors also find a correlation between a stock’s returns and its ROIC as returns are higher for companies with higher rates of ROIC. Their overall results is that companies with higher ROIC and growth do tend to deliver stronger returns to shareholders over the long term. They argue that the influence of expectations on shareholder’s returns is likely to dominate ROIC and growth over the short term. Because value investors focus on a company’s long term prospects this further supports the inclusion of ROIC in the Quantitative Value model.

Although the spread between a companies’ ROIC and WACC is a good indicator if a company is generating value it is difficult to compare the spread between industries because ROIC differs by industry. Empirical analysis on ROIC by Koller et al. (2010) suggests that industries such as pharmaceuticals and personal products tend to have a high median ROICs (15% to 20%), whereas companies in industries such as airlines and utilities tend to earn low ROICs (5% to 10%). Because of this, the spread between a company’s ROIC and its industry’s median ROIC is calculated in the Quantitative Value model to analyze a company’s performance relative to similar companies. In chapter 8.2 a more detailed analysis of which companies are in a high or a low ROIC industry and how the ROIC measure is included in the model is outlined. The next chapter introduces the Icelandic stock market and its short history as well as historical performance.
The Icelandic stock market is young as it was founded in the late 1980s after a series of unsuccessful attempts of establishing a successful stock exchange. The first Icelandic public company was founded in 1914, called Eimskipafélagið, were the founders consisted of 14,000 partners, representing 15% of the total Icelandic population. There wasn’t a lot of trading with the shares mainly because the shareholders had to seek approval from the board. The company was also except from paying taxes due to poor earnings and that, accompanied with the fact that the company wasn’t allowed to pay dividends higher than 4%, made the investment almost profitless. The shareholders were also focused on the welfare of their customers instead of focusing on profiting from their investment. Similar story can be told about other public companies established during the early 1900s. The first Icelandic company listed on an exchange was Íslandsbanki, founded in 1904 and listed on the Danish stock exchange. Roughly 90 years would pass until the next Icelandic company was listed on an exchange. During this time there were attempts to establish an Icelandic stock exchange without success. A financial company was established in 1934 which acted as a broker, mainly with bonds and the shares of Eimskipafélagið. From 1942 to 1944 one of the nation’s banks, Landsbankinn, ran an exchange similar to the Danish exchange. The supply of securities was limited and there were no stocks, only bonds (Magnússon, 2007).

The next four decades showed little progress, caused by the economic as well as business environment in Iceland. The tax system was not practical for companies to fund themselves with equity as interest rates were low and credit was rationed. The public company form was used because of its limited liability for the most part rather than to raise capital from many people. Cooperative companies and state enterprises were dominant and in the private sector family businesses were widespread. At last there was still requirement from the board of the biggest public companies that shareholders sought approval before they sold their shares (Magnússon, 2007).
It wasn’t until the 1980s with the privatization of companies that the first steps were taken to establish an exchange. Other changes that helped spark the foundation of a stock market include; the creation of Íslandsbanki in 1990, domestic savings dropped significantly, the establishment of the housing bond system in 1989, the growth of the pension industry and the free flow of capital between countries with the European Economic Area agreement. In 1985 the Icelandic stock exchange, Kauphöll Íslands, was established under the name Verðbréfaþing Íslands and a year later the first stock fund was established. Finally, the stock market began to grow and became a well-functioning market in the late 1990s with brokerages publishing buy and sell orders in newspapers (Magnússon, 2007).

The second Icelandic public company, Olís, was listed in 1990 and by the turn of the century there were 75 companies listed on the Kauphöll. Although the number of listed companies before the crises had diminished since the millennium, the market capital was almost tenfold. Behind this high market capitalization were the Icelandic banks Kaupthing, Glitnir and Landsbankinn which had all grown enormously and their subsequent downfall during the crises is well documented. The crisis did have a profound effect on the Icelandic stock market and by 2010 there were only 3 companies listed on Kauphöll with a market capitalization of roughly 5% of what it was in 2007 (Pétursson, 2013). Since then the market has shown signs of recovery as the number of listed companies has grown and, unlike the growth of the banks and other listed companies before the crash, they mostly generate their revenue domestically rather than abroad. Capital controls introduced by the Icelandic government in 2008 has prevented foreign investment in Icelandic stocks but there is hope that these capital controls will be relaxed in the coming years. This should pave the way for inflow of foreign capital and demand from foreign investors.

7.2 Historical Performance

Before the financial crisis the performance of the Icelandic stock market was remarkable as its annual real rate of return was 18.2% from 1986 to 2007. During this period there are only two significant downturns, from 1992 to 1993 and from 2000 to 2001, with the lowest annual return of -19.3% in 2000. The three banks mention before; Glitnir, Kaupthing and Landsbankinn, all participated in a substantial expansion resulting
in a significant growth in their balance sheets and market capital. From 2003 to 2005 the real rate of return of the Icelandic stock market was more than 50% each year, mainly due to growth of companies whose operations expanded excessively, such as Actavis, Bakkavör and others. The three banks then contributed to a further rise in the stock market in 2006 and 2007. However, the extraordinary returns could not last forever as the financial crisis hit in 2008. The stock market closed down in October 2008 because of the uncertainty regarding the survival of the Icelandic banks. When it reopened mid-October 94% of the market capital had vanished in 15 months. Despite this significant fall the return on the Icelandic stock market from 1986 to 2008, with dividends, still stands at a formidable 6.4% annually (Magnússon, 2010). More recent performance of the Icelandic stock market is detailed in chapter 9.2.

In chapter 2.3 it was outlined that research has shown that value stocks outperform growth stocks in the long run and the same results can be found for the Icelandic stock market. A study by Gunnlaugsson and Jónsson (2004) found that stocks with low P/E ratios showed statistically significant higher returns than stocks with high P/E ratios. The logic behind using the P/E ratio to distinguish between value and growth stocks is based on the perception that stocks with high P/E ratios tend to be growth stocks as the high ratio implies high expectations of future earnings. Using monthly data, Jónsson and Gunnlaugsson found that stocks with low P/E ratios managed an average return of 2.25% vs 1.11% for stocks with high P/E ratios from January 1993 to June 2003. This implies that, even for a relatively small and young stock market, value stocks remain the best bet.

7.3 Listed Stocks in 2014
As of July 2014 there are eight non-financial stocks on the Kauphöll that qualify for the Quantitative Value model. The investable universe is therefore very small, especially compared to the US stock market. In what follows is a brief description of the companies listed and their operations.

**Marel (Ticker: MARL)**
Marel is the leading global provider of advanced equipment, systems and services to the fish, meat and poultry industries with over 4,000 employees worldwide as well as offices and subsidiaries in 30 countries. The company was listed on the Icelandic Stock Exchange in 1992, making it the longest serving company on the Kauphöll of the listed companies today (Marel, n.d.).
**Össur (Ticker: OSSRu)**

Össur is a global leader in the development, production and sale of non-invasive orthopedics with over 2,200 employees in 14 different countries. It was listed on the Icelandic Stock Exchange in 1999 and shortly after the financial crisis and the subsequent fall of the Icelandic stock market Össur was also listed on the NASDAQ OMX Copenhagen Stock Exchange (Össur, n.d.).

**Icelandair Group (Ticker: ICEAIR)**

With its focus on international airline and tourism, Icelandair Group is a cornerstone of international route network for Iceland with roughly 3,100 employees. The company was listed on the Icelandic Stock Exchange in December 2006 and has recently gone through financial restructuring, completed in 2011 (Icelandair Group, n.d.).

**Hagar (Ticker: HAGA)**

A leading retailer in the Icelandic market, Hagar operates 56 stores within six retail chains and four warehouses. Hagar was listed on the Icelandic Stock Exchange in December 2011 and was therefore the first company to be listed after the financial crisis in 2008 (Hagar, n.d.).

**Eimskip (Ticker: EIM)**

Founded in 1914, Eimskip is the oldest company of the ones listed on the Icelandic Stock Exchange. Eimskip offers shipping transport to and from Iceland as well as total transport solutions around the world with offices in 19 countries worldwide. Initially Eimskip was listed in 1992 but delisted in 2009 due to financial restructuring. It was listed again in November 2012 following a successful restructuring (Eimskip, n.d.).

**Fjarskipti (Ticker: VOICE)**

Fjarskipti, more commonly known as Vodafone, is a telecommunications company with around 390 employees and base their services and products on their cooperation with Vodafone Group Plc. The company was listed in December 2012 (Vodafone, n.d.).
**N1 (Ticker: N1)**

N1 is a leading retail and service company, specializing in providing companies and people fuel, supplies and refreshments with over 500 employees and 101 fuel pump locations nationwide. The company was listed in December 2013 (N1, n.d.).

**HB Grandi (Ticker: GRND)**

HB Grandi is a leading fishing and fish processing company in Iceland with around 900 employees and their most important markets are Europe, North-America and Asia. The company was listed in April 2014 (HB Grandi, n.d.).
8 Data and Constructing the Model

The main objective of this thesis is to find out if Gray and Carlisle’s Quantitative Value strategy demonstrates the same successful returns for the Icelandic stock market as it did for the US stock market. To do that the author created the Quantitative Value model and to be sure it was correct and robust tried to replicate the returns for the US stock market that Gray and Carlisle demonstrated in their book. Therefore there are two models and two sets of data, one for the US stock market and another for the Icelandic stock market. Both models use fundamentals data from the Compustat database which has quarterly and annual data on companies’ fundamentals from December 31, 1962 which can be easily converted into Microsoft Excel. Because ROIC requires a careful and detailed examination to be calculated it has to be done manually as more often than not it requires examining a company’s footnotes. Doing so for over 700 companies was out of scope for this thesis and was therefore only done for the Icelandic model.

8.1 US Stock Market

The first step when creating the US model was to find stock symbols or tickers for the companies listed on the New York Stock Exchange (NYSE), National Association of Securities Dealers Automated Quotations (NASDAQ) and American Stock Exchange (AMEX). Tickers for these exchanges were found on the internet and were compiled in November 2013 (Khan, 2013). At first the author set out to back-test the model from 1974 to 2013 but ran into trouble when gathering historical information about listed stocks on these exchanges. To avoid survivorship bias it was decided to back-test the model from 2005 and 2013 with more recent information that was available for listed stocks (NYSE Listings, n.d.). Although the period is fairly short compared to Gray and Carlisle’s roughly 40 years of analysis it can be justified that it represents a full market cycle and one of the worst stock market downturns in recent history.

The next step in the model was to filter out stocks that don’t meet the criteria for the investable universe. These are financial stocks, utility stocks and then all stocks that have a lower market capitalization than the 40th percentile of all stocks on the NYSE at
any given point in time. For example, the 40th percentile of market capitalizations on the NYSE on December 31, 2011, is $1,749m and therefore all stocks with a lower market capitalization than $1,749m are excluded. In the 2014 US model the investable universe consists of 809 companies. Another filtering was used when identifying companies that are likely manipulators or likely to cause loss of capital. By excluding these companies the investable universe shrinks to 728 companies. The filtering was done using a fairly simple Visual Basic Application (VBA) code in Microsoft Excel to make the model as dynamic as possible.

The Quantitative Value model is very comprehensive and Gray and Carlisle’s checklist in appendix 1 is highly useful when constructing the model. There are however a few points that the author feels are worthy to mention that also apply to the Icelandic model:

- Holidays are accounted for when calculating returns and volatility for the probability of financial distress measure. All prices are adjusted for dividends and stock splits.
- Some companies do not have their fiscal year from January 1 to December 31 and therefore fundamentals data for the last twelve months (LTM) was used for all companies.
- All stocks are ranked on their quality and price measures based on a simple equally weighted average. So a stock that ranks 50th on the EBIT/TEV measure and 100th on the franchise power and financial strength measure receives an overall ranking of 75.

8.2 Icelandic Stock Market
The fundamentals data was available for the Icelandic companies on the Compustat database although some of the numbers for more recent financial statements had to be entered manually. Fundamentals data for Icelandic companies prior to 2008 was not available. The most notable difference between the Icelandic and US model is the number of firms in the investable universe. In July 2014 there are only eight non-financial stocks listed on the Icelandic stock market and because of the small size the author decided not to use the filtering methods used by Gray and Carlisle. Therefore
companies do not have to satisfy a certain market capitalization breakpoint and companies are not removed from the universe because they are likely manipulators or likely to cause a loss of capital. The companies are still ranked according to their performance on the manipulation and financial distress measures, so companies that perform poorly on these measures are identified. To be able to better measure the performance of the Icelandic companies on the Quantitative Value metrics their results were compared to similar firms worldwide, see chapter 9.2. Because there are so few companies in the investable universe it is inevitable that companies receive the same ranking according to the Quantitative Value model. If companies receive the same ranking the one with the higher EBIT/TEV multiple receives the higher ranking.

Another feature that is different for the Icelandic model is the inclusion of the ROIC measure. The financial statements for the eight listed companies were carefully analyzed to calculate their respective ROICs. For weighted average cost of capital, data from finance professor Damodaran was used as well as data from Compustat to compute debt and equity ratios. The leveraged beta for each company was found by taking the average unlevered beta for its respective industry and leveraging it with the company’s debt ratio, as such (Damodaran, 2014c):

$$\beta_L = \beta_U \times \left[1 + (1-T) \times \frac{D}{E}\right]$$

Where:  
\(\beta_L = \) Leveraged beta  
\(\beta_U = \) Average unlevered beta for respective industry  
\(T = \) Marginal tax rate  
\(D = \) Book value of debt  
\(E = \) Market value of equity  

The cost of equity is then found using the CAPM model with an implied risk premium taken from Damodaran and the yield on a 10-year Icelandic government bond used as a proxy for a risk-free rate (Damodaran, 2014a):

$$K_E = R_f + \beta_L \times \left(R_M - R_f\right)$$

Where:  
\(K_E = \) Cost of equity  
\(R_f = \) Risk-free rate  
\(\beta_L = \) Leveraged beta  
\(R_M - R_f = \) Equity risk premium
To figure out a company’s cost of debt its credit rating was determined from its interest coverage ratio. The ratio is calculated by dividing operating profit (EBIT) by its interest expense and is used to measure how easily a company can pay interest on its debts. A higher ratio is better. As an example, if a company has an interest coverage ratio of 8.5 it receives a default spread of 0.4% that is added onto the risk-free rate, while an interest coverage ratio of only 1.25 receives a default spread of 7.25%. With the cost of equity and cost of debt available it is easy to calculate a company’s cost of capital by using the weighted average cost of capital formula, see formula (23).

In the model the Icelandic companies are divided into low and high ROIC based on their respective industries. The division of companies into low or high median ROIC was determined by examining data from Koller et al. (2010) and Damodaran (2014b). Eimskip, Fjarskipti, Icelandair and N1 are in the low median ROIC group while HB Grandi, Marel, Hagar and Össur are in the high median ROIC group. The next step is to calculate the spread between the industries median ROIC, 10% for low ROIC and 20% for high ROIC, and a company’s respective ROIC. The average of this spread and the spread of the company’s ROIC and WACC is then used as a final measure of a company’s ability to generate value. As an example, if a company’s spread between ROIC and WACC is 5% and the spread between its ROIC and its industry’s median ROIC is 3% the company receives an average spread of 4%. The companies are then ranked according to their average spread.

There are two versions of the Icelandic model, one that does not include the ROIC computations and another that does. The one that uses the ROIC measures equally weights a company’s performance on the VALUE (ROIC), PRICE and QUALITY measures to determine its final ranking in the Quantitative Value model.

8.3 Back-testing and Calculations
The investment simulation starts on July 1, 2006 and ends on June 30, 2014 for the US market and spans the period July 1, 2011 to June 30, 2014 for the Icelandic market. As discussed in chapter 4.3, by starting the simulation on July 1 rather than January 1 look-ahead bias is avoided. That means that it is assumed that investors do not see the fundamentals data for the companies until July 1. For the US market the investable universe is divided into deciles and the top decile represents the portfolio used in the
simulation. The number of companies in the top deciles varies from 75 to 80, depending on the period examined. The performance of the lowest decile, or growth stocks, is calculated to see if the model is correctly sorting value stocks from growth stocks. All calculations are done using daily returns. The cumulative drawdown measure is calculated as the sum of the respective rolling period worst drawdowns for the designated strategy.

The methodology used by Gray and Carlisle was implemented to back-test the performance of the strategy with a few exceptions. The portfolio weights are market capitalization weighted for the US market, like in Gray and Carlisle’s model, but for the Icelandic market the portfolio weights are more difficult to determine because of its small size. In 2011 there are only three stocks in the investable universe so if market capitalization weights would be used the portfolio would resemble the general stock market index too much. To combat this problem it was decided to use weights that conform to Icelandic law no. 128/2011 for UCITS-funds. The rules state that a maximum of 20% can be invested in securities issued by the same issuer but an investment of up to 35% is permitted in a single listed security, given that the investment is over 20% in only one security from the same issuer. To prevent the portfolio from breaking these constraints the weights are made marginally lower than the breakpoint and a cash reserve maintained throughout the period. If the weight constraints prevent the portfolio from being fully invested the remainder of the portfolio is invested in cash. For example, in the first period there are only three stocks in the investable universe and because of the weight constraints only 72% of the portfolio is invested in stocks while 28% of the portfolio is invested in cash. The cash reserve receives a standard bank account interest rate of 4.4% annually (MP Banki, 2014). The weights for all periods can be found in appendix 3. The results of using this method are compared to the results using an equally weighted portfolio as well as a market capitalization weighted portfolio. That way it is possible to see if the model is giving the best performing stocks the highest ranking and therefore receive the most weight, i.e. if it manages to pick winners from losers.

To measure the performance of the Quantitative Value strategy similar performance measures to the ones used by Gray and Carlisle are used. The exception is that the
rolling periods are one year for the US model and three or one months for the Icelandic model. The daily returns of the S&P500 Total Return (S&P500 TR) Index are used as a benchmark for the US market and the OMX Iceland 8 Gross Index (OMXI8GI) for the Icelandic market. Both indexes include the effect of dividend reinvestment. For the US market a geometric average of the yield on a 10-year US treasury bond from 2006 to 2013 is used as proxy for the risk-free rate, which results in a yield of 3.08% (Damodaran, 2014a). For the Icelandic market the geometric average of the yield on a 10-year Icelandic government from 2011 to 2013 is used, which results in a yield of 6.97% (Bonds.is, 2014). The risk-free rate is used to calculate the Sharpe ratio as well as the Sortino ratio where it represents the minimum acceptable rate of return.

The performance of the Icelandic model is also compared to the performance of five Icelandic equity funds from January 1, 2013 to June 30, 2014. Because the weights for the QV strategy were made to conform to UCITS-funds rules the weights did not have to be adjusted to make the comparison fair. The only difference is that the portfolio can never be fully invested in stocks as most funds are likely to keep a cash reserve at all times. Therefore a cash reserve of 4% is maintained throughout the period. From January 1, 2013 to June 30, 2013 the portfolio consists of five stocks so the weights are 34% for the top ranking stock, 19% for the 2nd, 3rd and 4th and 5% for the 5th. From June 30, 2013 to June 30, 2014 the portfolio consists of six stocks so the weights are 33% for the top ranking stock, 19% for the 2nd and 3rd, 10% for the 4th and 5th and 5% for the 6th. The funds have to pay transaction costs when making trades so a 1.5% transaction cost is deducted annually from the Quantitative Value strategy’s returns.

### 8.4 Statistical Tests

Two statistical tests are used to measure the statistical significance of the results. The first is based on Sharpe (1966) where the test is to determine if the portfolio returns are significantly different from the risk-free rate. The second is based on Jensen (1968) where the portfolio risk adjusted excess returns are tested to determine if they are significantly higher than predicted by the CAPM. In both tests it is assumed that the returns are normally distributed. When the variance is unknown the t-distribution is used and the t-statistic for hypothesis testing is:
\[ t \sim \sqrt{n} \frac{\bar{r}_p - E(r_p)}{\sigma_p} \]

Where: \( n \) = number of observations
\( \bar{r}_p \) = portfolio average return
\( E(r_p) \) = portfolio's expected return
\( \sigma_p \) = sample standard deviation

If the expected return of the portfolio is substituted for the risk-free rate the statistic looks very similar to the Sharpe ratio. For the first test the Sharpe ratio is therefore multiplied with the square root of \( n \) to determine if the portfolio returns are significantly different from the risk-free rate.

Jensen (1968) proposed using the following regression equation as a performance measure to determine if portfolio managers were generating superior investment returns:

\[ r_{p,t} - r_{f,t} = \alpha_p + \beta_p (r_{m,t} - r_{f,t}) + u_{p,t} \]

Where: \( r_{p,t} \) = Portfolio return at time \( t \)
\( r_{f,t} \) = Risk-free rate at time \( t \)
\( \alpha_p \) = Intercept
\( \beta_p \) = Portfolio’s systemic risk compared to the market (beta)
\( r_{m,t} \) = Market’s return at time \( t \)
\( u_{p,t} \) = Error term

Assuming that CAPM is empirically valid the intercept should be zero as all securities are in equilibrium. Therefore a statistically significant positive intercept implies that the portfolio has persistently earned a positive risk premium and vice versa. For both tests a critical value of 1.96 (5% confidence level) is used to determine if the results are statistically significant.
9 Results

The main purpose of analyzing the performance of the US model is to confirm if the performance resembles the results shown in Gray and Carlisle’s book. One of the biggest criticisms of Greenblatt’s book, *The Little Book that Beats the Market*, is that no one has been able to replicate the returns shown in his book. Gray and Carlisle are very transparent in how they construct their model and the way they back-test their model which makes it easier to try and replicate their results. If the results are similar to Gray and Carlisle’s results it is more likely that the Icelandic model is robust and its performance and results more reliable.

9.1 US Stock Market 2006-2014

The period analyzed is an interesting one as it includes a bull period where stock prices rose significantly and then arguably the worst recession the United States has endured since the Great Depression where stock prices dropped dramatically. It is interesting to see the performance of the Quantitative Value strategy during this period as many financial institutions and investment funds suffered a considerable loss of capital which the QV strategy is constructed to avoid. It is also interesting to see if the value decile performs better than the growth decile. The assumption would be that the value decile should include companies that represent quality and possess a franchise and are therefore more likely to withstand a recession. The performance of the QV strategy and its comparison with the QV growth decile and S&P500 TR Index are shown in table 6. For more detailed results and a list of the companies included in the portfolio see appendix 2.
The results in table 6 suggest that the strategy would have performed remarkably well. The results are also similar to Gray and Carlisle’s results, shown in table 4, as the strategy comfortably outperforms the market. The value decile outperforms the growth decile and the S&P500 TR on almost every performance metric. The CAGR is almost double the S&P500 TR CAGR which accompanied with a similar standard deviation and downside deviation to the S&P500 TR results in a significantly higher Sharpe- and Sortino ratios. There are three different performance measures that determine the investment strategy’s ability to avoid a loss of capital; worst drawdown, worst month return and cumulative drawdown. The value decile of the Quantitative Value strategy performs the best on all three and does so with a considerably wide margin; the cumulative drawdown is almost half the cumulative drawdown for the S&P500 TR. The high correlation with the S&P500 implies that the strategy closely follows the general market. Figure 1 shows the cumulative performance of the QV Value decile, QV Growth decile and the S&P500 TR.
The performance of the growth decile is very poor and suggests that the model manages to sort value stocks from growth stocks. Not only does the growth decile generate a lower CAGR but it does so with a higher standard and downside deviation, resulting in very low Sharpe- and Sortino ratios. The best month return and rolling period metrics show that there are short periods where the growth decile has performed well but its performance in the worst drawdown and cumulative drawdown metrics is what ultimately results in such a poor performance. A cumulative drawdown of roughly -16,000%, more than three times more than the value decile, is very poor and requires dramatically high returns to recover from. The rolling 1-year CAGR shown in figure 2 demonstrates the high volatility of the growth decile.

Figure 1 Cumulative value for QV Value, QV Growth and S&P500 TR
The Sharpe t-values for the both portfolios and the market index are not above the critical value of 1.96 which can be attributed to high volatility; therefore it is not possible to conclude that the returns are different from the risk-free rate. Jensen’s alpha is positive for the QV value portfolio but negative for the QV growth portfolio, implying that the former outperformed the market but the latter underperformed. More importantly, the positive alpha for the QV value portfolio is statistically significant. This means that the QV value portfolio returned approximately 6.48% more than required by the CAPM on a yearly basis and therefore outperformed the market by a wide margin. Overall the results are very impressive and give reason to believe that the model is robust and correctly built. This paves the way to look at the results of the model for the Icelandic stock market.

9.2 Icelandic Stocks’ Performance on the Quantitative Value Model

Trying to interpret if a stock’s value for a metric in the model is good or bad when the investable universe only consists of eight stocks can be difficult. For example, for the PFD metric (see chapter 4.1) a stock might be in the lowest percentile but because there are so few companies to compare with its performance on the metric might not be bad.
at all. To better gauge the performance of the companies on the Icelandic stock market a list of each company’s comparable was compiled and the company’s performance stacked up against its competitors. In what follows are the comparables maximum, minimum, median and mean numbers for the most important metrics in the Quantitative Value model compared to the numbers for the respective Icelandic company in 2014. Unfortunately, comparables for N1 are very difficult to find so the company is excluded from this analysis. For a list of the comparables and their performance, see appendix 5.

**Eimskip**

Table 7 Output of the Quantitative Value model for Eimskip and its comparables

<table>
<thead>
<tr>
<th></th>
<th>STA</th>
<th>SNOA</th>
<th>PMAN</th>
<th>PFD</th>
<th>EBIT/TEV</th>
<th>P_FP</th>
<th>P_FS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>0.047</td>
<td>0.748</td>
<td>0.60%</td>
<td>0.043%</td>
<td>11.99%</td>
<td>86.78%</td>
<td>0.90</td>
</tr>
<tr>
<td>Minimum</td>
<td>-0.137</td>
<td>0.317</td>
<td>0.05%</td>
<td>0.015%</td>
<td>3.22%</td>
<td>28.47%</td>
<td>0.20</td>
</tr>
<tr>
<td>Mean</td>
<td>-0.041</td>
<td>0.492</td>
<td>0.37%</td>
<td>0.026%</td>
<td>7.94%</td>
<td>57.82%</td>
<td>0.63</td>
</tr>
<tr>
<td>Median</td>
<td>-0.045</td>
<td>0.441</td>
<td>0.38%</td>
<td>0.022%</td>
<td>7.91%</td>
<td>54.42%</td>
<td>0.70</td>
</tr>
<tr>
<td>Eimskip</td>
<td>-0.025</td>
<td>0.752</td>
<td>0.72%</td>
<td>0.007%</td>
<td>4.46%</td>
<td>15.63%</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Eimskip has not performed particularly well on the model. This is evident when their numbers are compared to similar companies worldwide. Although it is very difficult to draw any conclusions from the SNOA and PMAN metrics Eimskip’s numbers are both higher than the maximum. Eimskip is very unlikely to be in financial distress as its PFD number is lower than the minimum. Its EBIT/TEV is significantly lower than the mean and median implying that Eimskip is unlikely to represent a fair price. The franchise power measure is lower than the minimum for the comparables and its financial strength is only 0.4 compared to a mean of 0.7. Therefore it is improbable that Eimskip represents quality.
**Fjarskipti**

Table 8 Output of the Quantitative Value model for Fjarskipti and its comparables

<table>
<thead>
<tr>
<th></th>
<th>STA</th>
<th>SNOA</th>
<th>PMAN</th>
<th>PFD</th>
<th>EBIT/TEV</th>
<th>P_FP</th>
<th>P_FS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>0.251</td>
<td>0.774</td>
<td>7.08%</td>
<td>0.065%</td>
<td>11.75%</td>
<td>73.28%</td>
<td>0.80</td>
</tr>
<tr>
<td>Minimum</td>
<td>-0.144</td>
<td>0.379</td>
<td>0.07%</td>
<td>0.005%</td>
<td>5.15%</td>
<td>24.33%</td>
<td>0.30</td>
</tr>
<tr>
<td>Mean</td>
<td>-0.051</td>
<td>0.672</td>
<td>0.61%</td>
<td>0.023%</td>
<td>7.51%</td>
<td>51.64%</td>
<td>0.59</td>
</tr>
<tr>
<td>Median</td>
<td>-0.061</td>
<td>0.698</td>
<td>0.29%</td>
<td>0.019%</td>
<td>7.31%</td>
<td>48.95%</td>
<td>0.60</td>
</tr>
<tr>
<td>Fjarskipti</td>
<td>-0.074</td>
<td>0.885</td>
<td>0.31%</td>
<td>0.015%</td>
<td>10.58%</td>
<td>50.00%</td>
<td>0.70</td>
</tr>
</tbody>
</table>

Fjarskipti’s numbers overall are fairly good. The company is unlikely to be engaging in fraud or manipulation and seems to be in good financial health. The stock is likely to represent a bargain price as its EBIT/TEV is near the maximum. The company has good financial strength and the franchise power metric is between the median and mean, implying that Fjarskipti does have considerable quality.

**Hagar**

Table 9 Output of the Quantitative Value model for Hagar and its comparables

<table>
<thead>
<tr>
<th></th>
<th>STA</th>
<th>SNOA</th>
<th>PMAN</th>
<th>PFD</th>
<th>EBIT/TEV</th>
<th>P_FP</th>
<th>P_FS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>0.047</td>
<td>0.748</td>
<td>0.60%</td>
<td>0.054%</td>
<td>12.02%</td>
<td>86.82%</td>
<td>0.90</td>
</tr>
<tr>
<td>Minimum</td>
<td>-0.137</td>
<td>0.317</td>
<td>0.02%</td>
<td>0.015%</td>
<td>3.25%</td>
<td>26.16%</td>
<td>0.20</td>
</tr>
<tr>
<td>Mean</td>
<td>-0.043</td>
<td>0.535</td>
<td>0.36%</td>
<td>0.030%</td>
<td>8.14%</td>
<td>54.31%</td>
<td>0.62</td>
</tr>
<tr>
<td>Median</td>
<td>-0.046</td>
<td>0.564</td>
<td>0.35%</td>
<td>0.029%</td>
<td>8.30%</td>
<td>53.54%</td>
<td>0.65</td>
</tr>
<tr>
<td>Hagar</td>
<td>-0.040</td>
<td>0.565</td>
<td>0.59%</td>
<td>0.003%</td>
<td>8.03%</td>
<td>65.63%</td>
<td>0.70</td>
</tr>
</tbody>
</table>

Hagar’s numbers are very similar to the mean and median for the comparables as the stock doesn’t seem to outperform on any single metric and neither does it underperform by a significant margin. Despite this there are two numbers that are worth noticing. The franchise power and financial strength numbers are marginally higher than the mean and median, implying that Hagar represent quality in excess of some its comparables.
HB Grandi

Table 10 Output of the Quantitative Value model for HB Grandi and its comparables

<table>
<thead>
<tr>
<th></th>
<th>STA</th>
<th>SNOA</th>
<th>PMAN</th>
<th>PFD</th>
<th>EBIT/TEV</th>
<th>P_FP</th>
<th>P_FS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>0.096</td>
<td>0.870</td>
<td>6.22%</td>
<td>0.010%</td>
<td>16.36%</td>
<td>56.25%</td>
<td>0.70</td>
</tr>
<tr>
<td>Minimum</td>
<td>-0.055</td>
<td>0.675</td>
<td>1.62%</td>
<td>0.003%</td>
<td>4.44%</td>
<td>28.13%</td>
<td>0.20</td>
</tr>
<tr>
<td>Mean</td>
<td>0.029</td>
<td>0.760</td>
<td>3.35%</td>
<td>0.005%</td>
<td>12.06%</td>
<td>40.63%</td>
<td>0.53</td>
</tr>
<tr>
<td>Median</td>
<td>0.038</td>
<td>0.748</td>
<td>2.78%</td>
<td>0.004%</td>
<td>13.71%</td>
<td>39.06%</td>
<td>0.60</td>
</tr>
<tr>
<td>HB Grandi</td>
<td>-0.100</td>
<td>0.781</td>
<td>0.39%</td>
<td>0.003%</td>
<td>14.05%</td>
<td>65.63%</td>
<td>0.60</td>
</tr>
</tbody>
</table>

HB Grandi is unlikely to be in financial distress and the numbers do not imply that the company is engaging in manipulation or fraud. The company seems to have good quality as the franchise power metric is higher than the maximum and the financial strength metric is the same as the mean. It is very likely that the stock represents a bargain price as its EBIT/TEV number is near the maximum.

Icelandair

Table 11 Output of the Quantitative Value model for Icelandair and its comparables

<table>
<thead>
<tr>
<th></th>
<th>STA</th>
<th>SNOA</th>
<th>PMAN</th>
<th>PFD</th>
<th>EBIT/TEV</th>
<th>P_FP</th>
<th>P_FS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>0.112</td>
<td>0.598</td>
<td>0.76%</td>
<td>0.240%</td>
<td>26.74%</td>
<td>84.82%</td>
<td>1.00</td>
</tr>
<tr>
<td>Minimum</td>
<td>-0.215</td>
<td>-0.025</td>
<td>0.08%</td>
<td>0.002%</td>
<td>1.58%</td>
<td>7.40%</td>
<td>0.40</td>
</tr>
<tr>
<td>Mean</td>
<td>-0.070</td>
<td>0.349</td>
<td>0.34%</td>
<td>0.042%</td>
<td>9.30%</td>
<td>32.19%</td>
<td>0.71</td>
</tr>
<tr>
<td>Median</td>
<td>-0.072</td>
<td>0.371</td>
<td>0.30%</td>
<td>0.023%</td>
<td>8.39%</td>
<td>28.56%</td>
<td>0.70</td>
</tr>
<tr>
<td>Icelandair</td>
<td>-0.159</td>
<td>0.332</td>
<td>0.06%</td>
<td>0.003%</td>
<td>10.14%</td>
<td>65.63%</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Icelandair’s numbers are perhaps the best of all the Icelandic companies. The company is unlikely to be engaging in manipulation or fraud and the probability of it going into financial distress is minimal. The EBIT/TEV multiple is higher than both the mean and median, implying that the stock is available at a fair price. At last, the company shows that it has significant quality as its franchise power and financial strength are comparatively high.
**Marel**

Table 12 Output of the Quantitative Value model for Marel and its comparables

<table>
<thead>
<tr>
<th></th>
<th>STA</th>
<th>SNOA</th>
<th>PMAN</th>
<th>PFD</th>
<th>EBIT/TEV</th>
<th>P_FP</th>
<th>P_FS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>0.126</td>
<td>0.764</td>
<td>26.78%</td>
<td>0.029%</td>
<td>11.23%</td>
<td>96.77%</td>
<td>0.90</td>
</tr>
<tr>
<td>Minimum</td>
<td>-0.054</td>
<td>0.319</td>
<td>0.201%</td>
<td>0.000%</td>
<td>5.18%</td>
<td>26.16%</td>
<td>0.40</td>
</tr>
<tr>
<td>Mean</td>
<td>0.000</td>
<td>0.540</td>
<td>2.92%</td>
<td>0.017%</td>
<td>7.23%</td>
<td>57.07%</td>
<td>0.65</td>
</tr>
<tr>
<td>Median</td>
<td>-0.006</td>
<td>0.535</td>
<td>0.71%</td>
<td>0.016%</td>
<td>6.48%</td>
<td>56.49%</td>
<td>0.65</td>
</tr>
<tr>
<td><strong>Marel</strong></td>
<td>-0.037</td>
<td>0.766</td>
<td>0.35%</td>
<td>0.016%</td>
<td>5.07%</td>
<td>43.75%</td>
<td>0.70</td>
</tr>
</tbody>
</table>

Historically Marel does not seem to have been engaging in fraud or manipulation based on its STA, SNOA and PMAN values. Marel’s performance on the EBIT/TEV multiple is not particularly good as its value is lower than the minimum among comparables and its franchise power is lower than both the mean and median. Marel does perform well on the P_FS metric as it has a value of 0.7 which is marginally higher than the mean and median.

**Össur**

Table 13 Output of the Quantitative Value model for Össur and its comparables

<table>
<thead>
<tr>
<th></th>
<th>STA</th>
<th>SNOA</th>
<th>PMAN</th>
<th>PFD</th>
<th>EBIT/TEV</th>
<th>P_FP</th>
<th>P_FS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>0.080</td>
<td>0.763</td>
<td>1.51%</td>
<td>0.058%</td>
<td>7.23%</td>
<td>93.41%</td>
<td>0.80</td>
</tr>
<tr>
<td>Minimum</td>
<td>-0.135</td>
<td>0.144</td>
<td>0.04%</td>
<td>0.007%</td>
<td>3.26%</td>
<td>46.39%</td>
<td>0.40</td>
</tr>
<tr>
<td>Mean</td>
<td>-0.039</td>
<td>0.588</td>
<td>0.57%</td>
<td>0.022%</td>
<td>4.95%</td>
<td>73.69%</td>
<td>0.60</td>
</tr>
<tr>
<td>Median</td>
<td>-0.032</td>
<td>0.630</td>
<td>0.47%</td>
<td>0.014%</td>
<td>4.80%</td>
<td>81.84%</td>
<td>0.60</td>
</tr>
<tr>
<td><strong>Össur</strong></td>
<td>-0.026</td>
<td>0.791</td>
<td>0.67%</td>
<td>0.004%</td>
<td>5.97%</td>
<td>68.75%</td>
<td>0.40</td>
</tr>
</tbody>
</table>

The manipulation and fraud values for Össur are all near the mean or median and therefore it is unlikely that Össur is engaging in any kind of manipulation or fraud as the values are very low. Comparing Össur’s EBIT/TEV to the other Icelandic companies might indicate that it is performing poorly on that metric but compared to other similar
companies worldwide suggests otherwise as it is higher than both the mean and median. The metrics that measure quality, P_FP and P_FS, are high as seen by the mean and median. Össur is near the mean for the P_FP so performs admirably there but is equal to the minimum for the financial strength metric. It is therefore unclear if Össur represents quality compared to other similar companies.

### 9.3 Icelandic Stock Market 2011-2014

The period analyzed for the Icelandic model is a peculiar one as the stock market was recovering from the financial crisis and the fall of the Icelandic banks. Only three stocks were listed on the Icelandic stock exchange in early 2011 but for the next three years nine new stocks were listed which provided more opportunities, increased trading and made the general market more liquid and efficient. The listings of new stocks and more activity on the Icelandic stock market caused prices to rise and during 2013 the OMXI8GI generated a return of roughly 23%. Because of the small size of the market it is very interesting to analyze if the Quantitative Value model can generate the same impressive returns for the Icelandic market as it did for the US market and if it manages to rank the best performing stocks the highest. The results are summarized in table 14. For more detailed results and a list of the companies included in the portfolio see appendix 3.
<table>
<thead>
<tr>
<th></th>
<th>QV</th>
<th>QV Equally Weighted</th>
<th>QV Market Weighted</th>
<th>OMXI8GI</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAGR</td>
<td>29.32%</td>
<td>21.44%</td>
<td>11.10%</td>
<td>6.09%</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>10.67%</td>
<td>12.29%</td>
<td>13.67%</td>
<td>12.07%</td>
</tr>
<tr>
<td>Downside Deviation</td>
<td>9.26%</td>
<td>11.51%</td>
<td>12.68%</td>
<td>11.49%</td>
</tr>
<tr>
<td>Sharpe Ratio</td>
<td>2.09</td>
<td>1.18</td>
<td>0.30</td>
<td>-0.07</td>
</tr>
<tr>
<td>T-Statistic</td>
<td>3.61*</td>
<td>2.04*</td>
<td>0.52</td>
<td>-0.12</td>
</tr>
<tr>
<td>Sortino Ratio</td>
<td>2.41</td>
<td>1.26</td>
<td>0.33</td>
<td>-0.08</td>
</tr>
<tr>
<td>Worst Drawdown</td>
<td>-7.58%</td>
<td>-10.23%</td>
<td>-13.85%</td>
<td>-13.65%</td>
</tr>
<tr>
<td>Worst Month Return</td>
<td>-4.40%</td>
<td>-7.59%</td>
<td>-6.62%</td>
<td>-6.48%</td>
</tr>
<tr>
<td>Best Month Return</td>
<td>10.99%</td>
<td>9.73%</td>
<td>8.63%</td>
<td>9.43%</td>
</tr>
<tr>
<td>Profitable Months</td>
<td>80.00%</td>
<td>65.71%</td>
<td>54.29%</td>
<td>54.29%</td>
</tr>
<tr>
<td>Rolling 3-month wins</td>
<td>--</td>
<td>74.30%</td>
<td>82.67%</td>
<td>87.67%</td>
</tr>
<tr>
<td>Cumulative Drawdown</td>
<td>-129%</td>
<td>-527%</td>
<td>-1,344%</td>
<td>-1,648%</td>
</tr>
<tr>
<td>Correlation</td>
<td>--</td>
<td>0.61</td>
<td>0.52</td>
<td>0.50</td>
</tr>
<tr>
<td>Jensen’s alpha</td>
<td>0.08%</td>
<td>0.05%</td>
<td>0.02%</td>
<td>-</td>
</tr>
<tr>
<td>T-Statistic</td>
<td>3.25*</td>
<td>1.92*</td>
<td>0.59</td>
<td>-</td>
</tr>
</tbody>
</table>

*Statistically significant at a 5% confidence level

The QV strategy returns a very impressive 29.32% CAGR compared to OMXI8GI’s 6.09% CAGR. The CAGR is considerably higher than the CAGR for the equally- and market weighted portfolios which implies that the model does indeed give the highest ranking to the best performers. The standard- and downside deviations are also lower than the benchmarks, resulting in a significantly higher Sharpe- and Sortino ratios. Figure 3 shows the cumulative performance of the different weights for the Quantitative Value strategy as well as the OMXI8GI. An investment of $100 in the OMXI8GI index at June 30, 2011 would have cumulated to $119.41 on June 30, 2014 but an investment in the Quantitative Value strategy would have turned $100 into $216.26 for the same period.
The strategy’s ability to preserve capital is favorable as it has the lowest cumulative drawdown at -129% while the other strategies have significantly higher cumulative drawdowns. The strategy also has the highest percentage of profitable months and the highest single month return. The strategy has consistently outperformed its benchmarks which can be seen by the rolling 3-month wins in figure 4. Against the equally weighted portfolio it delivered a better return in roughly 7.5 out of every 10 three-month periods and against the market weighted portfolio and the OMXI8GI in roughly 8 out of every 10 three-month periods.

Figure 3 Cumulative value for Quantitative Value with different weights and OMXI8GI
The QV portfolio and the equally weighted portfolio both generate returns that are statistically significant different from the risk-free rate. This means that an investor would have been rewarded for the extra risk by investing in these portfolios rather than the risk-free rate. Jensen’s alpha is positive for all three portfolios, implying that all of them outperform the market. However, only two of them have statistically significant alphas; the QV portfolio and the equally weighted portfolio. The QV portfolio has a daily alpha of 0.08% which means that on a yearly basis the portfolio is generating a return that is 21.38% higher than required by the CAPM.

The overall performance of the Quantitative Value strategy is very impressive for the Icelandic stock market as it outperforms on a risk-adjusted basis and the results are statistically significant. In chapter 5 the author argued that another metric which measures value, ROIC, should be included in the model. In the next chapter the results of the Quantitative Value strategy with the ROIC metric are presented.

Figure 4 Three-month rolling CAGR for Quantitative Value
9.4 Icelandic Stock Market 2011-2014 with ROIC

In chapter 6 a new measure was introduced to the Quantitative Value model which measures a company’s ability to generate value, return on invested capital. If a company is generating a higher ROIC than its cost of capital it is creating value and is therefore a measure that fits well into the Quantitative Value model. The results for the Icelandic stock market with the ROIC measure are presented in table 15, more detailed results including companies’ ROIC and WACC can be found in appendix 4.

Table 15 Performance statistics for Quantitative Value with ROIC from 2011 to 2014

<table>
<thead>
<tr>
<th></th>
<th>QV ROIC</th>
<th>QV</th>
<th>OMXI8GI</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAGR</td>
<td>22.36%</td>
<td>29.32%</td>
<td>6.09%</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>10.45%</td>
<td>10.67%</td>
<td>12.07%</td>
</tr>
<tr>
<td>Downside Deviation</td>
<td>9.47%</td>
<td>9.26%</td>
<td>11.49%</td>
</tr>
<tr>
<td>Sharpe Ratio</td>
<td>1.47</td>
<td>2.09</td>
<td>-0.07</td>
</tr>
<tr>
<td>T-Statistic</td>
<td>2.54*</td>
<td>3.62*</td>
<td>-0.12</td>
</tr>
<tr>
<td>Sortino Ratio</td>
<td>1.62</td>
<td>2.41</td>
<td>-0.08</td>
</tr>
<tr>
<td>Worst Drawdown</td>
<td>-6.51%</td>
<td>-7.58%</td>
<td>-13.65%</td>
</tr>
<tr>
<td>Worst Month Return</td>
<td>-3.81%</td>
<td>-4.40%</td>
<td>-6.48%</td>
</tr>
<tr>
<td>Best Month Return</td>
<td>9.16%</td>
<td>10.99%</td>
<td>9.43%</td>
</tr>
<tr>
<td>Profitable Months</td>
<td>62.86%</td>
<td>80.00%</td>
<td>54.29%</td>
</tr>
<tr>
<td>Rolling 3-month wins</td>
<td>--</td>
<td>20.12%</td>
<td>75.77%</td>
</tr>
<tr>
<td>Cumulative Drawdown</td>
<td>-356%</td>
<td>-129%</td>
<td>-1,648%</td>
</tr>
<tr>
<td>Correlation</td>
<td>--</td>
<td>0.94</td>
<td>0.50</td>
</tr>
<tr>
<td>Jensen’s alpha</td>
<td>0.06%</td>
<td>0.08%</td>
<td>-</td>
</tr>
<tr>
<td>T-Statistic</td>
<td>2.38*</td>
<td>3.25*</td>
<td>-</td>
</tr>
</tbody>
</table>

*Statistically significant at 5% confidence level

The results aren’t quite as good as the author had hoped for although it was expected that it would be hard to improve the results presented in chapter 9.3. However, the QV ROIC strategy does perform very well compared to the general market. Its CAGR is roughly 7% lower than the original QV and its standard- and downside deviation are very similar, resulting in a Sharpe ratio of 1.66 versus 2.28 and a Sortino ratio of 1.83 versus 2.63. A favorable performance metric for the QV ROIC is that the worst drawdown and worst month return are higher than for the original QV but the cumulative drawdown is significantly lower. The high correlation between the two
QV strategies is likely because of the weights used are the same with only the ranking of the stocks changing. As seen in figure 5, the value of a $100 invested in the QV with ROIC cumulates to $183.18 compared to $216.26 for the original QV strategy and $119.41 for the OMXI8GI.

![Value of $100 invested](image)

**Figure 5 Cumulative value for QV ROIC, QV and OMXI8GI**

Looking at figure 6 it is clear that the QV ROIC strategy has not been able to generate higher rolling 3-month returns consistently as it only beats the original QV strategy around 2 out of every 10 three-month rolling periods. Because the investable universe doesn’t change the portfolio consists of the same companies as in the original QV model; the weights are therefore what ultimately determine the performance of the portfolio. Digging into the ranking of the stocks by the QV ROIC compared to the original QV explains the difference in performance. The QV ROIC model gives the highest ranking to either Össur or Hagar while the original ranked Icelandair the highest. For the three year period, 2011 to 2014, Icelandair’s stock price rose the highest which goes a long way in explaining the difference in CAGR between the two strategies.
The statistical tests for the QV ROIC model are similar to that of the original QV model as both the Sharpe t-values and Jensen’s alpha are statistically significant. However, the alpha of the QV ROIC is not as high as the originals’ or 15.73% versus 21.38% on a yearly basis. Including ROIC in the QV model did not perform better than the original QV model for the Icelandic market from 2011-2014. Nonetheless, that does not necessarily mean that the measure doesn’t belong in the model and should be discarded. The short period analyzed and the small size of the Icelandic stock market isn’t the ideal simulation environment to back-test the performance of the strategy. The theoretical rationale for including ROIC is strong as outlined in chapter 6 and for a better empirical argument a more comprehensive and thorough analysis is needed. The results are in no way poor for the QV ROIC strategy as it did demonstrate CAGR considerably higher than the general market with similar volatility.

9.5 Quantitative Value vs. Icelandic Equity Funds

As discussed in chapter 4.3 the Quantitative Value strategy managed to outperform successful value investing funds. In Iceland the mutual fund industry is not as big and diverse as in United States, mainly because of capital controls and a small stock market, so funds are not specialized in one certain investment strategy. There are, however,
equity funds that invest only in Icelandic stocks and in the last one or two years have been very successful. As was outlined in chapter 8.3 the back-testing for the QV strategy was made to comply with similar constraints the funds have to meet to make the comparison as real as possible. However, comparing the QV strategy with the funds is difficult because unlike the QV strategy the funds’ returns are not only based on price movements but also in-and outflow of capital which can impact the fund’s performance. Another reason is that large funds can cause substantial price movements on the market, especially a small market such as the Icelandic stock market and therefore they can have a big impact on market movements. At last, taking a position in a stock can be difficult because of the lack of market liquidity. The results for the QV strategy and the equity funds from January 1, 2013 to June 30, 2014 are summarized in table 16.

Table 16 Performance statistics for Quantitative Value and Icelandic equity funds

<table>
<thead>
<tr>
<th></th>
<th>QV</th>
<th>Júpíter</th>
<th>Íslanđssjóðir</th>
<th>Stefni</th>
<th>Landsbréf</th>
<th>ÍV</th>
<th>OMXI8GI</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAGR</td>
<td>35.55%</td>
<td>31.74%</td>
<td>25.31%</td>
<td>23.01%</td>
<td>14.31%</td>
<td>17.67%</td>
<td>6.41%</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>12.77%</td>
<td>10.98%</td>
<td>10.61%</td>
<td>11.15%</td>
<td>9.87%</td>
<td>11.13%</td>
<td>12.10%</td>
</tr>
<tr>
<td>Downside Deviation</td>
<td>11.30%</td>
<td>9.70%</td>
<td>9.15%</td>
<td>9.75%</td>
<td>9.05%</td>
<td>9.95%</td>
<td>11.45%</td>
</tr>
<tr>
<td>Sharpe Ratio</td>
<td>2.24</td>
<td>2.26</td>
<td>1.34</td>
<td>1.12</td>
<td>0.58</td>
<td>0.96</td>
<td>-0.05</td>
</tr>
<tr>
<td>T-Statistic</td>
<td>2.74*</td>
<td>2.77*</td>
<td>1.64</td>
<td>1.37</td>
<td>0.71</td>
<td>1.18</td>
<td>-0.06</td>
</tr>
<tr>
<td>Sortino Ratio</td>
<td>2.53</td>
<td>2.55</td>
<td>2.00</td>
<td>1.64</td>
<td>0.81</td>
<td>1.08</td>
<td>-0.05</td>
</tr>
<tr>
<td>Worst Drawdown</td>
<td>-6.94%</td>
<td>-5.97%</td>
<td>-6.95%</td>
<td>-8.62%</td>
<td>-9.13%</td>
<td>-9.85%</td>
<td>-10.92%</td>
</tr>
<tr>
<td>Worst Month Return</td>
<td>-3.58%</td>
<td>-4.32%</td>
<td>-3.25%</td>
<td>-3.61%</td>
<td>-2.72%</td>
<td>-4.12%</td>
<td>-5.95%</td>
</tr>
<tr>
<td>Best Month Return</td>
<td>8.27%</td>
<td>10.29%</td>
<td>9.53%</td>
<td>10.25%</td>
<td>9.32%</td>
<td>9.58%</td>
<td>9.90%</td>
</tr>
<tr>
<td>Profitable Months</td>
<td>76.47%</td>
<td>76.47%</td>
<td>64.71%</td>
<td>58.82%</td>
<td>58.82%</td>
<td>64.71%</td>
<td>58.82%</td>
</tr>
<tr>
<td>Rolling 1-month wins</td>
<td>--</td>
<td>66.96%</td>
<td>69.86%</td>
<td>76.81%</td>
<td>88.70%</td>
<td>78.55%</td>
<td>82.90%</td>
</tr>
<tr>
<td>Cumulative Drawdown</td>
<td>-142%</td>
<td>-174%</td>
<td>-191%</td>
<td>-229%</td>
<td>-266%</td>
<td>-301%</td>
<td>-461%</td>
</tr>
<tr>
<td>Correlation</td>
<td>--</td>
<td>0.69</td>
<td>0.63</td>
<td>0.64</td>
<td>0.60</td>
<td>0.60</td>
<td>0.57</td>
</tr>
<tr>
<td>Jensen’s alpha</td>
<td>0.10%</td>
<td>0.09%</td>
<td>0.07%</td>
<td>0.06%</td>
<td>0.03%</td>
<td>0.04%</td>
<td>-</td>
</tr>
<tr>
<td>T-Statistic</td>
<td>2.89*</td>
<td>4.07*</td>
<td>4.89*</td>
<td>4.40*</td>
<td>2.29*</td>
<td>3.27*</td>
<td>-</td>
</tr>
</tbody>
</table>

*Statistically significant at a 5% confidence level
The Quantitative Value strategy generated a higher CAGR than all of the funds for the period but has a relatively high standard- and downside deviation. The high CAGR does compensate for the higher deviation with only Júpíter managing to perform better on a risk-adjusted basis as it has the highest Sharpe- and Sortino ratios. Again Júpíter seems to be the fund challenging the QV strategy as it has a lower worst drawdown, similar profitable months and a higher best month return. The QV strategy performs best on the cumulative drawdown metric, demonstrating that it is the most successful at protecting capital. All of the funds manage to beat the market comfortably although their returns vary quite a lot with the lowest CAGR being 14.31% and the highest 31.74%. All of them have fairly similar standard- and downside deviations but it comes as no surprise that the best performing fund also has the lowest cumulative drawdown.

![Value of $100 invested](image)

Figure 7 Cumulative value for Quantitative Value, Icelandic equity funds and OMXI8GI

The cumulative value of $100 invested is $157.8 for the QV strategy compared to $122.2 for the lowest performing fund and $109.8 for the OMXI8GI Index. On a rolling 1-month CAGR basis the QV strategy manages to beat the best forming fund in roughly 7.5 out of every 10 one-month periods and almost 10 out of every 10 one-month periods for the worst performing fund. The strategy therefore consistently outperforms the funds on a 1-month rolling basis as figure 8 demonstrates.
The high CAGR and standard deviation generated by the QV strategy can be traced to the strategy’s weight in Össur during the period and explains the difference in its returns and the funds’. Össur’s CAGR for the period was 31.18% accompanied with a standard deviation of 23.7%; making it the riskiest stock for the period. Össur’s stock is not very liquid on the Icelandic stock market as it also listed on the NASDAQ OMX in Copenhagen where it is more frequently traded. The stock is therefore in limited supply and it would have been very hard for the funds to take a position similar to the QV strategy’s in Össur’s stock. The stock with the highest return for the period, Icelandair, receives the most weight from the QV model but it generated a CAGR of 67.55%. The second best performer, Hagar, receives a weight of 19% for the period but it generated a CAGR of 59.89%. Marel received a weight of 19% for the first period but 10% for the second period. Overall Marel generated a CAGR of -18.69% making it the worst performer but it was mainly during the second period where its price dropped, therefore its negative return had a minimal impact. Eimskip received a weight of 5% for the whole period where its CAGR was -0.04% and Fjarskipti received a weight of 10% for the second period where it generated a CAGR of 13.88%.

Figure 8 One-month rolling CAGR for Quantitative Value

The high CAGR and standard deviation generated by the QV strategy can be traced to the strategy’s weight in Össur during the period and explains the difference in its returns and the funds’. Össur’s CAGR for the period was 31.18% accompanied with a standard deviation of 23.7%; making it the riskiest stock for the period. Össur’s stock is not very liquid on the Icelandic stock market as it also listed on the NASDAQ OMX in Copenhagen where it is more frequently traded. The stock is therefore in limited supply and it would have been very hard for the funds to take a position similar to the QV strategy’s in Össur’s stock. The stock with the highest return for the period, Icelandair, receives the most weight from the QV model but it generated a CAGR of 67.55%. The second best performer, Hagar, receives a weight of 19% for the period but it generated a CAGR of 59.89%. Marel received a weight of 19% for the first period but 10% for the second period. Overall Marel generated a CAGR of -18.69% making it the worst performer but it was mainly during the second period where its price dropped, therefore its negative return had a minimal impact. Eimskip received a weight of 5% for the whole period where its CAGR was -0.04% and Fjarskipti received a weight of 10% for the second period where it generated a CAGR of 13.88%.
At last, viewing the Sharpe t-values shows that three funds manage to generate returns that are statistically significant different from the risk-free rate; the QV portfolio, Júpiter and Íslandssjóðir. Jensen’s alpha is positive for all funds and interestingly, they are all statistically significant implying that Icelandic mutual funds have consistently outperformed the market. The QV portfolio generates a daily alpha of 0.10%, the highest of all, which translates to an impressive yearly alpha of 26.04%.

9.6 Examining the Relationship between Returns and Multiples
One of the most important metrics in the QV model is the EBIT/TEV multiple which measures if a stock is undervalued and a stock with a high EBIT/TEV generally ranks high on the model. Stocks with high EBIT/TEV are expected to generate a high annual return which increases its market capitalization and therefore its total enterprise value. This means that if a stock with a high EBIT/TEV multiple rises considerably during a year its EBIT/TEV should be lower during the end of the year, unless it also manages to create considerable growth in its operating profit. Of course, this relationship isn’t perfect; a stock could have a high EBIT/TEV but its return negative for the next year. To examine the relationship further the annual return for the top six ranked stocks in the QV are compiled as well as comparison between their EBIT/TEV multiple before and after the period. The periods examined are June 30, 2008 to June 30, 2009 and June 30, 2013 to June 30, 2014 for the US stock market and for the Icelandic stock market June 30, 2013 to June 30, 2014.
For the first period the annual return is generally negative as it includes one of the worst downturns on the global stock market in recent times. At the beginning stocks like RAI and AIT seem to be available at bargain prices but did not generate positive returns, plausibly because of the events that unfolded during the period. A negative return lowers the market capitalization and should therefore, with everything else equal, result in a higher EBIT/TEV at the end of the period as is the case for two of the three companies with negative returns. Those two companies are also included in the top decile QV portfolio for the next period implying that they are still undervalued and represent quality. The three companies generating positive returns have an inverse relationship between its annual returns and the change in EBIT/TEV as it increases between the beginning and the end of the period.

The second period for the US market shows a strong relationship between the annual return and EBIT/TEV as all of the stocks that generate a positive return have a
lower EBIT/TEV at the end of the period. None of them are included in the next year top
decile QV portfolio, implying that they are no longer undervalued. The top ranking stock
actually generated a negative return and had a significantly lower EBIT/TEV at the end
of the period. A possible explanation is that the company’s EBIT at the beginning of the
period included significant extraordinary items which distorted the multiple.

The investment simulation period is eight years for the US market and there is no
company that manages to be in the top portfolio decile every year. The most persistent
companies manage to be in the top portfolio decile for seven years; although not
consecutively. The combination of the top 10 companies in the top portfolio decile
alternates a lot with only one of them managing to be in the top 10 for four years. This
implies that although companies might possess a franchise or be financially strong for a
long period they might not always represent a bargain price. This also shows that by
using the EBIT/TEV multiple the QV model manages to pick high-quality stocks at a time
when they are undervalued, a very desirable trait.

The stocks on the Icelandic market suggest a similar relationship between a stock’s
return and its change in the EBIT/TEV multiple. The three stocks with significant positive
annual returns have a lower EBIT/TEV multiple at the end of the period. The other three
companies show an inverse relationship. Fjarskipti did generate positive returns but its
EBIT/TEV multiple increased which can partially be explained by its increased operating
profits at the end of the period. The opposite goes for Marel and Eimskip as they
generated negative returns and had lower operating profits at the end of the period.

The overall results aren’t conclusive but it is evident that stock with a high EBIT/TEV
multiple seem more likely to generate high returns and have considerably lower
EBIT/TEV multiple a year later; causing it to no longer represent a bargain price. One
thing is clear though, for a company to maintain its high EBIT/TEV and consistently
produce high positive returns it has to show a persistent growth in operating profits.
10 Discussion

In chapters 9.1 to 9.6 various results for the Quantitative Value strategy were presented. The performance of the strategy for the US stock market suggests that the model was built in accordance to Gray and Carlisle’s model as the results are very similar. Despite analyzing a significantly shorter period the strategy generated a considerably higher CAGR than the S&P500 TR with a similar standard deviation; Gray and Carlisle’s results are analogous. Perhaps the most important part is that the model also seems to be able to sort value stocks from growth stocks as the growth decile performs poorly, producing lower CAGR than the S&P500 TR accompanied with a higher standard deviation. The results for the US market are statistically significant which gave the author confidence that to adopt the model to the Icelandic market would generate a robust outcome.

The analysis of the strategy’s performance for the Icelandic stock market begins by looking at Icelandic stocks’ output for the QV model compared to similar companies worldwide. This enables one to interpret each stock’s performance on the model and give the reader a better view of how the model chooses stocks based on its criteria. Only a single year’s result was presented but it gave a glimpse into the stocks most likely to receive a high ranking by the QV model. The results in chapter 9.3 for the QV model due indeed imply that the model is giving the highest ranking to the best performing stocks as it easily outperformers the OMXI8Gl index and the results are statistically significant. One of the main conjectures of this thesis was to see if the QV strategy could be implemented on the Icelandic stock market and show similar successful returns. Although the period used to back-test the strategy is short the results are promising and the model does give the highest ranking to stocks that perform well in the future. Further research could be done by analyzing the period before the financial crisis in 2008 but the author was unable to gather fundamental data for Icelandic companies from a comprehensive database for this period.

The author presented theoretical evidence that a new measure should be implemented in the QV model; return on invested capital (ROIC). The measure was only
included in the Icelandic version of the model as calculating ROIC requires a thorough and time-consuming analysis. The results, presented in chapter 9.4, are not as good as using the original QV model as the CAGR is considerably lower and both Sharpe- and Sortino ratios are lower. A more conclusive result is needed to determine if the ROIC measure manages to improve the QV strategy. A longer period for back-testing the strategy and a bigger investable universe should give a more detailed and convincing result. The author remains confident that the model could be improved by using the ROIC measure and could be used in conjunction with the QV model. Comparables analysis is often used to triangulate the results of a discounted cash flow analysis and the calculation of a company’s ROIC could also be used in a similar manner to support the model’s outcome for a more accurate and thorough analysis. With a combination of the QV model and the ROIC measure an investor should feel comfort in the fact that he is investing in a high-quality stock that is likely to be underpriced and creates value.

The QV strategy’s performance was also compared to Icelandic equity funds were it again displayed its impressive performance as it generated the highest CAGR despite taking portfolio weights restrictions, transaction cost and cash reserves into account when back-testing. When an investment strategy is presented that has only been back-tested and not used in the real world there is always skepticism if it can be successful in the real world with transaction costs, liquidity and cash in-and outflows. The results show that the strategy is indeed likely to work in the real world as the QV portfolio outperformed all the funds on a risk-adjusted basis.

At last, the relationship between a stock’s performance and its EBIT/TEV multiple was considered. The hypothesis was that a high EBIT/TEV multiple should result in a high annual return which increases the stock’s market capitalization. Its EBIT/TEV multiple at the end of the period should then be lower and the stock no longer undervalued. Using the results from the QV strategy showed that the relationship does generally hold. Because stocks that have a high EBIT/TEV receive a high ranking on the QV model this implies that if they generate a high annual return they are less likely to be ranked highly in the model for the next period unless it is able to generate a growth in operating profits. The top decile portfolio is highly diverse over the eight year investment period for the US market as very few companies manage to be consistently
in the top decile. This demonstrates the model’s ability to eliminate behavioral biases as it ignores investors’ expectations that are likely to include forecasting errors or a stock’s momentum caused by representativeness, features that can harm an investor’s decision making.
11 Conclusion

Value investing is a well-studied and highly effective investment strategy. While investment strategies differ they are all linked to Benjamin Graham’s philosophy that prices and values are distinct quantities, and that, if the two are sufficiently distinct an opportunity exists to invest in an underpriced security that provides a margin of safety. Combining value investing with a quantitative strategy that eliminates investors’ behavioral errors emanates in the Quantitative Value model developed by finance professors Wesley R. Gray and Tobias E. Carlisle. The model seeks to find high-quality underpriced stocks and rank them according to specific criteria. High-quality stocks are desirable and are likely to prevent a loss of capital while underpriced stocks represent a bargain, therefore successfully meeting Warren Buffett’s famous investment criteria: a wonderful company at a fair price.

This thesis adopted Gray and Carlisle’s Quantitative Value strategy to determine if its success could be replicated for the Icelandic stock market. When back-tested for the last three years the strategy has been highly successful, beating the market by a wide margin and generating a higher compounded annual return than Icelandic equity funds for the last 18 months. A new measure was introduced to the model, return on invested capital, to see if the strategy’s performance could be improved. There is a simple intuitive logic behind using return on invested capital to measure a company’s ability to create value and therefore its inclusion in the Quantitative Value model is highly relevant. The first results aren’t as good as the author had hoped for but give good reason for further research in the future. One thing is clear though from the overall results; Quantitative Value beats the market.
References


Appendix 1 – The Final Quantitative Value Checklist

Step 1: Avoid Stocks at Risk of Sustaining a Permanent Loss of Capital

1. Identify Potential Frauds and Manipulators

1.1. Accrual Screens

STA = Scaled Total Accruals = (CA (t) – CL (t) – DEP (t)) / Total Assets (t)

- CA = change in current assets – change in cash and equivalents
- CL = change in current liabilities – change in LT debt included in current liabilities
  - change in income taxes payable
- DEP = depreciation and amortization expense
- P_STA = percentile (STA) among all firms in the universe
- SNOA = (operating assets (t) – operating liabilities (t)) / Total Assets (t)
- P_SNOA = percentile (SNOA) among all firms in the universe
- COMBOACCRUAL = average (P_STA, P_SNOA)

1.2. Fraud and Manipulation Screen

Calculate variables:

- DSRI = days’ sales in receivables index
- GMI = gross margin index
- AQI = asset quality index
- SGI = sales growth index
- DEPI = depreciation index
- SGAI = sales, general and administrative expenses index
- LVGI = leverage index
- TATA = total accruals to total assets

Calculate probit probability of manipulation (PROBM) values:

PROBM = -4.84 + 0.92 × DSRI + 0.528 × GMI + 0.404 × AQI + 0.892 × SGI + 0.115 × DEPI – 0.172 × SGAI + 4.679 × TATA – 0.327 × LVGI
Calculate probability of manipulation from PROBM:

- \( \text{PMAN} = \text{CDF}(\text{PROBM}) \), where CDF is the cumulative density function for a normal \((0,1)\) variable.

2. **Identify Stocks at High Risk of Financial Distress**

2.1. **Probability of Financial Distress (PFD)**

Calculate PFA variables:

- \( \text{NIMTAAG} = \text{weighted average (quarter’s net income / MTA)} \)
- \( \text{MTA} = \text{market value of total assets = book value of liabilities + market cap} \)
- \( \text{TLMTA} = \text{total liabilities / MTA} \)
- \( \text{CASHMTA} = \text{cash & equivalents / MTA} \)
- \( \text{EXRETAVG} = \text{weighted average(log(1 + stock’s return) – log(1 + S&P500 TR return)))} \)
- \( \text{SIGMA} = \text{annualized stock’s standard deviation over the previous 3 months (daily)} \)
- \( \text{RSIZE} = \log(\text{stock market cap / S&P500 TR total market value}) \)
- \( \text{MB} = \text{MTA / adjusted book value} \)
- \( \text{Adjusted book value = book value + 0.1 \times (market cap – book value)} \)
- \( \text{PRICE} = \log(\text{recent stock price), capped at $15.} \)

Calculate logit for the probability of financial distress (LPFD) values:

\[
\text{LPFD} = -20.26 \times \text{NIMTAAVG} + 1.42 \times \text{TLMTA} - 7.13 \times \text{EXRETAVG} + 1.41 \times \text{SIGMA} \\
- 0.045 \times \text{RSIZE} - 2.13 \times \text{CASHMTA} + 0.075 \times \text{MB} - 0.058 \times \text{PRICE} - 9.16
\]

Calculate the probability of financial distress (PFD) value:

- \( \text{PFD} = 1 / (1 + e^{-(\text{LPFD})}) \)

3. **Eliminate Stocks at Risk of Sustaining a Permanent Loss of Capital**

Simultaneously conduct the following screens:

- Eliminate all firms in the top 5% of the sample based on COMBOACCRUAL.
- Eliminate all firms in the top 5% of the sample based on PMAN.
- Eliminate all firms in the top 5% of the sample based on PFD
Step 2: Find Cheapest Stocks

To calculate PRICE simply calculate EBIT enterprise value for each stock and then rank all stocks on PRICE.

- PRICE = EBIT / TEV

STEP 3: Find Highest-Quality Stocks

1. Franchise Power

8yr_ROA = Eight-Year Return on Assets (Geometric Average).
- Return on assets = net income before extraordinary items (t) / total assets (t)
- $P_{8yr\_ROA} = \text{percentile (8yr\_ROA) among all stocks in the universe.}$

8yr_ROC = Eight-Year Return on Capital (Geometric Average).
- Return on capital = EBIT (t) (1 – tax rate) / capital (t)
- $P_{8yr\_ROC} = \text{percentile (8yr\_ROC) among all stocks in the universe.}$

FCFA = Long-Term Free Cash Flow on Assets
- Sum (eight-year FCF) / total assets (t)
- $P_{FCFA} = \text{percentile (CFOA) among all stocks in the universe.}$

MG = Margin Growth
- Eight-year gross margin growth (geometric average).
- $P_{MG} = \text{percentile (MG) among all stocks in the universe.}$

MS = Margin Stability
- Eight-year average gross margin % / eight-year gross margin % standard deviation.
- $P_{MS} = \text{percentile (MS) among all firms in the universe.}$

MM = Margin MAX
- Max ($P_{MG}, P_{MS}$)

P_FP = Franchise Power
- Percentile (average ($P_{8yr\_ROA}, P_{8yr\_ROC}, P_{CFOA}, MM$) among all firms in the universe.

2. Financial Strength
2.1. Current Profitability

- \( \text{ROA} \) = return on assets
  - Net income before extraordinary items (t) / total assets (t)
  - \( \text{FS}_\text{ROA} = 1 \) if ROA > 0, 0 otherwise

- \( \text{FCFTA} \) = free cash flow (t) / total assets (t)
  - \( \text{FS}_\text{FCFTA} = 1 \) if FCFTA > 0, 0 otherwise

- Accrual = FCFTA – ROA
  - \( \text{FS}_\text{ACCRUAL} = 1 \) if ACCRUAL > 0, otherwise

2.2. Stability

- \( \text{LEVER} \) = long-term debt (t-1) / total assets (t-1) – long-term debt (t) / total assets
  - \( \text{FS}_\text{LEVER} = 1 \) if LEVER > 0, 0 otherwise

- \( \text{LIQUID} \) = current ratio (t) – current ratio (t-1)
  - \( \text{FS}_\text{LIQUID} = 1 \) if LIQUID > 0, 0 otherwise

- \( \text{NEQISS} \) = net equity issuance from t-1 to t
  - \( \text{FS}_\text{NEQISS} = 1 \) if NEQISS > 0, 0 otherwise

2.3. Recent Operational Improvements

- \( \Delta \text{ROA} \) = year-over-year change in ROA
  - \( \text{FS}_\Delta \text{ROA} = 1 \) if \( \Delta \text{ROA} > 0 \), 0 otherwise

- \( \Delta \text{FCFTA} \) = year-over-year change in FCFTA
  - \( \text{FS}_\Delta \text{FCFTA} = 1 \) if \( \Delta \text{FCFTA} > 0 \), 0 otherwise

- \( \Delta \text{MARGIN} \) = year-over-year change in gross margin
  - \( \text{FS}_\Delta \text{MARGIN} = 1 \) if \( \Delta \text{MARGIN} > 0 \), otherwise

- \( \Delta \text{TURN} \) = year-over-year change in asset turnover
  - \( \text{FS}_\Delta \text{TURN} = 1 \) if \( \Delta \text{TURN} > 0 \), otherwise

2.4. Financial Strength

- \( P\_\text{FS} = \text{Sum}(\text{FS}_\text{ROA}, \text{FS}_\text{FCFTA}, \text{FS}_\text{ACCRUAL}, \text{FS}_\text{LEVER}, \text{FS}_\text{LIQUID}, \text{FS}_\text{NEQISS}, \text{FS}_\Delta \text{ROA}, \text{FS}_\Delta \text{FCFTA}, \text{FS}_\Delta \text{MARGIN}, \text{FS}_\Delta \text{TURN}) / 10 \)

3. Identify Quality
To calculate quality take an average of the franchise power score and the financial strength score. Then rank all firms on QUALITY.

- QUALITY = 0.5 × P_FP + 0.5 × P_FS
## Appendix 2 – Results of the QV Model (US Market)

Table 18 Top 5 selected Quantitative Value portfolio holdings

<table>
<thead>
<tr>
<th>Date</th>
<th>EBIT/TEV</th>
<th>Quality</th>
<th>Market Cap ($ million)</th>
<th>Company</th>
<th>Rank QV</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.6.2006</td>
<td>25.85%</td>
<td>87.2%</td>
<td>$8,068</td>
<td>Reynolds American Inc.</td>
<td>1</td>
</tr>
<tr>
<td>30.6.2006</td>
<td>12.95%</td>
<td>87.6%</td>
<td>$9,605</td>
<td>Seagate Technology Plc.</td>
<td>2</td>
</tr>
<tr>
<td>30.6.2006</td>
<td>16.04%</td>
<td>80.5%</td>
<td>$4,029</td>
<td>Cummins Inc.</td>
<td>3</td>
</tr>
<tr>
<td>30.6.2006</td>
<td>14.22%</td>
<td>81.6%</td>
<td>$630</td>
<td>The Buckle Inc.</td>
<td>4</td>
</tr>
<tr>
<td>30.6.2006</td>
<td>10.72%</td>
<td>88.6%</td>
<td>$6,218</td>
<td>The Sherwin-Williams Company</td>
<td>5</td>
</tr>
<tr>
<td>30.6.2007</td>
<td>16.15%</td>
<td>84.9%</td>
<td>$5,980</td>
<td>Cummins Inc.</td>
<td>1</td>
</tr>
<tr>
<td>30.6.2007</td>
<td>12.54%</td>
<td>81.7%</td>
<td>$1,760</td>
<td>Partner Communications Company Ltd.</td>
<td>2</td>
</tr>
<tr>
<td>30.6.2007</td>
<td>11.09%</td>
<td>84.9%</td>
<td>$9,205</td>
<td>Parker-Hannifin Corporation</td>
<td>3</td>
</tr>
<tr>
<td>30.6.2007</td>
<td>11.03%</td>
<td>81.1%</td>
<td>$1,141</td>
<td>Applied Industrial Technologies Inc.</td>
<td>4</td>
</tr>
<tr>
<td>30.6.2007</td>
<td>9.98%</td>
<td>90.2%</td>
<td>$1,914</td>
<td>Toro Co.</td>
<td>5</td>
</tr>
<tr>
<td>30.6.2008</td>
<td>18.65%</td>
<td>86.3%</td>
<td>$11,165</td>
<td>Reynolds American Inc.</td>
<td>1</td>
</tr>
<tr>
<td>30.6.2008</td>
<td>15.56%</td>
<td>81.5%</td>
<td>$1,446</td>
<td>Big Lots Inc.</td>
<td>2</td>
</tr>
<tr>
<td>30.6.2008</td>
<td>12.42%</td>
<td>86.0%</td>
<td>$1,256</td>
<td>Applied Industrial Technologies Inc.</td>
<td>3</td>
</tr>
<tr>
<td>30.6.2008</td>
<td>12.18%</td>
<td>86.2%</td>
<td>$988</td>
<td>The Buckle Inc.</td>
<td>4</td>
</tr>
<tr>
<td>30.6.2008</td>
<td>12.21%</td>
<td>86.0%</td>
<td>$3,464</td>
<td>Ross Stores Inc.</td>
<td>5</td>
</tr>
<tr>
<td>30.6.2009</td>
<td>33.19%</td>
<td>91.0%</td>
<td>$433</td>
<td>Vaalco Energy Inc.</td>
<td>1</td>
</tr>
<tr>
<td>30.6.2009</td>
<td>55.34%</td>
<td>80.3%</td>
<td>$2,795</td>
<td>CF Industries Holdings Inc.</td>
<td>2</td>
</tr>
<tr>
<td>30.6.2009</td>
<td>29.08%</td>
<td>80.9%</td>
<td>$1,104</td>
<td>WABCO Holdings Inc.</td>
<td>3</td>
</tr>
<tr>
<td>30.6.2009</td>
<td>44.56%</td>
<td>77.7%</td>
<td>$416</td>
<td>Innophos Holdings Inc.</td>
<td>4</td>
</tr>
<tr>
<td>30.6.2009</td>
<td>27.93%</td>
<td>79.3%</td>
<td>$1,446</td>
<td>Guess? Inc.</td>
<td>5</td>
</tr>
<tr>
<td>30.6.2010</td>
<td>18.87%</td>
<td>80.8%</td>
<td>$1,307</td>
<td>Deckers Outdoor Corp.</td>
<td>1</td>
</tr>
<tr>
<td>30.6.2010</td>
<td>16.98%</td>
<td>81.7%</td>
<td>$934</td>
<td>Allegiant Travel Company</td>
<td>2</td>
</tr>
<tr>
<td>30.6.2010</td>
<td>13.41%</td>
<td>90.9%</td>
<td>$5,291</td>
<td>Ross Stores Inc.</td>
<td>3</td>
</tr>
<tr>
<td>30.6.2010</td>
<td>15.07%</td>
<td>81.1%</td>
<td>$1,339</td>
<td>The Buckle Inc.</td>
<td>4</td>
</tr>
<tr>
<td>30.6.2010</td>
<td>13.70%</td>
<td>85.1%</td>
<td>$1,400</td>
<td>Lancaster Colony Corporation</td>
<td>5</td>
</tr>
<tr>
<td>30.6.2011</td>
<td>24.07%</td>
<td>86.4%</td>
<td>$7,790</td>
<td>Western Digital Corporation</td>
<td>1</td>
</tr>
<tr>
<td>Date</td>
<td>Yield</td>
<td>NAV</td>
<td>Value</td>
<td>Company Name</td>
<td>Rank</td>
</tr>
<tr>
<td>------------</td>
<td>-------</td>
<td>----------</td>
<td>-------</td>
<td>--------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>30.6.2011</td>
<td>22.73%</td>
<td>85.4%</td>
<td>$2,736</td>
<td>Lexmark International Inc.</td>
<td>2</td>
</tr>
<tr>
<td>30.6.2011</td>
<td>15.23%</td>
<td>88.8%</td>
<td>$1,181</td>
<td>Deluxe Corp.</td>
<td>3</td>
</tr>
<tr>
<td>30.6.2011</td>
<td>17.50%</td>
<td>84.9%</td>
<td>$38,510</td>
<td>Eli Lilly and Company</td>
<td>4</td>
</tr>
<tr>
<td>30.6.2011</td>
<td>20.26%</td>
<td>82.3%</td>
<td>$39,719</td>
<td>United Health Group Inc.</td>
<td>5</td>
</tr>
<tr>
<td>30.6.2012</td>
<td>48.79%</td>
<td>88.7%</td>
<td>$1,108</td>
<td>Shanda Games Ltd.</td>
<td>1</td>
</tr>
<tr>
<td>30.6.2012</td>
<td>26.87%</td>
<td>90.3%</td>
<td>$9,480</td>
<td>CF Industries Holdings Inc.</td>
<td>2</td>
</tr>
<tr>
<td>30.6.2012</td>
<td>18.76%</td>
<td>81.7%</td>
<td>$1,131</td>
<td>Spirit Airlines Inc.</td>
<td>3</td>
</tr>
<tr>
<td>30.6.2012</td>
<td>18.39%</td>
<td>78.3%</td>
<td>$6,842</td>
<td>Apollo Education Group Inc.</td>
<td>4</td>
</tr>
<tr>
<td>30.6.2012</td>
<td>14.35%</td>
<td>83.8%</td>
<td>$8,526</td>
<td>Fluor Corporation</td>
<td>5</td>
</tr>
<tr>
<td>30.6.2013</td>
<td>24.42%</td>
<td>86.4%</td>
<td>$1,504</td>
<td>Alon USA Partner LP</td>
<td>1</td>
</tr>
<tr>
<td>30.6.2013</td>
<td>26.48%</td>
<td>84.9%</td>
<td>$2,338</td>
<td>Northern Tier Energy LP</td>
<td>2</td>
</tr>
<tr>
<td>30.6.2013</td>
<td>23.42%</td>
<td>80.8%</td>
<td>$12,773</td>
<td>CF Industries Holdings Inc.</td>
<td>3</td>
</tr>
<tr>
<td>30.6.2013</td>
<td>13.90%</td>
<td>93.6%</td>
<td>$1,641</td>
<td>Deluxe Corp.</td>
<td>4</td>
</tr>
<tr>
<td>30.6.2013</td>
<td>27.69%</td>
<td>75.9%</td>
<td>$11,483</td>
<td>Seagate Technology Plc.</td>
<td>5</td>
</tr>
<tr>
<td>30.6.2014</td>
<td>14.73%</td>
<td>80.6%</td>
<td>$3,788</td>
<td>The Babcock &amp; Wilcox Company</td>
<td>1</td>
</tr>
<tr>
<td>30.6.2014</td>
<td>10.69%</td>
<td>87.8%</td>
<td>$18,669</td>
<td>Lorillard Inc.</td>
<td>2</td>
</tr>
<tr>
<td>30.6.2014</td>
<td>11.30%</td>
<td>83.6%</td>
<td>$4,326</td>
<td>Taro Pharmaceutical Industries Ltd.</td>
<td>3</td>
</tr>
<tr>
<td>30.6.2014</td>
<td>22.04%</td>
<td>75.3%</td>
<td>$2,206</td>
<td>Lexmark International Inc.</td>
<td>4</td>
</tr>
<tr>
<td>30.6.2014</td>
<td>10.18%</td>
<td>83.5%</td>
<td>$17,244</td>
<td>Bed Bath &amp; Beyond Inc.</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 19: Quantitative Value’s annual performance

<table>
<thead>
<tr>
<th>Year</th>
<th>QV Value</th>
<th>QV Growth</th>
<th>S&amp;P500 TR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>25.69%</td>
<td>18.76%</td>
<td>20.59%</td>
</tr>
<tr>
<td>2007</td>
<td>-3.22%</td>
<td>-20.56%</td>
<td>-14.04%</td>
</tr>
<tr>
<td>2008</td>
<td>-14.40%</td>
<td>-45.33%</td>
<td>-26.51%</td>
</tr>
<tr>
<td>2009</td>
<td>22.27%</td>
<td>32.79%</td>
<td>13.92%</td>
</tr>
<tr>
<td>2010</td>
<td>33.74%</td>
<td>42.77%</td>
<td>31.11%</td>
</tr>
<tr>
<td>2011</td>
<td>16.64%</td>
<td>-6.55%</td>
<td>3.94%</td>
</tr>
<tr>
<td>2012</td>
<td>8.71%</td>
<td>31.94%</td>
<td>20.29%</td>
</tr>
<tr>
<td>2013</td>
<td>33.15%</td>
<td>17.60%</td>
<td>23.92%</td>
</tr>
</tbody>
</table>
Appendix 3 – Results of the QV Model (Icelandic Market)

Table 20 Outcome of the QV model for 2014

<table>
<thead>
<tr>
<th>Company</th>
<th>STA</th>
<th>SNOA</th>
<th>PMAN</th>
<th>PFD</th>
<th>Price (EBIT/TEV)</th>
<th>Quality</th>
<th>Rank QV</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>HB Grandi</td>
<td>-0.042</td>
<td>0.799</td>
<td>0.765%</td>
<td>0.003%</td>
<td>14.32%</td>
<td>62.48%</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>Fjarskipti</td>
<td>-0.074</td>
<td>0.840</td>
<td>0.255%</td>
<td>0.015%</td>
<td>10.57%</td>
<td>63.55%</td>
<td>2</td>
<td>N/A</td>
</tr>
<tr>
<td>Icelandair Group</td>
<td>-0.159</td>
<td>0.332</td>
<td>0.057%</td>
<td>0.003%</td>
<td>10.13%</td>
<td>75.70%</td>
<td>3</td>
<td>N/A</td>
</tr>
<tr>
<td>Hagar</td>
<td>-0.030</td>
<td>0.570</td>
<td>0.707%</td>
<td>0.005%</td>
<td>9.74%</td>
<td>76.06%</td>
<td>4</td>
<td>N/A</td>
</tr>
<tr>
<td>Össur</td>
<td>-0.026</td>
<td>0.791</td>
<td>0.669%</td>
<td>0.004%</td>
<td>5.96%</td>
<td>59.27%</td>
<td>5</td>
<td>N/A</td>
</tr>
<tr>
<td>N1</td>
<td>-0.122</td>
<td>0.599</td>
<td>0.083%</td>
<td>0.011%</td>
<td>7.22%</td>
<td>43.91%</td>
<td>6</td>
<td>N/A</td>
</tr>
<tr>
<td>Marel</td>
<td>-0.037</td>
<td>0.766</td>
<td>0.355%</td>
<td>0.016%</td>
<td>5.07%</td>
<td>58.18%</td>
<td>7</td>
<td>N/A</td>
</tr>
<tr>
<td>Eimskip</td>
<td>-0.025</td>
<td>0.752</td>
<td>1.169%</td>
<td>0.007%</td>
<td>4.45%</td>
<td>27.11%</td>
<td>8</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 21 Outcome of the QV model for 2013

<table>
<thead>
<tr>
<th>Company</th>
<th>STA</th>
<th>SNOA</th>
<th>PMAN</th>
<th>PFD</th>
<th>Price (EBIT/TEV)</th>
<th>Quality</th>
<th>Rank QV</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Icelandair Group</td>
<td>-0.071</td>
<td>0.433</td>
<td>0.327%</td>
<td>0.009%</td>
<td>14.20%</td>
<td>75.33%</td>
<td>1</td>
<td>34.0%</td>
</tr>
<tr>
<td>Össur</td>
<td>0.000</td>
<td>0.834</td>
<td>0.747%</td>
<td>0.015%</td>
<td>7.42%</td>
<td>81.06%</td>
<td>2</td>
<td>19.0%</td>
</tr>
<tr>
<td>Hagar</td>
<td>0.002</td>
<td>0.565</td>
<td>3.181%</td>
<td>0.012%</td>
<td>11.29%</td>
<td>75.70%</td>
<td>3</td>
<td>19.0%</td>
</tr>
<tr>
<td>Fjarskipti</td>
<td>-0.045</td>
<td>0.795</td>
<td>2.081%</td>
<td>0.021%</td>
<td>7.28%</td>
<td>78.91%</td>
<td>4</td>
<td>19.0%</td>
</tr>
<tr>
<td>Marel</td>
<td>-0.071</td>
<td>0.760</td>
<td>0.926%</td>
<td>0.023%</td>
<td>7.05%</td>
<td>61.76%</td>
<td>5</td>
<td>5.0%</td>
</tr>
<tr>
<td>Eimskip</td>
<td>-0.094</td>
<td>0.690</td>
<td>0.588%</td>
<td>0.013%</td>
<td>6.33%</td>
<td>40.33%</td>
<td>6</td>
<td>4.0%</td>
</tr>
</tbody>
</table>

Table 22 Outcome of the QV model for 2012

<table>
<thead>
<tr>
<th>Company</th>
<th>STA</th>
<th>SNOA</th>
<th>PMAN</th>
<th>PFD</th>
<th>Price (EBIT/TEV)</th>
<th>Quality</th>
<th>Rank QV</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Icelandair Group</td>
<td>-0.098</td>
<td>0.522</td>
<td>0.224%</td>
<td>0.006%</td>
<td>12.21%</td>
<td>53.55%</td>
<td>1</td>
<td>34.0%</td>
</tr>
<tr>
<td>Össur</td>
<td>-0.012</td>
<td>0.828</td>
<td>0.821%</td>
<td>0.014%</td>
<td>7.25%</td>
<td>82.85%</td>
<td>2</td>
<td>19.0%</td>
</tr>
<tr>
<td>Marel</td>
<td>-0.004</td>
<td>0.725</td>
<td>0.991%</td>
<td>0.015%</td>
<td>8.66%</td>
<td>68.91%</td>
<td>3</td>
<td>19.0%</td>
</tr>
<tr>
<td>Hagar</td>
<td>0.106</td>
<td>0.636</td>
<td>3.445%</td>
<td>0.015%</td>
<td>10.98%</td>
<td>45.70%</td>
<td>4</td>
<td>19.0%</td>
</tr>
<tr>
<td>Cash</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>9.0%</td>
</tr>
</tbody>
</table>
Table 23 Outcome of the QV model for 2011

<table>
<thead>
<tr>
<th>Company</th>
<th>STA</th>
<th>SNOA</th>
<th>PMAN</th>
<th>PFD</th>
<th>Price (EBIT/TEV)</th>
<th>Quality</th>
<th>Rank QV</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Icelandair Group</td>
<td>0.140</td>
<td>0.491</td>
<td>0.149%</td>
<td>0.009%</td>
<td>29.15%</td>
<td>77.12%</td>
<td>1</td>
<td>34.0%</td>
</tr>
<tr>
<td>Össur</td>
<td>0.009</td>
<td>0.795</td>
<td>0.898%</td>
<td>0.006%</td>
<td>6.26%</td>
<td>77.85%</td>
<td>2</td>
<td>19.0%</td>
</tr>
<tr>
<td>Marel</td>
<td>-0.055</td>
<td>0.710</td>
<td>0.387%</td>
<td>0.013%</td>
<td>8.54%</td>
<td>73.91%</td>
<td>3</td>
<td>19.0%</td>
</tr>
<tr>
<td>Cash</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>28.0%</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix 4 – Results of the QV ROIC Model

#### Table 24 Outcome of the QV ROIC model for 2014

<table>
<thead>
<tr>
<th>Company</th>
<th>Price</th>
<th>Quality</th>
<th>ROIC</th>
<th>WACC</th>
<th>Average Spread</th>
<th>Rank QV ROIC</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hagar</td>
<td>9.74%</td>
<td>76.06%</td>
<td>50.39%</td>
<td>9.47%</td>
<td>38.66%</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>Icelandair Group</td>
<td>10.14%</td>
<td>75.70%</td>
<td>33.83%</td>
<td>8.72%</td>
<td>26.47%</td>
<td>2</td>
<td>N/A</td>
</tr>
<tr>
<td>HB Grandi</td>
<td>14.33%</td>
<td>62.48%</td>
<td>19.17%</td>
<td>9.90%</td>
<td>8.22%</td>
<td>3</td>
<td>N/A</td>
</tr>
<tr>
<td>Fjarskipti</td>
<td>10.58%</td>
<td>63.55%</td>
<td>16.43%</td>
<td>9.66%</td>
<td>7.85%</td>
<td>4</td>
<td>N/A</td>
</tr>
<tr>
<td>Össur</td>
<td>5.97%</td>
<td>59.28%</td>
<td>37.47%</td>
<td>10.13%</td>
<td>27.34%</td>
<td>5</td>
<td>N/A</td>
</tr>
<tr>
<td>N1</td>
<td>7.22%</td>
<td>43.91%</td>
<td>6.64%</td>
<td>11.71%</td>
<td>-3.22%</td>
<td>6</td>
<td>N/A</td>
</tr>
<tr>
<td>Marel</td>
<td>5.07%</td>
<td>58.91%</td>
<td>6.98%</td>
<td>10.96%</td>
<td>-4.76%</td>
<td>7</td>
<td>N/A</td>
</tr>
<tr>
<td>Eimskip</td>
<td>4.46%</td>
<td>27.11%</td>
<td>7.12%</td>
<td>11.15%</td>
<td>-2.46%</td>
<td>8</td>
<td>N/A</td>
</tr>
</tbody>
</table>

#### Table 25 Outcome of the QV ROIC model for 2013

<table>
<thead>
<tr>
<th>Company</th>
<th>Price</th>
<th>Quality</th>
<th>ROIC</th>
<th>WACC</th>
<th>Average Spread</th>
<th>Rank QV ROIC</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hagar</td>
<td>11.29%</td>
<td>75.70%</td>
<td>44.16%</td>
<td>9.58%</td>
<td>32.37%</td>
<td>1</td>
<td>34.0%</td>
</tr>
<tr>
<td>Icelandair Group</td>
<td>14.20%</td>
<td>75.33%</td>
<td>16.90%</td>
<td>9.94%</td>
<td>8.93%</td>
<td>2</td>
<td>19.0%</td>
</tr>
<tr>
<td>Fjarskipti</td>
<td>7.28%</td>
<td>78.91%</td>
<td>12.92%</td>
<td>13.15%</td>
<td>2.60%</td>
<td>3</td>
<td>19.0%</td>
</tr>
<tr>
<td>Össur</td>
<td>7.42%</td>
<td>81.06%</td>
<td>38.42%</td>
<td>10.72%</td>
<td>25.56%</td>
<td>4</td>
<td>19.0%</td>
</tr>
<tr>
<td>Marel</td>
<td>7.05%</td>
<td>61.76%</td>
<td>16.76%</td>
<td>12.61%</td>
<td>4.21%</td>
<td>5</td>
<td>5.0%</td>
</tr>
<tr>
<td>Eimskip</td>
<td>6.33%</td>
<td>40.33%</td>
<td>8.02%</td>
<td>9.73%</td>
<td>-0.85%</td>
<td>6</td>
<td>4.0%</td>
</tr>
</tbody>
</table>

#### Table 26 Outcome of the QV ROIC model for 2012

<table>
<thead>
<tr>
<th>Company</th>
<th>Price</th>
<th>Quality</th>
<th>ROIC</th>
<th>WACC</th>
<th>Average Spread</th>
<th>Rank QV ROIC</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Össur</td>
<td>7.25%</td>
<td>82.85%</td>
<td>42.78%</td>
<td>10.97%</td>
<td>29.97%</td>
<td>1</td>
<td>34.0%</td>
</tr>
<tr>
<td>Hagar</td>
<td>10.98%</td>
<td>45.70%</td>
<td>36.25%</td>
<td>9.99%</td>
<td>24.26%</td>
<td>2</td>
<td>19.0%</td>
</tr>
<tr>
<td>Icelandair Group</td>
<td>12.21%</td>
<td>53.55%</td>
<td>17.77%</td>
<td>11.78%</td>
<td>8.88%</td>
<td>3</td>
<td>19.0%</td>
</tr>
<tr>
<td>Marel</td>
<td>8.66%</td>
<td>68.91%</td>
<td>20.07%</td>
<td>12.50%</td>
<td>7.57%</td>
<td>4</td>
<td>19.0%</td>
</tr>
<tr>
<td>Cash</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>9.0%</td>
</tr>
</tbody>
</table>
Table 27 Outcome of the QV ROIC model for 2011

<table>
<thead>
<tr>
<th>Company</th>
<th>Price</th>
<th>Quality</th>
<th>ROIC</th>
<th>WACC</th>
<th>Average Spread</th>
<th>Rank QV ROIC</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Össur</td>
<td>6.26%</td>
<td>77.85%</td>
<td>48.16%</td>
<td>9.87%</td>
<td>35.73%</td>
<td>1</td>
<td>34.0%</td>
</tr>
<tr>
<td>Icelandair Group</td>
<td>29.15%</td>
<td>77.12%</td>
<td>31.91%</td>
<td>10.67%</td>
<td>23.57%</td>
<td>2</td>
<td>19.0%</td>
</tr>
<tr>
<td>Marel</td>
<td>8.54%</td>
<td>73.91%</td>
<td>12.55%</td>
<td>11.56%</td>
<td>0.52%</td>
<td>3</td>
<td>19.0%</td>
</tr>
<tr>
<td>Cash</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>28.0%</td>
</tr>
</tbody>
</table>
## Appendix 5 – List of Comparables

**Table 28 Comparables used for Icelandic stocks**

<table>
<thead>
<tr>
<th>Eimskip</th>
<th>Fjarhúsi</th>
<th>Hagar</th>
<th>HB Grandi</th>
<th>Icelandair Group</th>
<th>Marel</th>
<th>Össur</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENXTPA:CA</td>
<td>DB:DTE</td>
<td>ENXTPA:CA</td>
<td>OB: AUSS</td>
<td>XTRA:AB1</td>
<td>DB:G1A</td>
<td>ASX:COH</td>
</tr>
<tr>
<td>ENXTBR:DELB</td>
<td>ENXTAM:KPN</td>
<td>ENXTBR:DELB</td>
<td>NasdaqGS:ALGT</td>
<td>ENXTAM:PHIA</td>
<td>OM:GETI B</td>
<td></td>
</tr>
<tr>
<td>LSE:MKS</td>
<td>NasdaqGS:SHEN</td>
<td>LSE:MKS</td>
<td>HELSE:FIA1S</td>
<td>TSE:6272</td>
<td>SWX:STMN</td>
<td></td>
</tr>
<tr>
<td>CPSE:TDC</td>
<td>NYSE:TGT</td>
<td>OB:NAS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPSE:TDC</td>
<td>LSE:TSO</td>
<td>ISE:RY4B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OM:TEL2 B</td>
<td>NYSE:WMT</td>
<td>OM:SAS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIT:TIT</td>
<td>DB:M5H</td>
<td>NYSE:LUV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WBA:TKA</td>
<td>LSE:MRW</td>
<td>NasdaqGS:SAVE</td>
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</tr>
<tr>
<td>OB:TEL</td>
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<td></td>
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</tr>
<tr>
<td>OM:TLS5N</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>LSE:VOD</td>
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</table>